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Horizon Cloud – The Forum for Strategy Focused Cloud Stakeholders

# D1.4: Success Stories and Good Practices Guide

# Appendix: Good Practices Record Cards

Second release

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# Abstract

This is the Appendix to the second release of the H-CLOUD Success Stories and Good Practices Guide. It presents the profiles of good practices i in the form of record cards of interviews.

### Keywords:

Cloud computing, cloud federation, edge computing, green IT

#### **Document Revision History**

Version	Date	Description of change	List of contributor(s)

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\* R: Document, report (excluding the periodic and final reports) DEM: Demonstrator, pilot, prototype, plan designs DEC: Websites, patents filing, press & media actions, videos, etc. OTHER: Software, technical diagram, etc



### **APPENDIX – RECORD CARDS**

This appendix to D.1.4 Success Stories and Good Practices Guide presents the record cards produced for each good practice initiative based on desk research and interviews. The record cards from the 1<sup>st</sup> release of the report are marked with an asterisk.

### **1.1 Public Initiatives**

Name	Туре
Austrian Federal Government EGIZ and BRZ*	Public
Bulgarian Ministry of Transport*	Public
City of Valencia*	Public
de.NBI	Public
Digital Portugal	Public
EGI Federation	Public
eSPAP	Public
G-Cloud*	Public
International institution	Public
Irish Government Cloud*	Public
LOGIUS*	Public
Polish Common State IT Infrastructure Program – WIIP*	Public
Regional government IT shared service center*	Public
SPOTES*	Public
Statens IT*	Public
WeNMR	Public

Table 1 List of Public Initiatives record cards (Asterisk = from the 1<sup>st</sup> release)



### **Austrian Federal Government EGIZ and BRZ\***

Identification	
Name of interviewee	Prof. Dr. Reinhard Posch
Title	Founder of the Institute of Applied Information Processing and Communications
Organisation	Graz University and Austrian Federal Government
Country and location	Austria
Sector	Public sector

Initiative	
Description of the initiative	The Austrian government started a digital reformation process 20 years ago. Austria was lagging behind in the EU rankings. One of the key actions consisted of separating strategy from implementation.
	At the policy/strategy level, the focus is on feasibility and prototyping so as to define a minimum set of strategic guidelines.
	At the operational level, the key goal is to deliver IT services that are commercially competitive.
	The eGovernment Innovation Center (EGIZ) is in charge of strategic innovation. Scope of work: feasibility and prototyping; unbiased from the perspective of companies that are selected to do the work. The goal is to make sure that openness and interoperability are the gold standards for government technology innovation. Any organisation, down to the municipal level, can leverage the work of EGIZ. The need to do so is particularly urgent in small to medium-sized public administration because, internally, such organisations have the resources only to carry out day-to-day activities.
	BRZ is the operating arm. It provisions finance systems, citizen web portals, and registries for the federal government.
	EGIZ and BRZ collaborate closely, but they are independent. For example, they are currently working to integrate pictures from passports and driving licenses with school grades to create an official school record that can help citizens apply for jobs.
Timing of the initiative	Approximately 20 years ago
Key stakeholders	All levels of government, with federal government acting as the primary policy/strategy orchestrator





Initiative	
Funding	The EGIZ and BRZ are owned by the Federal Ministry of Digital and Economic Affairs, but they are managed and funded separately.
Relation to H-CLOUD key areas	<ul> <li>Like in all member states, public cloud is hardly used in core government business in Austria.</li> <li>Barriers: <ul> <li>The need to be the master of what is happening with the systems: Imagine that a tech supplier wins a procurement contract. The question then becomes: 'Does the administration have the capability to ensure continuity of service – for example, in the COVID-19 situation?' The public sector cannot say, 'If I cannot produce a passport for you, I'll reimburse you with €10,000.' So typical service level agreements and operating level agreements that work in the private sector do not apply in the public sector. There need to be different options, such as the ability to replicate a portable copy of the data in the private cloud.</li> <li>Vendor lock-in: For instance, the Austrian government is in discussion with SAP to make some of their cloud solutions work in both public and private cloud environments to provide government agencies with more control over interoperability.</li> <li>Data protection: Hyperscalers move at least the metadata across borders. 'You cannot ask citizens to approve of data being transferred out of the EU.' In Germany, the government tried to avoid O365, and Austria is still in discussion with Microsoft. In small municipal governments, this is a problem because those small administrations are unaware of the risks, yet they are still responsible for the data.</li> </ul></li></ul>
Business model	The E-Government Innovation Center is staffed by university researchers and contracted for work by the Federal Ministry of Digital and Economic Affairs. BRZ is also owned by the Federal Ministry of Digital and Economic Affairs and charges some fees for its services.

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Impacts	
Business success	<ul><li>BRZ goal is to keep its service catalogue commercially competitive in the long run for the Austrian Federal Government by continuously adjusting the balance of its service portfolio between what is shared and what is left to the individual ministries.</li><li>EGIZ's goal is to drive innovation that can foster open and interoperable tech solutions for the whole Austrian public sector.</li></ul>
Technology innovation	At EGIZ, innovation is very much dependent on political commitment to advance work; it involves a lot of back and forth with all stakeholders, so it becomes very hard to keep the political focus on the value of IT. Politicians have their own short-term outcomes that they need to focus on.
Governance / Organisational structure	There are CIOs in every ministry. There is a committee meeting every six months. They discuss strategic innovations in particular. Ministries, landers, and communities are obligated to use approved EGIZ concepts, interfaces, methodologies, and standards for solution design and procurement.
Data governance	Data protection is a serious matter – not only from a GDPR- compliance standpoint, but also because not all public administrations have the resources and skills to ensure that citizen data is treated properly. There needs to be a clear demarcation of responsibilities.
	EGIZ does not operate any systems that touch citizen data. For instance, once the solution design to integrate passport/driving license pictures with school diplomas is completed, the responsibility for running such a system will be entrusted to the Ministry of Interior.

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Obstacles/Barriers	
Technical barriers	Standardising data sharing and user interfaces across multiple proprietary systems to avoid vendor lock-in, in both legacy on- premises environments and the cloud.
Legal barriers	Data sovereignty and data protection concerns.
Economic barriers	Other key barriers are organisational. Getting agreements across public administrations to collaborate on service and data sharing is complex because of different missions and program priorities. Political pressures make things even more difficult.





# **Bulgarian Ministry of Transport\***

Identification	
Name of interviewee	Yasen Markov
Title	Head of department – Risk Management, Prevention, and Administration of Irregularities
Organisation	Ministry of Transport, Information Technology, and Communications
Country and location	Bulgaria
Sector	Public administration / transportation

Initiative	
Description of the initiative	Cloud computing is interesting because it can enhance the speed and scalability of data analysis and reporting, but it is merely a technical solution. There are other data governance challenges to be solved, such as what data to collect and how to collect it and make it comparable across EU member states.
	One critical area is the construction of transport infrastructure. A lot of transport infrastructure data is generated during the construction phase – data that becomes relevant for timely maintenance and the avoidance of incidents and data that can be used for predictive analytics for preventive maintenance, as well as for enhancing the effectiveness of the initial investments.
	Recently, Mr. Markov attended the online Bridges forum <sup>1</sup> , organised by the Federal Ministry of Transport and Digital Infrastructure, where a case study relating to bridge infrastructure predictive maintenance based on drone surveillance data was presented. However, there was no discussion about the construction phase.
	The challenge is that in the different member states' legislations mandate different requirements in terms of documents to be collected in the construction phase. This prevents the transnational use of data. There is a need for 'legal interoperability'.
	The transport infrastructure construction phase data includes both technical data and contract implementation data. All of that could be feed into a big data repository. The data can then be analysed to detect anomalies that could trigger preventive maintenance. For example:
	<ul> <li>There are certification laboratories/bodies that control what construction materials comply with national</li> </ul>

<sup>&</sup>lt;sup>1</sup> https://www.eu2020.de/eu2020-en/events/-/2343062





Initiative	
	requirements. Different legislations mandate different requirements in terms of the certification process (who signs the certificates) and governance (national or regional government audit and oversight responsibilities).
	<ul> <li>Testing standards can be different. For instance, in Bulgaria, some of the bridge load design and testing standards are still – or at least were until very recently – based on normative documents implemented 40–50 years ago.</li> </ul>
	• Construction projects have different timing. Depending on how long the project is, there are different reporting requirements on how to document problems that arise during the project. These audit logs could be used as red flags for predictive maintenance.
	A year and a half ago, Mr Markov proposed transportation as a topic for Horizon 2020 – namely, the implementation of a common standard for the exchange of such road infrastructure construction data between the transport infrastructure owners and operators.
	Mr Markov and his team have not looked at sensors for monitoring the conditions of roads and bridges once they are operational, such as bridge vibration sensors or data from carmakers on how bumpy or slippery certain sections of a road can be.
	Mr Markov mentions the Transport Research Cloud report <sup>2</sup> as one document that may be of interest for the H-Cloud study.
	Another such document with regard to possible use cases, is the

Another such document, with regard to possible use cases, is the STRIA Road Map on Infrastructure<sup>3</sup>.

<sup>&</sup>lt;sup>2</sup> https://trimis.ec.europa.eu/sites/default/files/documents/ki0318383enn.en\_.pdf

<sup>&</sup>lt;sup>3</sup> http://smart-transportation.org/stainaction/stria-roadmap-on-transport-infrastructure-2019-updatereport-now-available/



# City of Valencia\*

Identification	
Name of interviewee	Ramón Ferri Tormo
Title	Head of Smart Valencia
Organisation	City of Valencia
Country and location	Spain
Sector	Public sector

Initiative			
Description of the initiative	the	The Valencia Smart City Project (a.k.a. the VLCi platform project) – which began in July 2014 and was initially to integrate data and processes related to municipal services into a platform that would help the administration improve efficiency and responsiveness – includes 17 initiatives and aims to provide the city with new solutions in five different areas: mobility, governance, environment, society, and wellbeing.	
			The VLCi platform is the first smart city commercial platform deployed in Spain that uses the European FIWARE Smart City context broker. Key capabilities include:
			<ul> <li>Information acquisition – collects data from the sensors and information systems of Valencia's various city council services</li> </ul>
			<ul> <li>Information distribution – manages huge amounts of information from multiple sources</li> </ul>
			<ul> <li>Information storage and analysis – statistical and predictive analysis based on Big Data analytics</li> </ul>
		<ul> <li>Information availability – report generation, dashboards, and open data management</li> </ul>	
		During the COVID-19 emergency, Valencia focused its response to the COVID-19 crisis on providing information and support to citizens and managing the situational awareness required by the Municipal Operational Coordination Centre (CECOPAL) to guarantee the continuation of municipal services and the provision of crisis management from Valencia City Council.	
			The core of the solution is the VLCi platform, where data and information from many municipal information systems (population, integral water cycle, mobility, electronic headquarters, municipal buildings, etc.) is consolidated with information from devices deployed in the city (environmental noise and traffic sensors, traffic control cameras, lighting controllers, etc.).





Initiative	
	Valencia offers its citizens updated and consolidated information and communication through a COVID-19 unified information site <sup>4</sup> and an app (AppValencia).
	These solutions provide real-time information about the crisis, including dynamic dashboards displaying information provided by the city's platform (water management, traffic flow, air quality, noise level, etc.), including useful information from municipal services, news and twitter feeds of municipal accounts, and an overview of the situation at the national level.
	The website also has services embedded from other public entities, such as the National Statistical Office (INE), which provides maps to indicate every day (although not in real-time) what percentage of population is on the move vs. the percentage staying at home.
	The website also has a section called 'New Normal', which provides guidelines for various activities – work, shopping, restaurants, beaches, hotels, sports, cultural events, transport, and so forth.
Timing of the initiative	See the previous paragraph
Key stakeholders	Telefonica, the Polytechnic University of Valencia, the University of Valencia, InnDEA Valecia, Esri, Cap Gemini, and Deloitte
Funding	At the end of December 2016, an agreement was signed between public business entity Red.ES and Valencia City Council. This agreement grants Valencia financing for its Impulse VLCi proposal within the 2nd Call for Smart Cities, launched in 2015. The sum granted amounts to approximate $\in 6$ million. Telefonica won the contract, for which tenders were submitted from 10 strong market players. Telefonica's quote was $\in 3.9M$ with a 4-year contract period, with the option to renew for another 2 additional years (1 plus 1).
Technical solution	VLCi is based on FIWARE.
Relation to H-CLOUD key areas	VLCi is hosted as a private cloud instance in the Telefonica data centre.
Business model	n/a

<sup>&</sup>lt;sup>4</sup> http://coronavirus.valencia.es



Impacts	
Business success	The platform aggregates information across the city's previously siloed systems, analyses it, and delivers insights to city service managers to make evidence-based and timely decisions. Information is also published on the Open Data Portal – not only for the citizenship to view, but also for developers and businesses that want to reuse the data through APIs to build new services.
Technology innovation	Valencia wants to make VLCi available to Spanish universities. Instances of the platform will be made available through containers to be run in universities' private clouds. The business objective is to allow academic researchers to work with city data, i.e. to give them access to very rich datasets. Universities can then develop new components for FIWARE, which the city could reuse. Universities' engineering departments can also help certify devices for connectivity, which can then be procured by the city for new IoT/edge projects. The university pays for the data centre, and the city requires the contractor to deploy the instance through containers – for example, for 6 months.
Governance / Organisational structure	n/a
Data governance	All the data that VLCi brokers is non-sensitive data
Environment and sustainability performance	n/a
Focus on SME	n/a

Obstacles/Barriers	
Technical barriers	Ramon Ferri is the head of the ITU U4SSC city platform thematic group <sup>5</sup> . The goal of this program is to make the platform available to other cities, with a focus on medium-sized to large cities. There are four working groups:
	Sharing city best practices
	<ul> <li>Data interoperability – better integration of health data between regional government and local government, which was a big problem for Valencia during the pandemic</li> </ul>
	<ul> <li>Architecture – defining the key principles and guidelines on the key capabilities that enable smart cities (One of the</li> </ul>

<sup>&</sup>lt;sup>5</sup> https://www.itu.int/en/ITU-T/ssc/united/Pages/thematic-groups.aspx





Obstacles/Barriers	
	focus areas is to look for future capabilities around AI and edge.)
	<ul> <li>Improving preparedness and resilience, with focuses on health, tourism, and resilience</li> </ul>
	The output of this collaboration will be standards and guidelines – so, no real federated products.



### de.NBI

Identification	
Organisation	Charité – Health Data Hub
Country and location	Germany
Sector	Healthcare and life science
Name of interviewee	Harald Wagener
Title	Cloud Lead

Cloud-related activities	
Activity name	German Network for Bioinformatics Infrastructure (de.NBI)
Website	https://www.denbi.de/
Description	The 'German Network for Bioinformatics Infrastructure – de.NBI' is national academic and non-profit infrastructure supported by the Federal Ministry of Education and Research providing bioinformatics services to users in life sciences research and biomedicine in Germany and elsewhere in Europe. The partners organise training events, courses, and summer schools on tools, standards, and compute services provided by de.NBI to assist researchers to more effectively exploit their data.
	In the simplest terms, EOSC-Life is:
	<ul> <li>13 European life science research infrastructures</li> <li>Making their data FAIR (findable, accessible, interoperable, and reusable)</li> </ul>
	<ul> <li>So that researchers can combine resources from multiple RIs for new research funded through our Open Calls</li> </ul>
	<ul> <li>And receive support through the variety of additional services we offer, including alignment with relevant standards and policies (GDPR, etc.)</li> </ul>
	de.NBI Cloud is part of EOCS-Life – Harald Involved in EOSCS-Life as the co-lead for one of the work packages.
	Charité is heavily involved in GAIA-X. They have submitted two use cases. One of them is a genomics research platform. The goal is to close the gap between the academic approach of de.NBI cloud and life-science companies to allow analytics workflows and APIs to be deployed across multiple clouds. At the moment, commercial companies are not allowed to use de.NBI's services because de.NBI is funded with public money.
Timing of the initiative	Launched in 2013



Cloud-related activities	
Key stakeholders	Academia
Funding	Funding comes from the Federal Ministry of Education and Research (BMFB).
Technical solution	Charité runs two types of service, cloud and HPC. It is an interesting contrast because these are different styles of consuming computing resources – although the underlying SKUs are actually the same:
	<ul> <li>Cloud/HTC – short lived workloads, constantly changing setups: The users can build their own infrastructure. It is for users that want a dedicated instance. With cloud, you stop thinking about computers (and storage and CPU); you think about services, containers, etc.</li> </ul>
	<ul> <li>HPC – stable workloads, fixed infrastructure, and a rulebook: There is no flexibility in job scheduling and queueing.</li> </ul>
	de.NBI is a heavy user of open source:
	<ul> <li>A federated identity and access management solution as part of ELIXIR (https://elixir-europe.org/) – run by justNET GMBH in the Czech Republic, using Perun open source (https://perun-aai.org/)</li> </ul>
	<ul> <li>Bioinformatics computing workflows – Galaxy (https://usegalaxy.org/)</li> </ul>
	• The different locations of de.NBI are free to use the infrastructure software that they want. The standard is OpenStack, but some locations use commercial offerings, like Red Hat. Very much dependent on local capabilities.
Relation to H-CLOUD key areas	Cloud, federation

Impacts	
Business success	They measure success to justify requests for grants. KPIs include:
	The number of users
	Citations in research papers
	<ul> <li>The number of new applications deployed</li> </ul>
Governance / Organisational structure	de.NBI has a special interest group that provides training and support.
	The private cloud that we have is very small compared with those of commercial providers, but it's a controlled environment that you can show to the customer (8 locations, all in Germany).

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Impacts	
	Users usually access one location, and there is no automated load balancing among locations, without asking the users.
	There are monthly calls among the locations to define the service portfolio. Recently stopped offering SWIFT object storage because there were too few users; everyone now uses AWS S3.
Data governance	Users have to apply via the de.NBI website to be authorised. They place a request for resources; they describe the project; they indicate whether they use sensitive data or not. de.NBI then sets up a tenant for the user for the project and lets the user configure the resources and grant access to others. de.NBI only gets an identifier (access token) from the federated IAM system. Being able to delegate access to the system and allowing people to use the institution account are huge drivers for research consortia. (Most of the large projects are international consortia.) There could even be independent researchers that come with a Google account.

Obstacles/Barriers	
Technical barriers	Lack of skills.
Legal barriers	One of the biggest hurdles is the protection of sensitive medical data. If someone at Charité wants to use resources in the Freiburg node of de.NBI cloud, they need to sign data processing agreements. Internally, at Charité, that is not necessary. Charité is currently working to get ISO 27001 certification to make sure they have risk management in place. This is relevant for HTC, although it does not apply for HPC clusters yet.
Economic barriers	Funding from the Ministry has not been a problem so far.



# **Digital Portugal**

Identification	
Organisation	Estrutura Missão Portugal Digital
Website	https://portugaldigital.gov.pt/
Country and location	Portugal
Sector	Public sector
Main areas	Digital transformation
Name of interviewee	Raul Martins
Position in the organisation	Coordinator

Cloud-related activities	
Description of the activities	<ul> <li>Portugal Digital is based on three pillars:</li> <li>Competencies and capabilities: digital skills, overall IT literacy (Portugal is lagging the European DESI average in this area.)</li> <li>SME digitalisation: digital innovation hubs, training, link academia and business, economic free zones</li> <li>Public administration modernisation/transformation (prioritised 25 services to be truly transformed – barriers: skills, culture, bureaucratic processes)</li> <li>In the context of public administration modernisation, Portugal Digital launched a cloud computing strategy. The principle is cloud first. And with commercial cloud providers. There is no big plan to build data centres in Portugal owned by the government.</li> </ul>
Timing	Digital Portugal was launched in 2019.
Key stakeholders	All industries are addressed within the strategy. The role played by the stakeholders are usually those of orchestrator and regulator.
Funding	Yes
Relation to H-CLOUD key areas	Cloud and federated cloud





Impacts	
Business success	<ul> <li>The benefits of cloud computing are articulated in the strategy in terms of:</li> <li>Speed of innovation</li> <li>Efficiency</li> <li>Cybersecurity (the need to address shared responsibilities)</li> </ul>
Technology innovation	The Digital Portugal plan has a fourth leg, beyond the three pillars, called "Catalyst". It is dedicated to emerging technology: cybersecurity strategy, data strategy, AI, super-computing.
Governance / Organisational structure	The Digital Portugal program office includes nine people responsible for overseeing the implementation of the Digital Portugal action plan. To grow adoption of cloud computing in public administration, they need to work closely with government departments – in particular, with ESPAP (the largest national government shared service centre) to establish common procurement frameworks.
Environment and sustainability performance	Energy savings will only happen if cloud replaces existing government data centres; public cloud provider data centres are much more energy efficient.
Focus on SME	In order to include SMEs as a target for cloud adoption (not covered by the public administration cloud adoption strategy), they are working the definition of memorandums of understanding with the main public cloud manufactures. Theses MoUs cover, in addition to other things, the adoption of cloud by SMEs.

Obstacles/Barriers	
Technical barriers	The major technical barrier has to do with a lack of time to develop skills within public administration.
Legal barriers	The most important barrier is going to be contractual. Regulatory change needs to happen in the budget approval process. Right now, government IT investments, particularly when they use EU funds, require an investment case approval process, which aligns with CAPEX, unlike for other services such as electricity, water, and telecommunications. Until this regulation is changed, purchasing from commercial cloud providers will be very difficult.
Economic barriers	The Digital Portugal team has met with GAIA-X representatives, but they are not active participants yet. The European Data Strategy is still too vague in terms of the open data space roadmaps and benefits. So, even though GAIA-X is an interesting





Obstacles/Barriers	
	initiative, Portugal has decided to wait and see to make sure it can align with the overall European strategy.
	"Cloud federation is something that needs to be done in Europe." It needs to go faster. Otherwise, Europe will continue to be dependent on Asian hardware manufacturing and on American software and cloud services.





## **EGI Foundation**

Identification	
Organisation	EGI Foundation
Website	EGI   EGI Advanced Computing Services for Research
Country and location	Headquarters in Amsterdam, NL - EU
Sector	Public services/ R&D
Name of interviewee	Tiziana Ferrari
Title	Managing director

Cloud-related activitie	s
Description of the activities	EGI is a federation of computing and storage resource providers united by a mission to support research and development. The federation is governed by the participants represented in the EGI Council and coordinated by the EGI Foundation.
Timing	The EGI Foundation is not-for-profit and was established in Amsterdam in 2010 under Dutch law. Ongoing initiative since foundation.
Technical solution	The EGI Federated Cloud is an laaS-type cloud, made of academic private clouds and virtualised resources and built around open standards. Its development is driven by requirements of the scientific community. It provides advanced computing and data analytics services for research and innovation as well as delivering advanced computing services to support scientists, multinational projects and research infrastructures. The EGI e-infrastructure is publicly funded and comprises hundreds of data centers and cloud providers spread across Europe and worldwide. The EGI Services are provided by EGI's federated cloud providers and data centers while the services can be requested by everyone involved in academic research and businesses via an EGI Marketplace. They have 23 research centers: some use Open Nebula, and some OpenStack. For this second one, there is a huge participation in development from Europe. EGI started with 70% Open Nebula and 30% open stack. EGI has two infrastructures: • High throughput • Federated cloud
Relation to H- CLOUD key areas	Federated Cloud
Business model	EGI is publicly funded to help researchers access technical infrastructures, since funding in research is impacted by economic cycles and operates at constant or decreasing level. Research institutes tend to have little money to invest in technologies and





Cloud-related activities	
	need to share access to common data processing resources. EGI shows that federating infrastructures helps organizations without a sufficient budget for their own technical needs.
Impacts	
Business impact	The adoption of EGI cloud services has been ramping up over the last 3 years with a number of users currently over 72,000 researchers globally. EGI increased by 100% the capacity made available and actively used by scientific collaborations. Success has

	cross-disciplinary access to data.
Governance Structure	EGI is the largest cloud federated infrastructure in the world. During the COVID-19 pandemic, EGI has supported the research community, by delivering IaaS and PaaS and leveraging partnerships with research institutes that deliver SaaS to researchers. One of EGI partner provided simulation tools for molecular docking, which is used against the virus. In summary, the key element of success for EGI is to provide added value services on top of cloud infrastructure like IaaS; the SaaS layer is familiar for researchers freeing them of worrying about the infrastructure.

been driven by European open science cloud initiative by promoting

Obstacles/Barriers	
Technical barriers	N/A
Legal barriers	Policy in research funding is the main legal barrier.
	Most research funding nationally is targeted at national research organizations, funded for access by national users.
	Power of sharing infrastructure and data is limited to access policies that restrict access.
	Struggling with national funding policies, not opening national research to international community.
Economic barriers	N/A



# eSPap

Identification	
Organisation	Public Administration Shared Services Agency – eSPap
Website	https://www.espap.gov.pt/en/Pages/Home.aspx
Country and location	Portugal
Sector	IT for Public Administration
Name of interviewee	Teresa Girbal, César Pestana
Title	Vice-President

Cloud-related activities	
Description of the activities	eSPap is the shared business and IT services agency for the national government in Portugal.
	eSPap has adopted cloud in various ways:
	<ul> <li>Infrastructure as a service: Public administration systems are obsolete, and there was limited budget to invest in new systems. They purchased back-up services in the public cloud (with AWS) to replace storage tapes.</li> </ul>
	• Software as a service: They have longer-term experience in both designing and purchasing systems, which means they can help other government entities. Workloads – procurement (been up and running since 2009); electronic invoicing broker, O365 being deployed.
	<ul> <li>eSPap has four main shared business services. They use SAP for shared financial services and human resources. The SAP cut-off date has triggered internal discussions about reviewing business processes and architectures.</li> </ul>
	The new national government cloud strategy says that it should be "public cloud first, but intelligent, secure, and efficient." The framework includes things like the suitability of cloud for the individual system – from the legal, organisational, and economic perspectives.
	https://tic.gov.pt/documents/37177/0/CTIC+Estrate%CC%81gia Cloud+-+novembro2020.pdf/4c7b4f4f-4647-a6d8-b6a5- a988ae133c95
	The National Cybersecurity Cabinet helped define the information assurance guidelines (high/medium/low data sensitivity).
	There are very few data centres in Portugal. eSPap has one. But the strategy is NOT to make a huge investment in a government owned DC.





Cloud-related activities		
Timing	Started to use cloud in 2009.	
Technical solution	Multi-cloud environment	
Relation to H-CLOUD key areas	Cloud	

Impacts	
Business success	Overall, the adoption rate is going up quite fast in public administration. The quality/complexity of workloads is growing, too.
	There is a national survey of cloud adoption; across public sector, the latest results indicate that 33% of central government have adopted cloud; for local government, the level is almost at 50%. For them, it enables faster time to market and more efficiency, since they have limited resources to manage.

Obstacles/Barriers	
Technical barriers	The survey also indicated that the cost of cloud is high because government entities do not have the right skills to predict, monitor, and manage consumption. European suppliers: Telcos do not really have their own
	co-location, but the higher end of the stack is provided by global providers. The best option would be to have a set of intermediaries that can help to contextualise global offerings.
Legal barriers	Legal constraints: In the public sector, budgeting is annual. If the budget is not approved, there are no funds to pay for ongoing subscriptions, so you may get disconnected. They are now looking to apply a budgeting approach similar to other bills (electricity, telecom, etc.). Also, structural funds from Europe make it difficult to pay for a subscription. This should be improved from a policymaking perspective.
Economic barriers	Skills: The skills needed to adopt cloud correctly are lacking – from both design and deployment perspectives, but also in terms of the procurement, operation, and benefits realisation.
	Vendors are bringing to market a buffet approach. You can eat everything and pay for everything. But you do not have the time or resources to eat everything. Most multinational cloud vendors' salespeople do not understand public procurement laws. The big challenge is how to push them to address the special European regulations.

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### **G-Cloud**\*

Identification	
Organisation	Various interviews and secondary research on G-Cloud were conducted by IDC over the past 10 years, both with UK government representatives and tech suppliers
Country and location	UK
Sector	Public Administration

<b>Description</b> of the UK government is ahead of the curve compared with other countries in Western Europe in terms of cloud computing adoption. The move to the cloud started with the 2011 Government Cloud Strategy <sup>6</sup> . The UK government was led by a Conservative-LibDem coalition. Austerity measures were a big focus for the HM Treasury. Cloud computing was considered the key to unlocking the oligopoly of large systems integrators and outsourcers, like Accenture, HP-EDS, Capgemini, IBM, Capita, Fujitsu, BT, and a few others, which had locked many central government departments in all-encompassing 5–10-year deals. This oligopoly resulted in the loss of skills that were incrementally outsourced to these firms. It yielded limited innovation because the contracts were built around SLAs focused on ongoing systems operation and maintenance. And SMEs were left out of public sector procurement, unless as subcontractors to large firms. This approach to procuring and deploying IT capabilities was also ill-equipped to respond to the increasing demand for the agile and fast-paced digital transformation of government processes and programs. Any business innovation need was	Initiative			
<ul> <li>tackled by specifying detailed functional requirements, which resulted in rigid and siloed custom-built solutions that were hard to integrate and reuse beyond individual government programs. Cloud computing offered a completely different approach. Standard services, instead of custom-built code, could be purchased on a modular consumption basis. But the transition from the old paradigm required a comprehensive program that addressed procurement, skills, cultural change, information assurance, and budgetary hurdles.</li> <li>The G-Cloud program entailed five elements that the 2011 strategy spearheaded:         <ul> <li>A cloud first policy – first issued in 2013 – which mandates that central government 'Departments remain free to the term.</li> </ul> </li> </ul>	Description initiative	of	the	The UK government is ahead of the curve compared with other countries in Western Europe in terms of cloud computing adoption. The move to the cloud started with the 2011 Government Cloud Strategy <sup>6</sup> . The UK government was led by a Conservative-LibDem coalition. Austerity measures were a big focus for the HM Treasury. Cloud computing was considered the key to unlocking the oligopoly of large systems integrators and outsourcers, like Accenture, HP-EDS, Capgemini, IBM, Capita, Fujitsu, BT, and a few others, which had locked many central government departments in all-encompassing 5–10-year deals. This oligopoly resulted in the loss of skills that were incrementally outsourced to these firms. It yielded limited innovation because the contracts were built around SLAs focused on ongoing systems operation and maintenance. And SMEs were left out of public sector procurement, unless as subcontractors to large firms. This approach to procuring and deploying IT capabilities was also ill-equipped to respond to the increasing demand for the agile and fast-paced digital transformation of government processes and programs. Any business innovation need was tackled by specifying detailed functional requirements, which resulted in rigid and siloed custom-built solutions that were hard to integrate and reuse beyond individual government programs. Cloud computing offered a completely different approach. Standard services, instead of custom-built code, could be purchased on a modular consumption basis. But the transition from the old paradigm required a comprehensive program that addressed procurement, skills, cultural change, information assurance, and budgetary hurdles.

that central government 'Departments remain free to choose an alternative to the cloud but will need to demonstrate that it offers better value for money,'

6

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\_data/file/266 214/government-cloud-strategy\_0.pdf



Initiative	
	whereby cloud first means 'public cloud rather than a community, hybrid, or private deployment model.' The policy is not mandatory, but 'strongly' recommended for the rest of public sector.
	• The Digital Marketplace <sup>7</sup> , whereby any supplier that is pre-qualified through framework contracts can advertise and sell its services.
	A standardised cloud information assurance approach.
	<ul> <li>Coordinated governance, which, in the initial phases of the program, assigned responsibilities for proofs of concepts to various public sector entities, but then centralised the scaling and operations of the programs into the Government Digital Service (GDS) and the Crown Commercial Service (CCS). GDS is in charge of defining and disseminating the strategic and technical guidelines for digital transformation across government, such as the Technology Code of Practice. CCS is in charge of managing pan-government procurement programs, including the G-Cloud frameworks, and qualifies which suppliers can sell on the Digital Marketplace.</li> </ul>
	<ul> <li>Crown Hosting data centres is a public-private partnership that offers managed private cloud services for those organisations that are not ready to migrate all of their systems to the public cloud or to build and run their own private cloud data centres.</li> </ul>
Timing of the initiative	2011-ongoing
Key stakeholders	n/a
Funding	The initiative was funded by the UK HM Treasury
Technical solution	The Digital Marketplace is a publicly accessible, searchable database of services offered under G-Cloud frameworks. The service began in 2012.
Relation to H-CLOUD key areas	Cloud and federated cloud
Business model	The Digital Marketplace – initially the Appstore and then the CloudStore – has been the flagship initiative of the G-Cloud program. It greatly increased the maturity of buyers and providers, notwithstanding the fact that the volume of cloud services purchased through the Marketplace is still small relative to the total ICT spending of the government sector. In fact, in fiscal year 2019, the total G-Cloud services purchased through the marketplace were approximately £1.4 bn across the whole of public sector (including central government, devolved

<sup>&</sup>lt;sup>7</sup> https://www.digitalmarketplace.service.gov.uk/



Initiative	
	administration, local governments, the NHS, schools, colleges and universities, and housing providers), against a total ICT spending that is estimated at above £10 bn.
	Services are classified into 3 lots:
	• Lot 1: Cloud Hosting (IaaS) and (PaaS): Cloud platform or infrastructure services that can help buyers do at least one of the following: deploy, manage, and run software, or provision and use processing, storage, or networking resources.
	• Lot 2: Cloud Software (SaaS): Applications that are typically accessed over the internet and hosted in the cloud.
	• Lot 3: Cloud Support, including planning, setup and migration, training, security services, quality assurance and performance testing, and ongoing support of cloud hosting and cloud software.

Impacts	
Business success	As of Q1 of fiscal year 2020/21 (June 2021), the cumulative value of cloud services purchased through the Marketplace <sup>8</sup> amounts to £6.43 billion, of which £5.11 billion is from central government departments and agencies, to which the cloud-first policy mandate applies.
	Lot 3 type of services account for over 60% of all services purchased through the Digital Marketplace, clearly indicating that consuming public cloud IaaS, PaaS, and SaaS is a complex endeavour for the government, which requires specialist support to migrate from legacy systems, integrate across hybrid multi- sourced environments, manage risk and security, and master technical and organisational capabilities.
Technology innovation	On the demand side, G-Cloud gave public sector departments the opportunity to transform their legacy architecture by developing and scaling business innovations much more rapidly and at lower cost. Initially, these tended to focus on net new workloads or workloads that deal with non-sensitive datasets, such as web servers for citizen portals and open data portals, collaborative tools, and backup storage systems. Over time, the transition to the cloud has entailed more sensitive business systems. For instance, in the first half of 2020, the HMRC announced a plan for more than 600 services to migrate to cloud; the Financial Conduct Authority signed a contract for an SaaS

8

https://app.powerbi.com/view?r=eyJrljoiNTEyMTZhZDAtZGNiNi00OWQxLWI5ODYtMjg1ZWNIMmNk ODVhliwidCl6ljImOGMwZDc5LTNIODctNGNkMy05Nzk5LWMzNDQzMTQ2ZWE1ZSIsImMiOjh9



Impacts	
	ERP solution; and HMCTS signed a contract for a cloud-based video platform for remote criminal hearings.
Data governance	One of the key factors that drove up the level of trust among UK government CIOs of cloud was the transparent common approach to information assurance adopted by G-Cloud. Although other European governments had similar initiatives, they were not promoted with the same strength. Moreover, the European Union did not have the power to influence member state government approaches beyond the policy guidelines put forward by the EU's cloud computing and cybersecurity strategies. In the UK, policies are issued and overseen by the Government Digital Service, part of the Cabinet Office, and by the National Cyber Security Centre, part of Government Communications Headquarters (GCHQ), which is a British intelligence and security agency.
	The key information assurance milestones of the G-Cloud program included the launch of a pan-government accreditation mechanism, which became operational a few months after the launch of CloudStore, in 2012. As of July 2014, approximately 60 services offered by more than 10 different providers had received G-Cloud pan-government accreditation. The pan-government accreditation mechanism was particularly helpful for smaller government agencies that could not afford a thorough review and audit of services. These agencies could thus make their own decisions (which remained their full responsibility) based on a standard accreditation mechanism. The information assurance guidelines that formed the basis for the pan-government accreditation mechanism were:
	<ul> <li>A formal and independently verified process similar to the ISO 27001 standard</li> </ul>
	A Government Protective Marking Scheme (GPMS).
	The latter is the policy that describes how 'government classifies information assets to: ensure they are appropriately protected; support public sector business and the effective exploitation of information; and meet the requirements of relevant legislation and international/bilateral agreements and obligations.' The legacy GPMS classified information assets in six categories (Unclassified, Protect, Restricted, Confidential, Secret, and Top Secret), which directly matched the business impact levels (BIL, or IL) – 1, 2, 3, 4, 5, and 6 – used to assess the risks of loss of confidentiality, integrity, and availability of government information and ICT systems. (It must be noted that the exact match between the GPMS and BIL was a one-way only relationship.)
	The pan-government accreditation process was not without drawbacks. In particular, it proved rather slow and expensive for both buyers and suppliers. As a result, in 2014, the UK government took two steps to streamline it. Firstly, in April 2014, a simplified GPMS entered into force. The new GPMS classifies

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information assets into Official, Secret, and Top Secret. Secondly, at the end of July 2014, the Government Digital Service (GDS) issued a communication that indicates that suppliers on G-Cloud will no longer need to obtain pangovernment accreditation and that G-Cloud will also stop accepting new accreditation submissions. G-Cloud suppliers are instead required to self-certify their services, and buyers will become responsible for assessing and selecting the most appropriate cloud services that meet their individual security requirements. However, cloud services that connect to the Public Network (PSN) still require Pan-Government Services Accreditation (PGA). Cloud information assurance policies and practices took into account interdependencies with broader government strategic objectives - for instance, with cybersecurity strategies. In the UK, from 1 October 2014, all government suppliers must comply with the new Cyber Essentials controls when bidding for public sector contracts that involve handling sensitive and personal information and the provision of certain technical products and services. The Cyber Essentials scheme was developed by the government in consultation with industry: 'It covers the basics of cybersecurity in an organisation's enterprise or corporate IT system. The implementation of these controls can significantly reduce the risk of prevalent but unskilled cyber-attack'.9 Although not directly related to G-Cloud information assurance policies, the scheme's set of five critical controls have become a key complement to reduce the government's (IT and non-IT) supply chain levels of cybersecurity risk. The Cyber Essentials scheme assurance framework explicitly describes how cloud services create additional interdependencies among buyers and suppliers.

Environment and	Making it easier for SMEs to do business with the public sector
sustainability	was one of the strategic goals of G-Cloud. By May 2013, there
performance	were over 700 suppliers, over 80% of which were SMEs.

#### **Obstacles/Barriers**

**Economic barriers** On the supply side, G-Cloud created a level playing field for a whole new set of suppliers. SMEs were the first beneficiaries. They have captured over 40% of G-Cloud cumulative business. UK Cloud, Specialist Computer Centres, Mastek, BJSS, and other UK suppliers scaled from small specialists to medium-sized and large companies that can compete with global IT vendors. However, the SME share of G-Cloud framework business decreased slightly over time because major cloud vendors, like Microsoft, IBM, Amazon Web Services (AWS), and Google, started to capture larger contracts. AWS entered the competition in 2013 with the G-Cloud 4 framework and Google only in 2018. The companies that struggled the most were the traditional

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<sup>&</sup>lt;sup>9</sup> https://www.cyberstreetwise.com/cyberessentials/files/scheme-summary.pdf



#### **Obstacles/Barriers**

systems integrators and IT outsourcers, which were slow to change their business models to adapt to shorter and smaller contracts and modularised consumption-based solutions.





## International institution

Identification	
Organisation	Public sector organisation (anonymous)
Country and location	EU
Sector	Public Sector
Title	CIO

Cloud-related activities	
Description of the activities	<ul> <li>The organisation started its cloud roadmap with SaaS.</li> <li>In the HR space, with SuccessFactors, because it was a mature solution. However, SuccessFactors was an American company before it was acquired by SAP. So, GDPR compliance is not easy.</li> <li>The organisation is also very much investing into Microsoft. Not yet fully invested into O365. Started with TEAMS (although also use WebEx). They use Dynamics CRM; they have implemented case management workloads for regulatory procedures on it. And they use SharePoint for document archival. They make use of Azure, such as Active Directory and security services.</li> </ul>
	90% of them are bespoke Java-based, Oracle database systems. They are in the midst of a benchmarking study and developing a cloud strategy. It's not about migration. It's about replat forming. The organisation is a heavy user of the European Food and Safety Agency framework contract. Missed the deadline for DPS1. But, overall, they want to participate in what DIGIT has to offer. Would like to have DIGIT support to tackle data protection and information assurance centrally, to give the individual agencies some relief.
Relation to H-CLOUD key areas	Cloud

Impacts	
Business success	Regulatory business optimisation – that is, the centralised procedures carried out by the organisation. The scientific advice service is a new service set up during the COVID-19 emergency to speed up vaccine approval. The service enables life-science companies' researchers to get early feedback from the organisation. That ultimately shortens the approval process. The



Impacts	
	organisation gets an early view of what's coming. The solution for scientific advice was implemented in a matter of months, thanks to cloud. Speed and agility were impressive.
Governance / Organisational structure	Organisationally, the cloud is complex. Cloud management has been under the information security unit, which is outside of the CIO team. Expertise on how to configure and orchestrate cloud services is very limited. The organisation is used to procuring and installing servers and CPUs. It needs to transition to a cloud operation centre. Budget is not the problem. The problem is skills. But, over time, they will be forced to transition: "We cannot develop an email client." The organisation has 86 IT people. Not a lot of redundancy. For instance, there is a data protection coordinator. She is super good, but no back up. The information security unit has an additional 5 people. There are specialists for digital workplace and case management (MS).
Data governance	Last year this was a big discussion. They have Documentum. It is a dinosaur, but it's perceived as secure. Business leaders are risk averse. They had to issue a new policy for TEAMS. They put the heads of the division in control. They approve TEAMS rights. The retention limit is six months. They are still in the process of completing the GDPR impact assessment for most cloud services, even though they are already using the services.

Obstacles/Barriers	
Economic barriers	AWS brings scale and speed of innovation. In the US, the government's aggregated demand for cloud services has enabled AWS to build a GovCloud. It is very hard to replicate in Europe. In Europe, AWS is confronted with very fragmented demand.





### Irish Government Cloud\*

Identification	
Name of interviewee	Barry Lowry
Title	Irish Government CIO
Organisation	Department of Public Expenditure and Reform, Irish Government
Country and location	Ireland
Sector	Public administration

Initiative			
Description initiative	of	the	In 2016, Mr Barry Lowry (the interviewee) was appointed to his current position. He has since helped design and implement the Government ICT Strategy <sup>10</sup> following three key principles:
			Always honour the past by building on what his predecessors had done and considering international best practices, such as the UK Government Digital Service.
			<ul> <li>Always invite people to create the future. Shortly after his appointment, all departmental CIOs gathered for a 2-day workshop, in June 2016, to discuss and align priorities.</li> </ul>
			<ul> <li>Earn the right to ask for more by demonstrating the benefits.</li> </ul>
			When all the government department CIOs gathered in a hotel in June 2016 they worked on:
			Digital services transformation
			<ul> <li>Data sharing solutions and skills</li> </ul>
			• A 'BUILD TO SHARE' concept: If there is a good idea, build it once, build it well, and make it available for others to share. Examples of shared solutions so far include:
			<ul> <li>EDRM system</li> </ul>
			<ul> <li>Shared desktop</li> </ul>
			<ul> <li>Government cloud: There was already a Government Network. A state data centre project was set up, which has so far undergone planning and permission and is now being procured. The business case was built around cost/competitiveness against co-location alternatives. Everybody was opposed to co- location</li> </ul>

<sup>&</sup>lt;sup>10</sup> https://ictstrategy.per.gov.ie/



Initiative	
	<ul> <li>Electronic ID</li> </ul>
Timing of the initiative	<ul> <li>The BUILD TO SHARE part of the strategy aimed to bring together 20 departments: 3 large ones – namely, finance, employment affairs and social protection, and agriculture/food &amp; marine – which provided pretty good services; the rest offered variations of mediocre. A roadmap for hybrid delivery model of ICT infrastructure was created, including two steps:</li> <li>1) Step 1 – Guidance: The policy left the option open for private vs. public based on data sensitivity. Other factors driving the choice included: <ul> <li>a. Availability of commercial solutions: If you are buying an HCM system, the best solutions exist in the cloud, so the type of workload guides the choice.</li> <li>b. A lot of the legacy core systems cannot be migrated to public cloud, so it does not make sense to run them on AWS or Azure.</li> <li>c. Some systems are audited quite frequently, and auditors want to see physical security, which is difficult for public cloud.</li> <li>d. If users are outside government, it is easier to build them outside of the government firewall.</li> </ul> </li> <li>2) Step 2 – Build a government private cloud, but with ability to burst to Microsoft and Amazon services. The environment is fairly cheap and reliable. Full automation enables remote maintenance, which has proven very valuable during the COVID-19 crisis. But it cannot cope with huge scalability requirements. For instance, www.gov.ie was getting 70,000 hits per minute after COVID-19 announcements. The web server is hosted on AWS because it was not scalable in the private cloud. CHALLENGES: The state data centre aims to build the greenest in Europe, but the approval process was slow. ISO 27001 certification takes a lot of time and energy. Some civil servants like to work for the government (as opposed to working for or being transferred to an external company. So the government retained the capability to see and the government retained the capability to so the covernment retained the capability to the government retained the capability to burst to</li></ul>
	service, like the UK government did.
Key stakeholders	All central government departments
Funding	No
Relation to H-CLOUD key areas	Cloud

Impacts	
Business success	<ul> <li>Make shared services available across central government</li> <li>EDRM system</li> <li>Shared desktop</li> <li>Government cloud: By 2022, there will be cloud provisioned infrastructure.</li> <li>Electronic ID, which went from &lt;10,000 users to 750,000</li> </ul>
Technology innovation	<ul> <li>Looking at innovation in various areas – particularly, where cloud could help scale new services:</li> <li>IoT/Edge computing and analytics for agricultural policy decision making – for instance, monitoring crop yields to decide whether to convert them into forests</li> <li>Working on a project to use a blockchain-powered app that can help validate education certificates when applying for a job; collaborating with an insurance company and other European governments, but some EU member states are not open to using smartphone apps because of privacy concerns over iOS and Android</li> </ul>
Governance / Organisational structure	<ul> <li>Operational governance – three tiers:</li> <li>Civil service management board – the secretary general of every department: Barry gets invited twice a year, and there is a dashboard available about the progress of the strategy.</li> <li>Sub-group – co-chaired by two of the most influential secretary generals (of the spending/finance department and the welfare department): This is where the collective decision making happens among digital leaders across all departments.</li> <li>ICT advisory board: This is the head of IT of every department; in some departments, this is a role that reports to the secretary; in others, they are more junior</li> <li>They are considering a memorandum of understanding (MoU) to enable local governments to access some of the resources, but local councils are still very independent and have their own shared services entity<sup>11</sup>.</li> </ul>

Obstacles/Barriers	
Technical barriers	The government does not want to do bleeding edge innovation; they prefer to start small, with basic services such as identity

<sup>&</sup>lt;sup>11</sup> https://www.lgma.ie/en/



Obstacles/Barriers	
	management and analytics, and then scale through more advanced solutions such as blockchain and ML/AI.
Legal barriers	<ul> <li>More than legal, the barriers are political:</li> <li>Politicians want to retain control over data.</li> <li>Politicians want to control how data is used; for example, do they really want to leverage IoT/satellite and analytics to analyse in more detail land usage and determine whether farming grants should be directed to convert farms into forests?</li> <li>Similarly, at the EU level, if the EC decided to go down the path of EUCF, the practical implementations could be slowed down by discussions around the member state in which EUCF would be located.</li> </ul>
Economic barriers	The cost of renting data centre space: The value of EC support cannot stop at 'We make something available and you figure out how to use it,' because the difficult part is not in setting up standards or a marketplace; the complexity is in implementation at the use-case level. So, the EU strategy should be built from the bottom up because reusable federated cloud and edge capabilities need to be ready to be applied to practical problems.




## LOGIUS\*

Identification	
Name of interviewee	Martin Dias D'Ullois
Title	Product Owner for Logius private cloud
Organisation	Logius (owned by the Ministry of Internal Affairs, which is in charge of the whole Digital Government Agenda)
Country and location	Netherlands
Sector	Public sector

Initiative	
Description of the initiative	<ul> <li>Logius has about 500 people (some self-employed).</li> <li>It provides critical digital services for the Dutch public sector: <ul> <li>Dutch digital ID for citizens (DIGID)</li> <li>Freight/Port customs declaration management systems (XBRL-based declarations)</li> <li>Dutch digital ID for businesses</li> </ul> </li> <li>Logius is always part of a value chain where multiple services are connected in a federated manner. For instance, digital ID can be used to log in to Tax Agency digital services.</li> <li>The process is quite structured: <ul> <li>Every Dutch citizen is assigned a national ID number.</li> <li>The national ID number is used to ask for the DIGID that Logius maintains.</li> <li>The ministry that provides the services. There is a certification to use DIGID for their services. There is a certification and audit process.</li> </ul> </li> <li>From the technical perspective, a custom interface usually needs to be set up between DIGID and the ministry. Logius is trying to make DIGID more open and reusable as a service, but it is not yet fully there.</li> </ul>
Key stakeholders	Public sector
Relation to H-CLOUD key areas	Cloud and federation

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Impacts	
Technology innovation	Technology wise, cloud computing is a pillar of agility that uses Kubernetes container-based architecture. It creates a multi- cluster multi-data centre solution and needs at least three data centres to run clusters.
	Martin's team is building an orchestration solution based on open source (OpenStack, OpenShift) – Cloud Native Computing Foundation.
	Dashboard, orchestration, and backup are all considered in the roadmap.
	Logius has two platforms:
	A single data centre platform acquired from other government entities
	A second data centre platform that supports non-critical applications
	The orchestration layer aims to converge the pipelines to deploy services from both platforms. The desired outcome is to be able to rollout to AWS, Azure, and the government private cloud data centre, creating a truly interoperable orchestration layer for agile deployment.
	A European service repository for reusable building blocks in terms of IaaS and PaaS management would be really useful in this context.
Governance / Organisational structure	Logius is owned and funded by the Ministry of Internal Affairs. This is a change compared with the previous governance, whereby digital government was split between the Ministry of Internal Affairs and the Ministry of Economic Affairs.
	However, each ministry still has its own CIO, and there is a government-wide CIO, so strategic decisions are hard to align.
	There is a process to decide on innovation – for example, on the development of the building blocks for a cloud management & orchestration solution. There's a rigorous process to evaluate demand; the number of users needs to be big enough. The challenge is political influences – for instance, from large agencies, such as the Tax Agency and the Ministry of Health – which may create biases.
	There is a need to meet transnational requirements, such as EC eIDAS, which need to be embedded in the roadmap.
	The Logius internal organisation is really changing the traditional 'product' focus. Big islands were broken up in 2019. In the production house, planning is in three-month cycles. Everything is based on business case discussions. The focus is on delivering value in a fast and agile manner.



Obstacles/Barriers	
Legal barriers	There are big contracts: The data centres are not Logius's; they are procured through contracts. Using two Equinix data centres. Starting new contracts for security operation centres (SOCs).
	Not using public cloud services, with the exception of minor workloads across the government, which are in the Azure or AWS clouds, but not very popular.
	Logius is considered critical infrastructure: It was categorised as such during the COVID-19 outbreak, with very stringent business continuity and data protection limits applied.
Economic barriers	There are some governmental data centres, but they are not yet mature. For example, global load balancing with redundancy for every service is not available. In the future, Logius foresees four government data centres. The director of the main data centre was unaware of H-Cloud and GAIA-X. The Ministry of Defence wants to maintain its own infrastructure.



#### Polish Common State IT Infrastructure Programme (WIIP)\*

Identification	
Organisation	Ministry of Digital Affairs
Country and location	Poland, Warsaw
Sector	Public administration
Initiative	
Description of the initiative	Wspólna Infrastruktura Informatyczna Państwa – The Common State IT Infrastructure Programme (WIIP)
	The WIIP program is responsible for increasing the security of

The WhP program is responsible for increasing the security of data processed in the ICT systems of public administration entities and optimising the maintenance costs of these systems. The program covers the introduction of uniform high standards regarding IT system protection and support for public administration entities in the running of these systems, and the provision of the services necessary for the construction, development, and maintenance of these systems. Such contributions will ensure public administrations provide a high level of services to the public. The WIIP program assumes the optimisation of existing ICT resources and applications in public administration by providing modern and cost-optimised IT. Such an approach to public administration enables priorities to be set in terms of increasing the level of security, comprehensive migration plans, and balancing the use of cloud solutions.

The WIIP program comprises the following projects and initiatives:

- The Common State Information Infrastructure Project (WIIP), implemented under POPC – Axis 2.1 'High Accessibility and Quality of Public E-Services'
- The Innovative Administration Platform (PIA) project, which includes, among others, the GovTech competition platform, ZUCH, and joint applications
- A project to modernise the existing infrastructure of integrated state registers
- Additional initiatives: government administration communication platform, the EBRD project, data embassy, and a data processing centre for administration.

# **Timing of the initiative** On 24 September 2019, the Council of Ministers adopted a resolution on the Common State Information Infrastructure initiative, which is a response to the arrangements adopted on 25 September 2018 by the Economic Committee of the Council of Ministers.



Initiative	
	First services were launched in Q1 2020.
Key stakeholders	<ul> <li>WIIP is a public administration initiative, with the main stakeholder being the Ministry of Digitalisation. The program's partners are:</li> <li>Naukowa i Akademicka Sieć Komputerowa – Państwowy Instytut Badawczy (National Research Institute under the supervision of the Ministry of Digital Affairs)</li> <li>Centralny Ośrodek Informatyki (Central IT Centre)</li> <li>GovTech Polska.</li> </ul>
Funding	Yes, some initiatives and works within WIIP projects are financed from the EU budget under the POPC 2.1 program – high accessibility and quality of public e-services.
Technical solution	All systems and applications are developed internally (using ministry resources) but with cooperation from some partners. The main concept is based on the UK's G-Cloud, but with everything adjusted to comply with Polish regulations.
Relation to H-CLOUD key areas	<ul> <li>WIIP is a federation of clouds:</li> <li>Government Cloud: This is a private cloud for central and local government and is currently in development; some services are already available. This will be completed in 2022. Currently, basic laaS services are available, with plans to gradually add more complex laaS services. Over time, the services catalogue will expand to include XaaS (everything as a service).</li> <li>Cloud Services Provision System (ZUCH): On this platform, verified cloud partners can offer their cloud services to the government sector in Poland. ZUCH was launched in Q2 2020 and is now open to partners. Partners include Netia, Hostersi, and Oktawave.</li> <li>As an element of WIIP, a national data processing centre will be developed as a green data centre – with the efficient and modern use of energy to optimise costs and to follow the trend for green data centres. For example, photovoltaics will be utilised.</li> </ul>
Business model	The main idea behind WIIP is to offer a cloud platform for central and local government. Commercial cloud providers are to become partners in this project. Their services will be available to public administration organisations via the Cloud Services Provision System. But security is the key, and the ministry, in cooperation with other organisations, will establish a set of rules concerning which data and systems can use cloud:





Initiative	
	<ul> <li>Classified data (confidential) CANNOT be stored or processed in any clouds.</li> </ul>
	<ul> <li>Sensitive data can be stored and processed in the Government Cloud (private cloud).</li> </ul>
	<ul> <li>Personal data and systems with personal data that have to be GDPR compliant may be stored or processed in public cloud, BUT only when the data centre is located in Poland.</li> </ul>
	• Other data (small systems, websites, office apps, and open databases) may be stored and processed in public clouds when the data centres are located in Europe.

Impacts	
Business success	This initiative will be successful if we see a growing number of providers joining the Cloud Services Provision System (ZUCH) and a growing number of government organisations reach out to use cloud. It is a little too early to tell what hard data KPIs will be applied.
	It will be important to see a large number of Polish/local providers join ZUCH.
	Finally, the ministry would like to see ZUCH as a role model solution for other countries and governments in Europe. The Ministry would also like this platform to become a part of a wider European cloud federation so that clients in Poland could use cloud services offered on similar platforms in other countries.
Technology innovation	The WIIP platform does not directly employ any innovation accelerators (AR/VR, blockchain, Al, IoT, or edge) with the exception of security; security is a key element of this initiative.
	It is important to know that WIIP is planned as a key platform for any projects run by public administrations. Therefore, if projects involve the previously listed accelerators (AI, VR, or IoT), these projects will still use WIIP's infrastructure and cloud services platform.
Governance / Organisational structure	The current organisational structure successfully supports active collaboration and the participation of stakeholders, in terms of both project development and the process of expanding the pool of external partners.
	ZUCH was launched a few months ago and already has close to 40 registered partners; it is running successfully, as intended.
	Government Cloud is a part of WIIP. The whole project is run by the Central IT Centre. Government Cloud will be managed by the Ministry of Digital Affairs, with COI support.





Impacts	
	As stated above, ZUCH is an element of WIIP. The COI plays a vital part in development; the ministry manages the platform.
	However, as is usual in central government, the ministry needs to cooperate with other ministries (e.g. when defining security levels for various data sources and systems to make sure data within the Ministry of Health and the Ministry of Justice is handled correctly). Ultimately, everything must be approved by the prime minister, but it is more on a legal/approval level, as opposed to being about the concept and technology.
Data governance	Data protection and regulatory compliance are the key elements of the projects – how the system can be used, depending on data type within public administration, as described above.
	It is crucial to note that partners that want their cloud services to be available to public administration customers must be verified before they can use ZUCH. Formal verification – company legitimacy, taxes paid, no debts, and so on – establishes whether the prospective partner is reliable. Security verification is included – norms, certificates, security policies, and so on. The prospective partner must complete a questionnaire. The Ministry of Digital Affairs must also verify each service the prospective provider wants to add to ensure the service is safe and meets all requirements.
	ZUCH also verifies buyers – for example, checking whether the system data will be placed in public cloud and, if so, whether it is categorised correctly.
Environment and sustainability performance	As a new data centre for administration, the National Data Centre will be a green data centre.
Focus on SME	SMEs are not the target group for this project in any way or form (unless very small local government organisations).
	WIIP and ZUCH are open to SMEs that wish to offer their services on the platform. The Ministry considers this openness to be a good way to promote local GovTech initiatives (hence the partnership with GovTech Poland).





Obstacles/Barriers	
Technical barriers	<ul> <li>The most challenging aspect was to standardise services criteria for providers willing to join ZUCH. Services must be compliant with regulations and security policies in terms of technologies, pricing, and invoicing. This took a long time – especially since various providers differ significantly in the ways they offer their services. The ministry eventually resolved the issues involved. In some cases, the ministry decided to focus more on the comprehensiveness of a service rather than on its individual parameters. Also, framework agreements have been introduced. The ministry understands that standardisation is important but cannot be done to the detriment of any providers whose offerings might be discriminated against due to such issues.</li> <li>The ministry decided to introduce ZUCH to offer various services to various customers and ensure technical diversity within central and local government.</li> <li>ZUCH is based on the UK's G-Cloud, which presents a partial legal barrier and a partial technical barrier. The Polish systems had to be adjusted to be compliant with local regulations.</li> <li>Governmental Cloud is not a barrier as such, but it is a project that is still in a relatively nascent state; it will be finalised within the next 2 years. So, to some extent, it is a challenge for data and systems that cannot use public cloud but which require cloud a.s.a.p.</li> </ul>
Legal barriers	<ul> <li>Public procurement regulations are not prepared for or suited to cloud delivery models. A dynamic procurement model exists, but it is not very common and not often used. The level of uncertainty around how it will be adopted in the future is high.</li> <li>The split between central and local administration is legally problematic – for example, what to do about local governments that process sensitive data (which should be processed in governmental cloud) but have local budgets so cannot use central government cloud. One solution, which is in a very early stage, is to create 'cloud regions' to be used on a local government level.</li> </ul>
Economic barriers	<ul> <li>There are always potential budget limitations. Governments – especially on a local level – might find other needs more pressing than IT, cloud in particular.</li> <li>Split between central and local administration is legally problematic – mostly, in term of budget allocation, EU funding, etc. The question relates to how to use local government budgets in central government projects. This will need time to resolve.</li> </ul>





## **Regional government shared IT services center\***

Identification	
Organisation	Regional government shared IT services centre
Sector	Public sector

Initiative	
Description of the initiative	This is the shared services unit of the regional government. Their data centre services constitute multiple services:
	<ul> <li>Infrastructure services: There are three data centres. One is ready for sunsetting; one of the other two is certified to the highest standards – TIA-942 – working 24/7 to support, in particular, healthcare users.</li> </ul>
	<ul> <li>System and technical architecture services</li> </ul>
	Database administration services
	• Solutions and products: These are essentially shared applications, like collaborative tools (email, Sharepoint), virtual agents (e.g. Citrix), and Active Directory.
	All regional and municipal governments, as well as hospitals, emergency contact centres and community centres, GPs, and public health services, rely on the centre for their critical IT infrastructure.
	220 municipalities
	<ul> <li>3 healthcare authorities and 2 research centres</li> </ul>
	<ul> <li>10+ regional government entities</li> </ul>
Timing of the initiative	Community cloud IaaS program started in 2014
Key stakeholders	Public sector and SMEs
Funding	Yes, participating to R&I projects
Technical solution	n/a
Relation to H-CLOUD key areas	Cloud, federation, and green
Business model	The primary business model is to sell services to regional and municipal public administrations. The centre also aims to earn 20% of revenues from small and medium-sized private enterprises.





Impacts	
Business success	Business success is defined in terms of cost-quality and the take up of services by public administration.
Technology innovation	Investments on data centres were driven by the need to control data – particularly for healthcare entities that the centre serves – to maintain accountability, business continuity, and data sovereignty. That has driven the implementation of a community cloud architecture for laaS. Some public cloud is used – for instance, O365 for the majority of users, but not all. The centre manages overall 60,000 mailboxes; it was not possible for operational and data protection reasons to migrate all of them. The centre is starting to work on containerisation, but there is no clear demand for hybrid cloud from the end users yet. They are considering using storage as a service from public cloud providers, but often the volume/price thresholds that the CSPs set in their contracts are too high. The centre is also working to implement a totally new infrastructure, based on hyperconverged equipment and software defined network (VMware-based). This full virtualisation of the network also helps with disaster recovery: Everything is fully replicated. This will also make the centre ready for the
Covernance /	hybridisation of cloud services.
Organisational structure	<ul><li>The centre is a private company but 100% owned by the regional government. So, essentially, it is a public corporation subject to public sector procurement, budgeting, and other regulatory requirements.</li><li>All strategic decisions are made by a board that reports to regional elected officials. It has a dual system of governance.</li><li>At the technical architecture level, the centre is quite independent, as long as it follows those strategic guidelines.</li></ul>
Data governance	Investments in data centres were driven by the need to control data – particularly for the healthcare entities that serves – to maintain accountability, business continuity, and data sovereignty.
Environment and sustainability performance	In 2013, the data centre infrastructure energy bill was $\in 1$ million. In 2014, with more data and higher workloads, some rationalisation drove a saving of $\in 400,000$ . In 2019, with the new data centre, with all the latest technology and physical architecture and automation, the bill was $\in 300,000$ , having changed all island, heating, and cooling systems, etc.
Focus on SME	In the new strategy to work with other industries, the centre is focusing on driving revenue growth with local SMEs – in particular, SMEs that have IT solutions (PaaS and SaaS) that





Impacts	
	need an infrastructure provider to host their services. The centre differentiates in two ways:
	• For companies that want to bid for public sector business, they offer a certified data centre.
	• For SMEs that do not have the skills to work with hyperscalers, the centre offers value-added support services to configure and maintain the virtual servers, backup services, etc. the centre works with the regional branch of the national industry association to market services. It set up a dedicated relationship management structure.
	services. It set up a dedicated relationship management structure.

Obstacles/Barriers	
Technical barriers	The inability to migrate/port all 60,000 mailboxes to O365 is an indication of the gap in terms of internal resources, both skills and infrastructure.
Legal barriers	The regional government is accountable for data protection and feels more in control by having the data in its own data centres – particularly sensitive data, like healthcare data.
Economic barriers	The contract/pricing volume threshold sometimes makes it difficult to experiment with public cloud.





#### **SPOTES\***

Identification	
Organisation	Ministry of Ecological Transition
Country and location	France
Sector	Public administration
Initiative	
Description of the initiative	SPOTES – which is a part of <u>DINUM</u> /SNUM, the government IT organisation, and the digital transformation agenda – is a marketplace for IT services for government employees. The ministry has received funding from DINUM to act as the pilot user for SPOTES.
Timing of the initiative	It was announced at VIVATEC 2019.
Key stakeholders	French government direction interministérielle du numérique (DINUM) and other central government ministries
Funding	French government
Technical solution	The marketplace is now running on the ministry's private cloud,

	which is based on OpenStack.
Relation to H-CLOUD key areas	Federated cloud

Impacts	
Business success	The service catalogue includes:
	Workplace services
	Collaborative tools
	• laaS
	• PaaS
	Helpdesk support
	Architecture and methodology
	Services are available both individually and as packaged solutions.
	They started by defining a taxonomy.



Impacts	
	There are currently over 50 services published by different entities in the ministry, including events, seminars, educational material, and blogs.
	The KPIs that they monitor include:
	User experience
	Number of transactions
	Number of registered users
	Number of tickets
	Number of offerings
	<ul> <li>Time saved by end users (by finding products rapidly)</li> </ul>
Technology innovation	They implement cloud technologies which are already quite innovative for the government environment but do not address emerging technologies such as AI.
Governance / Organisational structure	There are governance committees with representatives from all ministries. In terms of user governance, all ministries will have access, with different kinds of profiles being defined.
Data governance	Three layers of services were defined:
	<ol> <li>most secure, provided by three ministries (Ministère de l'Interieur, Ministère de la Transition écologique et solidaire,)</li> <li>all government</li> <li>commercial services, with framework contracts to be set up for the whole government.</li> </ol> The French Agency for Security provides certification. Authentication services are based on what the government
	already has in place and are API driven.
Focus on SME	No (they address the public employees market)





#### **Obstacles/Barriers**

Economic, technical,	The main challenge they had to face was engineers and end
and legal barriers	assets to a user-oriented service value chain – finding a service.
	ordering, payment, support.





### Statens IT\*

Identification	
Name of interviewee	Peder Wiese
Title	Head of Digitalisation/CTO
Organisation	Statens IT
Country and location	Denmark
Sector	Public administration

Initiative		
Description of initiative	the	Statens IT started as a cost efficiency program. It currently serves 30K government agency end users; including education institutions, that goes up by an additional 15K.
		Statens IT was built as a shared IT service centre for the whole of the Danish central government and placed under the umbrella of the Ministry of Finance.
		All of the people initially transferred were operations people. They did not have a digitally enabled business innovation perspective in mind. And they depleted each ministry of technical skills. So, when they started to go back to 'selling' services to the ministries, STATENS was possibly talking in a technical language that nobody on the demand side could understand.
		They then started to put together a service catalogue to make their offering more structured. The catalogue is still in PDF, but there are plans to make it web based.
		They joined Euritas to learn from peers around Europe.
		They invested in personnel certification and security clearance to offer high-quality information assurance.
Timing of the initiati	ve	Over 10 years ago
Key stakeholders		Public sector
Funding		Solely funded by 'customer' demand. Prices calculated by dividing the cost of operations by the estimated demand. No central budget granted.
Technical solution		Statens IT brokers services from external providers and provides its own services.
		External service brokerage
		Each customer has a Statens IT identity. Statens IT manages the single sign on for external service providers.





Initiative	
	They have tried to build a 'shared tenant' setup with Microsoft to avoid having to purchase a lot of new licenses, with subtenants for each user that could be swapped. However, Microsoft apparently did not like this concept of 'consolidated clients', so they are now trying to set up an agreement of transferring licenses, thus finding a contractual solution. They are learning this approach from the Danish environmental portal (dmp.dk), which provides shared IT environmental services to Danish counties. For example, they are trying to build cost profiles for different user types. A lot of assumptions are being made to be able to budget for these services.
	Currently, Statens IT does not use AWS.
	They are starting to use IBM cloud services; the initial indication is that IBM is more mature in terms of service delivery/engagement models than Microsoft.
	Government-Owned Data Centre Services
	GovCloud is the community cloud being run within Statens IT data centres. The services are set up to comply with GDPR. Tenants are separate. GovCloud.DK includes all layers:
	OpenStack – IaaS
	<ul> <li>MapR solution from HPE – PaaS services: 2 customers in operation, but 20 customers that are doing PoCs. However, Statens IT is evaluating the option of phasing out MapR, or using it only for IoT to feed analytics, but then using open source for other workloads.</li> </ul>
	There is also a traditional managed on-premises setup for legacy application. This can be connected with GovCloud.
Relation to H-CLOUD key areas	Cloud and federation
Business model	Statens IT is trying to align with commercial pricing, while covering the cost of Statens IT. But that is hard because it is difficult to estimate the volume of workloads. So, finalising the price per CPU, rack, etc., very few applications can be metered. Core applications will move to GovCloud over time, starting with BI/AI. That is the roadmap for a 'Statens IT 2.0'. The team is trying to understand how to make it only SaaS and not have to reengineer the entire stack. For example, they are looking at enabling the Jitsi.org web conference platform (similar to Zoom), offering a privately hosted service.



Impacts	
Business success	<ul> <li>There is recognition among customers that Statens IT adds value – for instance, on information security. That is good, but it also constantly challenges the organisation's maturity.</li> <li>Statens IT has 4 major goals in the current strategy period: <ul> <li>A high level of customer satisfaction and stable operations</li> <li>Competitive pricing</li> <li>Reliable projects</li> <li>A high level of information security</li> </ul> </li> </ul>
Governance / Organisational structure	Governance. This is an area of continuous improvement. Being IT operations people, we had a tendency to communicate in technical terms. And there were no more technical people in the customer organisations. So, we needed to set up several layers of governance. There is no opting out of Statens IT. A governance board and a customer board meet every six weeks to improve dialogue. And then there are working groups on specific topics. For instance, when you go into the application areas that are common across ministries, costs can be reduced by consolidating to one database server with multiple instances. Such topics are discussed in working groups.
Data governance	All services are natively GDPR compliant
Environment and sustainability performance	STATENS It is currently designing a new data centre to be operational in early 2021. Energy efficiency is a key part of the design, as it was with our current data centre, but the development of technology has moved quite a bit since we built our current data centres. Also, STATENS It is currently making a study of energy consumption at the end user workspace – and the results of this study will be an active component in coming purchases. (Statens IT owns the end-user laptops, screens/terminals, printers, and related services.)



#### WeNMR

Identification	
Name of interviewee	Alexandre Bonvin
Title	Scientific director of the Bijvoet Centre for Biomolecular Research at the Department of Chemistry of the Faculty of Science
Organisation	University of Utrecht – WeNMR project
Country and location	Netherlands
Sector	Academia and research

Initiative	
Description of the initiative	The department started to set up HPC/HTC capabilities for computational structural biology in 2008.
	Researchers from around the world can register then access services through a portal. They usually have their own datasets and use the UUL computational services to run the analysis. In the backend, high-throughput computing machines are available.
Timing of the initiative	2008
Key stakeholders	Academia, some life science companies. But commercial companies are concerned about IP protection, so there are very few that use the services.
Funding	Funding is a mix of Dutch government research grants used to develop the software and European funds to support the service provisioning:
	Europe HPC project funds
	Europe HTC scalability funding
	WeNMR project funding
Technical solution	The WeNMR suite of computational tools is composed of eight individual platforms:
	<ul> <li>DISVIS, to visualise and quantify the accessible interaction space in macromolecular complexes</li> </ul>
	<ul> <li>POWERFIT, for rigid body fitting of atomic structures into cryo-EM density maps</li> </ul>
	HADDOCK, to model complexes of proteins and other biomolecules
	<ul> <li>AMBER, a web portal for Nuclear Magnetic Resonance (NMR) structures</li> </ul>





Initiative	
	CS-ROSETTA, to model the 3D structure of proteins
	<ul> <li>FANTEN, for multiple alignment of nucleic acid and protein sequences</li> </ul>
	<ul> <li>SPOTON, to identify and classify interfacial residues as Hot-Spots (HS) in protein-protein complexes</li> </ul>
	EOSC-Hub (finishing in April 2021) and EGI-ACE (just starting) provide the core back-end federation services. UUL act as an intermediary between researchers (21,000 registered users from all over the world; the majority from India, then EU, then US, UK, China and some users in Africa). The service is also being used in education, like the university of Bologna recently started a course in bioinformatics and suddenly there was a spike in registrations.
	The UUL software defines the workflow and the computational model. The researchers can change configurations (depending on their level of access: easy-expert-guru authorization). This allows UUL to control the consistency and robustness of the model, to have error catching and error checking, validation of input data, to avoid failures and queues. Too much freedom would result in high risk of failure and would create a lot of work to figure it out.
	This helps optimize resources. If there is disruption in the back end grid EGI is responsible for OLA-SLAs, still UUL are monitoring any major disruption, because they are the one that get the calls from the users.
	Behind the portal there is a complex machinery. Distributed computing (access to more 100,000 CPU cores in Europe, plus US Open Science grid and a China node). Using the EGI workload manager. The EGI workload manager can access grid resources and a few hundred cloud cores. Utrecht and Florence universities are the entry points/portals, same user experiences.
	Utrecht have their own clusters too, for resilience purposes. And not everything is suited for distribution, if the data set is too large – typical job are small datasets and short running times.
Relation to H-CLOUD key areas	Cloud Federation
Business model	Public and research funding

Impacts	
Business Impact	<ul> <li>Business impact is measured in terms of:</li> <li>Number of users – they have been constantly growing since 2008. From Utrecht in 2020, 20mln jobs were</li> </ul>



Impacts	
	launched. Because of COVID usage more than doubled in 2020 – 1/3 of jobs were COVID related.
	Continuity of the service
Technology innovation	Advanced analytics and ML
Governance /	User governance:
Organisational structure	• The service is popular with ethical hackers, so they need to have clear policies and procedures to register users. There is an approval process, it's not automatic registration
	• There is an email communication from the server to the user. They get notification on the status of jobs.
	There is a trial license
	<ul> <li>There are different access levels: Easy-Expert-Guru – only 10% are Guru users, most are happy with the basic service</li> </ul>
	<ul> <li>Commercial users have to pay for the service</li> </ul>
	Supplier governance. EGI has always been doing the negotiation with the distributed / federated service providers. UUL started in 2008 with a European project to build their own grid. Then partnered with EGI and stopped operating their own resources. So the supplier SLAs are managed EGI. They do not operate reserved time, nor can reserve site specific resources. There are some sites without SLA agreement, but they have been part of the distributed network for a long-time, so there is trusted relationship– e.g. Observatory of Paris. 60% of jobs happen on Dutch resources, because there is a lot of capacity.
Data governance	Researchers that register for the service own the data.
J	Data is persisted on the grid for only two weeks, then it gets deleted.
Green IT, Environment and sustainability performance	No evidence of good practices.
Obstacles/Barriers	

Technical barriers	You have to provide support services for the users: emails, forums, tutorials, workshop – this is quite a significant investment in time; even prof. Bonvin has to answer to technical support emails
Legal barriers	Fully compliant with regulation, no barrier
Economic barriers	Skills are a gap. The team is composed of only post-doc students; it is a challenge to keep the expertise. After 4 years they need to



#### **Obstacles/Barriers**

be turned into permanent positions but creating permanent positions in academia is tough.



#### **1.2 Private Initiatives**

The record cards of private initiatives are listed in alphabetical order. An asterisk marks those interviewed in the 1<sup>st</sup> release of this report. The second column shows how each initiative is classified in terms of the 4 groups described in the report, that is:

- Cloud and Federated Clouds
- Edge Computing
- Green IT and Sustainability
- Cloud system Integrators

A few interviews concern initiatives which were not considered to be good practices but are reported here for documentation.

Table 2 List of Private Initiatives (Asterisk=from the 1<sup>st</sup> release)

Name	Туре
1&1 IONOS SE	Green IT
A1 Digital	Cloud/Federated Cloud
AquaCloud	Cloud/Federated Cloud
Axis	Edge
BrianzAcque	Edge
Capgemini	Cloud system Integrators
Citynetwork	Cloud/Federated Cloud
Cloud 28+	Cloud/Federated Cloud
Cloud & Heat	Green IT
CloudFerro	Cloud/Federated Cloud
CloudSME	Cloud/Federated Cloud
Comarch	Cloud/Federated Cloud
CS Group	Cloud system Integrators
GEVA group	Cloud/Federated Cloud
Green Data Center AG	Green IT
Insentis	Cloud/Federated Cloud
Keeplt	Cloud/Federated Cloud
Leading EU car manufacturer	Edge





Name	Туре
Nodeweaver	Edge
OpenNebula	Cloud system Integrators
OVHcloud	Green IT
Polymore	Green IT
QBeyond	Edge
Reply	Cloud system Integrators
Scaleway	Green IT
Sovereign Cloud Stack	Cloud/Federated Cloud
Talentsoft	Cloud/Federated Cloud
Telefonica	Cloud/Federated Cloud
ThreeFold Network	Cloud/Federated Cloud
T-Systems	Edge
Vivacity Labs	Edge
Worldsensing	Edge





## 1X1 IONOS SE

Identification	
Organisation	1&1 IONOS SE
Country and location	Germany
Sector	IT
Company size	> 2,000 employees
Name of interviewee	Rainer Sträter
Title	Head of Global Platform Hosting

Initiative	
Description of the initiative	1&1 IONOS SE is a cloud services and IT hosting company
Timing	1&1 IONOS SE was founded in 1988 as a hosting provider. In 2018, 1&1 Internet merged with Profitbricks and became 1&1 IONOS SE as part of United Internet AG. In 2020, IONOS Cloud was launched to bundle the company's cloud competencies.
Key stakeholders	Fully owned by United Internet AG
Funding	No EU funding
Technical solution	IONOS Cloud offers its own IaaS compute engine based on its own codestack for virtualisation and containers (Kubernetes), as well as a VMware-based private cloud solution, a cloud backup solution, and S3 object storage.
Relation to H-CLOUD key areas	Cloud
Business model	A private sector company selling cloud infrastructure services and hosting.

Business success - NPS: Happy customers are the main criterion, because happ customers mean more customers. - New customers - Revenue: €948 million in 2020	у





Impacts	
	- Cost competitiveness: they price their services lower than the market leader AWS and they rely on efficiency and productivity to be profitable.
Technology innovation	<ul> <li>IONOS Cloud standardises IT infrastructure on its own stack and builds services on top of it.</li> <li>IONOS Cloud is a big believer in open source and building open-source communities.</li> <li>Once the infrastructure is completely standardised, innovative services can be built on top.</li> <li>1x1 IONOS SE and its parent company, United Internet, have a fibre network, offer 5G licenses, and provide cloud services to enable different use cases in the cloud-edge continuum.</li> </ul>
Governance / Organisational structure	1x1 IONOS SE is very engaged in GAIA-X and is a day-1 member of the initiative. The GAIA-X service portal will be of critical importance as a place where everyone can post their GAIA-X compliant services, so that others can find these services and operate them. GAIA-X is trying to create an architecture of standards, as many standards are already available.
Data governance	Customers are responsible for their own data governance processes. 1x1 IONOS SE provides infrastructure.
Environment and sustainability performance	1x1 IONOS SE is very engaged in providing climate-neutral IT hosting and cloud services. Data centres in Germany and the UK are operated 100% based on renewable energy. Other locations are compensating their CO2 emissions. The supply chain is also optimised for sustainability.
Focus on SME	1x1 IONOS SE serves customers ranging from SMEs to large enterprises.

Obstacles/Barriers	
Technical barriers	<b>Competitiveness</b> Global cloud providers are driving differentiation on all layers of the stack, as well as on the hardware layer and, specifically, the chip layer. They are moving away from the commodity standards and building their own variants of chips and other hardware components. Ionos also builds its own hardware based on open-source hardware standards. If organisations used the same commodity hardware, differentiation could happen higher up the stack. As an example, a microelectronics project – an Important Project of Common European Interest (IPCEI) – focuses on the chip design of chips made in Europe based on RISK architecture. Ionos is already building its cloud services based on an open-process architecture and an open-source RISK 5- based chip architecture.

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Obstacles/Barriers	
	Sustainability To drive sustainability and decarbonisation at scale, Europe needs to develop and produce new hardware architectures at scale, which smaller providers can use — for example, in the areas of microelectronics design and hydrogen batteries. Cloud – Edge continuum Data centres will become more decentralised with edge locations everywhere. Compute power will move closer to the data, instead of sending growing data volumes back to a central data centre. This cloud-edge continuum needs to be managed well.
Legal barriers	Political impulses are important to create a thriving European cloud community.
Economic barriers	<ul> <li>Marketing and Awareness</li> <li>The biggest challenge is awareness. European customers are not aware that they have European cloud alternatives that they can choose. It will require a lot of marketing investment to educate European customers about the benefits of European cloud services. Initiatives like GAIA-X also need to do much more marketing to educate customers about the business benefits.</li> <li>Services Ecosystem</li> <li>Investment is needed in a European cloud services ecosystem, which includes open-source applications as well – for example, productivity applications</li> <li>like NextCloud, Collabora, and open office.</li> <li>Feature Parity</li> <li>European providers do not have feature parity today and cannot keep up with the pace of innovation that larger scale cloud providers can achieve, but they offer the most important features that customers are using. Lack of feature parity is often used as an argument against European providers, but they offer most of what a customer need.</li> <li>Open Source</li> <li>European providers can innovate by using standard opensource components at each layer of the IT stack and integrating them into their ecosystems. This requires a different open-source license for hyperscalers, so that they cannot build proprietary services on open-source components. Open-source communities only thrive when they are treated in a fair way.</li> <li>Open-source licensing needs to be revisited to protect it from exploitation.</li> <li>Governance</li> <li>An IT stack and IT solutions based on open-source components need a strong governance organisation. GAIA-X could provide this governance mechanism.</li> <li>The idea is to create open-source ecosystem solutions based on GAIA-X architecture – solutions that are fully portable, run on standardise IT infrastructure, and can be used and open-source license.</li> </ul>

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#### Obstacles/Barriers

The abstraction layer needs to be at the container/Kubernetes layer. Orchestration can be done through Open Stack or OpenNebula. TOSCA 2.0 can be the interface for the abstraction layer. There can be flavours of GPU, ARM, and RISK processors underneath, but 90% of all workloads would be able to run on the container layer. Differentiation should come from the services layer and not from below the container layer.



# A1 Digital – Exoscale

Identification	
Organisation	A1 Digital
Country and location	Austria
Sector	Telekom
Company size	201-500
Name of interviewee	Matthias Nöbauer, Evelyn Hager
Title	CEO Exoscale/ Communications department

Initiative	
Description of the initiative	Exoscale is the public cloud division of A1 Digital
Timing	A1 Digital was founded in 2017 as a fully owned subsidiary of Telekom Austria Group, and Exoscale was acquired from Swisscom in 2017 as the cloud services provider for A1 Digital.
Key stakeholders	Parent company: A1 Telekom (Austria)
Funding	No EU funding – private company
Technical solution	Exoscale provides infrastructure and services for cloud applications in Europe. Exoscale offers IaaS, including computing power, network capacity, and storage. In 2020, a Kubernetes container platform was added.
Relation to H-CLOUD key areas	<ul> <li>A1 Digital is focusing on three areas:</li> <li>Cloud: Exoscale Cloud Service (IaaS &amp; PaaS)</li> <li>IoT</li> <li>Security</li> </ul>
Business model	A privately owned company. Swisscom, CERN, and fintech start- up Bity are amongst the customer base. Focused on Fintech, healthtech, and legaltech customers – SMEs and large enterprises. Geographical focus is on DACH and CEE countries.



Impacts	
Business success	We look at the following parameters when we look at our success:
	<ul> <li>Business and customer growth: Cloud is only interesting when you can scale up through fast growth.</li> </ul>
	<ul> <li>Consumption: How many workloads are running on the platform</li> </ul>
	• Competitive success: Winning customers in competition with global cloud providers because of lower cost (up to 30% more cost efficient), better performance (proven in performance tests), and for legal and emotional reasons.
	• Customer satisfaction: Very happy customers; hardly any customer churn. Customers are happy to recommend the solutions and services through the customer community.
	Have experienced accelerated growth in the last 18 months.
Technology innovation	Have developed a fully automated platform based on its own internally developed technologies and opensource technologies. A1 also has a marketplace for SaaS solutions from various software vendors.
	Offers a full portfolio of IaaS services (S3 storage, compute, and networking) and a Kubernetes services fully integrated in the platform, all accessible through APIs and provisioned with Terraform. Offer all services through a self-service portal, with a true pay-per-use pricing model – no hidden costs.
Governance / Organisational structure	A private company. Exoscale is part of A1 Digital, which is in turn a wholly owned subsidiary of Austria Telekom Group.
Data governance	A1 Digital focuses on security as one of three priorities.
Environment and sustainability performance	Austria Telekom Group has a company-wide sustainability program, of which Exoscale and A1 Digital are parts.
Focus on SME	Customers are mostly SMEs and large enterprises, but the focus is on start-ups and scale-ups.

Obstacles/Barriers	
Technical barriers	Hyperscale cloud providers have a bigger R&D budget and can maintain a higher pace of innovation. Scalability could be accelerated through large customers. Develop their own IP, which takes time but ensures control of the IT stack.





Obstacles/Barriers	
Legal barriers	GDPR and GAIA-X drive customer demand for European- headquartered cloud-service providers and can potentially be accelerators for Exoscale.
Economic barriers	It would be great to be able to hire more developers to develop more features for the cloud platform faster. Economic support from the EU would be appreciated.





# Aquacloud\*

Identification	
Name of interviewee	Joern Torsvik
Title	Project Manager
Organisation	Aquacloud
Country and location	Norway
Sector	Aquaculture
Company size	10 part-time employees dedicated to project; over 100 participating in the wider project

Initiative	
Description of the initiative	Aquacloud was established in 2017 and is a Big Data project anchored in the aquaculture industry's need to solve common challenges in order to create sustainable growth. Sea lice have been identified as a threat to the growth of the aquaculture industry, so leading aquaculture companies came together to share data to solve this problem and identify and prevent new outbreaks of sea lice in their fish farms.
	The initial scope of this initiative was to establish a secure database for storing data and to use advanced analytics to identify where sea lice outbreaks were probable. This part of the project celebrated some success. However, data quality and dependability were insufficient to reach the ambitious goals at the time.
Timing of the initiative	The idea for Aquacloud started in 2016, when awareness of digitalization and the application of IT in the seafood industry started to grow. The project was officially launched in 2017.
Key stakeholders	Some private companies saw the opportunity to come together to understand and solve some of the biological challenges in the aquaculture industry and to create sustainable growth for the industry. The idea was to combine data from multiple companies to create a base strong enough to solve these biological challenges.
	The project is run by NCE Seafood Innovation and began with the following cluster members: Lerøy Seafood Group ASA, Grieg Seafood ASA, Mowi ASA, Bremnes Seashore AS, Lingalaks AS, Eide Fjordbruk, and Bolaks AS clusters. The project has developed substantially since 2017. Today, the project involves an even broader group of leading aquaculture companies.





Initiative	
Funding	Aquacloud is financed through partner contributions, Innovation Norway, and Siva (since 2019) through the financing of Ocean Innovation Catapult Centre.
Technical solution	The initial scope of the Aquacloud initiative was to establish a secure database for storing data and to use advanced analytics to identify where sea lice outbreaks were probable. The Aquacloud project partnered with IBM to provide the technology platform, which integrates with production systems of the aquaculture companies to extract their data into a common data repository. Based on the collected data, the aim is to predict and prevent sea lice outbreaks.
	The project has evolved from being purely a sea-lice forecasting asset to becoming a hub of industry activities, including companies from multiple subsectors of the industry.
	Because data quality was an issue in the initial phase of the project, Aquacloud has now launched several workflows to address data standardization needs in the industry:
	<ul> <li>Sensor Data – an open IoT-based standard allowing equal access to aquaculture sensors and systems</li> </ul>
	<ul> <li>Fish Health – common standards for areas such as mortality causes and fish group identification, as well as digital information exchange between various health and welfare entities</li> </ul>
	<ul> <li>Environmental Data – to review the environmental section of NS9417 standard on unambiguous terminology and methods for documentation of production</li> </ul>
Relation to H-CLOUD key areas	Federation
Business model	The business model is the collaboration of leading aquaculture businesses in Norway. They collaborate to remove common obstacles to growth in the industry. They share data from their production systems in a common data repository.

Impacts	
Business success	The definition of success has changed over the lifetime of the project.
	At first, success was defined as solving the sea-lice prediction problem to achieve sustainable growth for the aquaculture industry. During the project, the most important success criteria has become the learning curve that comes from collaboration. Improving data quality has also emerged as a success criterion, as well as identifying next steps and widening the stakeholder group to achieve networking effects and drive the adoption of data

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Impacts	
	standards. Ultimately, the goal is to drive innovation through shared data.
Technology innovation	The next step for Aquacloud is to include IoT and Edge technologies for monitoring the fish.
Governance / Organisational structure	The project is running on specific project funding at the moment, and the long-term structure has not yet been decided. The plan is to move to a commercial model that will make Aquacloud self- sustainable, but it will remain a non-profit organization. Aquacloud is governed under a steering committee from the participating companies.
Data governance	Achieving a common data structure is the key goal of the Aquacloud project to enable effective and efficient data sharing while ensuring the data sovereignty of the stakeholders. Aquacloud is compliant with regulations and best practices. Rules around data usage (for example, for research) and data monetization are still evolving.
Environment and sustainability performance	Aquacloud uses highly virtualized data centres and is very focused on green computing and energy efficiency. The Aquacloud project is dedicated to the use of renewable energy sources and energy efficient technologies.
Focus on SME	Four large companies operate in the aquaculture industry on the west coast of Norway, but most companies in this industry are SMEs. Aquacloud is attracting more members, and most of them will be SMEs.

Obstacles/Barriers	
Technical barriers	The biggest technical barrier was around data classification. We had to identify and classify data into, for example, a) data that is already shared, b) data that is harmless to share, c) data that is sensitive from a business perspective, and d) data that is illegal to share from an antitrust perspective.
	Other challenges included a lack of a common data standard; many manual entries of data into the system, which created problems with data quality; how to access various submerged environmental sensors; and how to transfer data and make it available in a standardized way, offering access to data across multiple systems. We launched a new standard in September, with broad participation from industry players.
	We then started to work on an industry standard for data from environmental monitoring. This standard defines the semantics around monitoring, at what depth you need to measure the temperature, and how we measure fish health and welfare. We also needed a common language for why fish die or disappear to

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Obstacles/Barriers	
	improve biological efficiency. We started working with a Norwegian university to conduct mortality analysis for fish, and we mapped a wide range of different mortality causes into eight categories to strengthen the quality and potential of combined data sets in the project.
	There was also a realization that, when the participating companies expose their data through the platform, they lose direct control of their data, as it is shared so efficiently and potentially reaches many stakeholders. We discussed how to best share data – for example, in real-time, with a time delay, and anonymized to maintain data confidentiality.
	Another technical challenge relates to the data platform. How can we continuously load data from all partners and enhance and improve the quality of data streams so that we can make aggregated datasets available for innovation in the aquaculture industry.
Legal barriers	We had to build a legal framework that takes various multilateral relationships into account – data providers, IT providers, data and consumers.
Economic barriers	No economic barriers at the moment. We are exploring the mutual benefits of sharing data for all participating companies.





#### Axis\*

Identification	
Name of interviewee	Andrea Sorri
Title	Director, Business Development Smart City
Organisation	Axis
Country and location	Turin, Italy
Sector	Private, technology
Company size	3400 employees worldwide

Initiative	
Description of the initiative	Edge computing is part of the natural development of our company. We are a producer of IP cameras. Our products are scalable, use open standard, and are easy to integrate into various platforms. Together with open standard, edge is the philosophy driving what we do, as it guarantees lower connectivity levels and server loads.
Timing of the initiative	The development of edge camera capabilities started 10 years ago. We have improved our hardware platform and our developer partner ecosystem over time. Currently, we are launching a proprietary platform with a DLPU (a deep learning process unit) as the latest evolution. The application layer needs to become more scalable from a developer standpoint.
Key stakeholders	We sell only to our channel network/distributors. Nevertheless, we foster and drive a partner ecosystem on the hardware and software sides to ensure easy integration with other platforms and solutions and to stimulate software developers (AI, bid data, analytics, management platforms) to work with our products. Our end-customers for edge-distributed solutions are in retail, for people counting, pure monitoring in retail and banking, and government/authorities for traffic management use cases (statistics, average time, and intersection monitoring). We have both private and public customers for critical infrastructure perimeter control.
Funding	Not using EU funding
Technical solution	The cameras have an internal computing platform for analysis and to run applications that usually run on servers. Apps (video analysis, audio analysis) can be proprietary or third party. Applications support insights (metadata) and facilitate other layers of the solution (e.g. different connectivity platforms that





Initiative	
	would be difficult to integrate elsewhere, cybersecurity, and the management of the device or of other devices – e.g. turning on smart lighting via motion detection). Our aim is to move integration complexity to the edge camera to ease our partners' integration, development, and use of software for our platform. We focus on the device edge. New intermediate edge architectures are a new trend. We're open to them, but we don't yet need them.
Relation to H-CLOUD key areas	Edge
Business model	We primarily develop the hardware and part of the software. We sell the hardware to a distributor, and an SI usually integrates it with the software platform and other applications.

Impacts	
Business success	Video surveillance is a growing sector per se. The edge part is a tech inevitability that people do not always want.
	Our metrics beyond the usual business KPIs (revenues, profits) are:
	The number of sensors sold
	<ul> <li>The number of ecosystem apps running on our systems</li> </ul>
	The number of cameras running edge analytics in relation to the total
	• The number of cameras (A city of 1 million inhabitants usually has around 300–400 cameras.)
	• The number of edge-enabled cameras per use case (e.g. traffic monitoring)
	• The number of partners and partner apps migrating to edge (This is growing fast.)
Technology innovation	Our edge solutions are mainly connected via IoT. 5G could be very interesting in the future. Video surveillance can be very relevant when coupled with 5G, but only if the cameras have edge capabilities – mostly for scalability, latency, and bandwidth.
	this pushes innovation to the software development side.
Governance / Organisational structure	The partner ecosystem is driven by new features that can be leveraged in smart cameras. Usually, new features are not used for complexity reasons, but we encourage our partners to find smart ways of using new features.




Impacts	
Data governance	Data that is transmitted outside of the domain of our cameras can be anonymous or not, depending on the application or use case (e.g. people counting or license-plate recognition). Our aim is to provide the maximum amount of flexibility. We are also working to ensure different types of secured connectivity and data transmission from our cameras. When data leaves a camera, the data is outside of our domain.
Focus on SME	Have you conducted activities related to SMEs? Not via a direct focus, but our solutions work as well for SMEs' needs as they do for those of large enterprises.

Obstacles/Barriers	
Technical barriers	There are no major technical barriers, but more standardisation around IoT and wireless connectivity would be good. There are a lot of protocols out there (e.g. Sigfox, LoRa, and NbIoT), and it would be good to have more standardisation. Standardisation in general would also be good for developers. It would be easier for them if a platform emerged as the main edge platform for software development. This is especially true with edge.
Legal barriers	Legislation to ease cloud usage would be very useful. Leveraging cloud apps is currently difficult in Europe. Deregulation and easier governance are needed. At present, we overcome such barriers by using on-premises solutions. We also target early adopters and the most advanced users.
Economic barriers	There are always economic barriers. Regarding edge, we try to communicate the added value of the edge approach, and we promote TCO in our communication. Such communication is more complex to create, but it usually works.





### BrianzAcque\*

Identification	
Name of interviewee	Enrico Pivari (BrianzAcque), Maurizio Galotti (Plurimedia)
Title	Responsible for the Casette dell'Acqua project
Organisation	BrianzAcque
Country and location	Monza, Italy
Sector	Public owned Utility
Company size	322

Initiative	
Description of the initiative	BrianzAcque is a public company that manages the water cycle and sewerage systems in Brianza, a territory in Northern Italy encompassing 56 villages, with a total of 900,000 inhabitants. Casette dell'acqua is an initiative to distribute high-quality filtered drinking water dispensers (Casette) outside throughout the territory for citizens. The water can be dispensed as still, sparkling, and cooled. In a similar way, the company also distributes indoor dispensers to schools, libraries, etc. The target is to reduce the use of plastic bottles across the territory, with benefits connected to less traffic, pollution, and plastic consumption.
Timing of the initiative	The first Casette were installed in 2015 and 2016. The indoor dispensers started in 2019. As of now, the next targets are to install new cassette covering the entire Brianza territory (in northern Italy) and possibly to upgrade the Casette with new features, providing new services to citizens.
Key stakeholders	Local government is the customer and key stakeholder. End users and key stakeholders are citizens that use Casette dell'acqua as a drinking water supplier. Other stakeholders include public health authorities, which are responsible for water quality control.
Funding	No EU funding – all local government public funding for Casette and Brianzacque funding for dispensers.
Technical solution	The Casette dispenser can be seen as a multifunctional IoT device able to run locally cloud-native applications that have been developed as part of the architectural digital transformation of the company. Each outdoor dispenser includes a technological solution to monitor the status of the dispenser, measure how much water has been delivered, manage maintenance, provide

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Initiative	
	communication to users using a screen, and managing the security of the data and the data transmission.
	Edge intelligence is at the IoT level. The single Casette is managed with a micro PC deployed at the edge with tailored Linux OS and custom applications for different functions.
	IoT components continuously exchange data with the central cloud platform, which manages the IoT devices and provides information to be shared on the screen. The screen can share information regarding the water service and water quality, as well as public utility information from BrianzAcque or other partners (e.g. local government). All technical aspects are governed and managed by an external IT solution provider.
Relation to H-CLOUD key areas	Cloud, edge
Business model	BrianzAcque is a public utility company, so the service is delivered under this framework. During the summer season, the water at Casette dell'acqua is free. In other seasons, it has a symbolic cost. Each user accesses the system using a magnetic card. End consumers pay for the water with prepaid top-up cards.

Impacts	
Business success	KPIs:
	• The number of Casette installed: now more than 70, with a target to expand to 100 in 2021, covering the whole territory
	• The number of dispensers installed: now 50, rising to 80 by end of year
	• The number of litres dispensed: 10I million in 2019, with a strong increase expected for 2020
	How the service to citizen has evolved in terms of information about water quality and customer service
	This last KPI is significant, even though it covers an area that is difficult to monetise and is not always monitored. This KPI is mostly about what drives usage.
Technology innovation	The initiative primarily uses a mix of IoT, edge, and cloud computing. It has had a huge impact on the company's processes, as this project is framed within the general digital transformation of the company, whereby the whole architecture has shifted to services enabled by cloud-native applications on a single cloud platform.





Impacts	
Governance / Organisational structure	Local government and public health authorities are key stakeholders, along with citizen. The relationship relates not only to the service delivered (water to citizens), but also to the information shared: We are forced by law to exchange data with public health authorities for quality control. But we are also very open with local governments and citizens about the data we gather from water analysis.
	Another important stakeholder is the IT provider that manages a great part of the solutions for BrianzAcque.
Data governance	GDPR governs the data that public administrations handle. In this case, the IoT layer, data transit, and the application layer are all encrypted on https at the maximum level of security, ensuring data handling exceeds compliance with GDPR.
Environment and sustainability performance	n/a
Focus on SME	No

Obstacles/Barriers	
Technical barriers	No major technical barriers exist because this initiative has leveraged past experiences with cloud-native applications. The main issue was change management with internal IT due to digital transformation. BrianzAcque leverages the experience of the IT provider on the complexity of the cloud platform and applications.
Legal barriers	<ul> <li>The only barrier is relative to data regulation. The IT provider manages this complexity in order to</li> <li>Ensure solutions are GDPR compliant</li> <li>Ensure high security standards with https and encryption</li> </ul>
Economic barriers	Casette is a funded project, and there are no particular economic barriers. On the IT side, having a consumption-based model on an all-cloud-native platform and application helps pay for only what we use.



# Capgemini

Identification	
Organisation	Capgemini
Country and location	France
Sector	IT System Integration
Company size	270,000
Name of interviewee	Simon van den Doel
Title	Cloud Expert
Initiative	
Description of the initiative	Capgemini is a France-based global consulting, outsourcing, and IT services vendor serving clients in almost 50 countries in the Americas, Europe, Asia/Pacific, Africa, and the Middle East. Capgemini's key service lines are Strategy and Transformation, Applications and Technology, Operations and Engineering, and Capgemini Invent. The latter is the strategy and transformation arm of the group. It supplies digital strategy consulting and related professional services, including design and data science services.
	Concerning cloud, their activities are quite diverse, two main types:
	Quite diverse, two main types:
	Cases of end-to-end cloud projects where the customer, with their complete IT ecosystem, takes responsibility for operations and migration support.
	Cases where Capgemini supports the customer with some of the key teams, within the customer's environment, to complete the entire journey towards cloud.
	More and more customers use centres of excellence within the organization to help customers' organization make the transformation. Capgemini fulfils a key role in supporting the development team in the customers' transition to cloud.
	A good example is a retail company called Action. Capgemini supported Action in the entire journey, from the initial strategy towards the actual migration and operation of the cloud infrastructure. Action is a customer that grew rapidly and is expanding throughout Europe: being able to scale the ICT infrastructure rapidly is one of the main strategic reasons to adopt cloud. The Covid-19 pandemic forced many retailers to suddenly move to cloud and Capgemini was able to help them adapting to the new business context.
Timing of the activities	Most of Capgemini customers are very large organisations. In general Capgemini has observed two main approaches to cloud migration: moving quickly to the cloud (within a year) or using the cloud integration





Identification	
	process as a transformation opportunity with the focus of improving business agility (normally over a 3 year timeframe). In the first case (projects taking 1 year or less) customers aim at optimizing costs by leveraging cloud: they are less interested in digital transformation and more focused on adaptation ("lift and shift") to manage the transition faster. In the second case, customers using the move to Cloud as a transformation opportunity make much more use of the cloud native tools and its way of working, adopting DevOps methods. That takes up to three years to finalize the full transformation. These customers are focusing more on business agility, really changing the way they develop applications in order to become more agile and to develop new functionality quicker.
Key stakeholders	Capgemini operates in the retail, manufacturing and public sectors.
Funding	Private
Technical solution	Mainly IaaS, PaaS, SAP in the cloud. Customers trying to finalize a cloud migration really quickly tend to adopt the low-level Cloud services like IaaS and the basic cloud services. Organizations trying to become more agile go higher in the cloud stack and use more PaaS components, or products like SAP in the Cloud. Capgemini sees a huge momentum around this solution at the moment.
Relation to H- CLOUD key areas	<b>Edge</b> is a part of Capgemini strategy, especially in the industry. These organizations have sites where they need a computer on side, around a distribution centre, for a fraction of time. Capgemini sees most of its customers utilizing multicloud rather than cloud federation models. Some customers have a primary and a secondary cloud that they use just to see what is going on in that environment and to make sure that they also have some competitive information when they are negotiating with the main cloud providers. Concerning <b>Green Computing</b> , big shared external infrastructures such as cloud already offer a lot of advantages, in terms of efficiency of energy consumption (and are constantly improving), compared to having your own data centre, with its own cooling and security systems. The demand for green clouds and energy efficient data centres is growing as customers want to become net-neutral so they have zero percent footprint. This is driving cloud providers to be more efficient, but this is not the number one reason for organizations to adopt cloud. Choosing cloud is a broader strategy and Cloud services need to fit into Green IT.
Business model	Capgemini delivers people (body rental) or resells cloud services. Capgemini has been successful in partnering with customers and they also can agree on shared revenue, especially for companies that are looking to have a trusted partner.

Impacts	
Business	Concerning cloud computing, customer demand is increasingly focused
success	on achieving <b>agility</b> , so business success is measured as the ability to





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	deliver new functionality better and faster. In the past, IT was often seen as kind of a barrier for the business, because obtaining new functionalities for the organization could take a long time. Today, organisations are really looking at IT to be an enabler helping them move faster in the market. Responding to this need was a challenge for IT departments in the last 5 years, especially with the introduction of Cloud services and the use of more shadow IT (bought and implemented by non-IT departments) within the company. Companies also realised they could not rely completely on cloud providers for issues such as security, data protection, and compliance with regulation (GDPR). The main change of the last couple of years is that IT departments have understood they must become a partner with business departments, helping them to develop new services and use their skills to deal with cloud providers. To do so IT departments have moved to DevOps methods and are prioritizing agility, with the support of system integrators such as Capgemini.
Technology innovation	Capgemini leverages a wide range of innovative technologies, including edge and AI, tailored to different customers' needs. They have many projects around <b>Edge</b> . <b>AI</b> technologies vary and may be applied to different functions and services, for example there is strong demand about AI-enabled fraud detection. Capgemini's portfolio includes Blockchain in a marginal way with few projects ongoing, reflecting the low demand from customers on this thematics. For example it is used in the retail industry, where Capgemini uses it to guarantee the transparency of the supply chain. According to IDC, Capgemini is a good choice for organizations looking for a partner with strong IT consulting skills and a good understanding of the connection between business and technology drivers. For example, Capgemini offers EAPM, an AI-enabled portfolio management software tool that provides a detailed digital model of a client's application portfolio landscape and evaluates the health of the portfolio against benchmarks from hundreds of engagements. Another tool is the Intelligent Automation Platform, a cloud-ready, technology-neutral, plug-and-play platform designed to take clients from limited deployments and proofs of concept (POCs) to intelligent automation at scale. This helps customers accelerate their innovation adoption.
Governance / Organisational structure	Involve the organization across the partner ecosystem: Capgemini has very close relations with all the big cloud vendors and big software vendors. They also have influence on Cloud providers roadmaps to make sure that they meet customer demands. Capgemini is often in a "collaboration mode" when they are looking for new solutions for the customers, working together with the cloud vendors to build specific solutions for the customer. Capgemini now has around 270,000 employees. They have a global presence, stronger in some countries and newer in others. They are concentrating their operations in India, about half of their team is working in India, where they try to do all of the off-shore work. They also have a near off-shore center in Poland which they also use for compliance reasons, as sometimes customers don't want to use resources outside of the European Union. They always try to operate in a hybrid model, where they have people on-shore working together with the customer in close contact, to make sure that they really understand the customer and know what it is trying to achieve, and then



Impacts	
	they make use of their global delivery centres, to cost-effectively fulfil that.
Data governance	They work in a lot of sectors, with really specific compliance regimes. They do a lot of work for example for pharmaceutical companies to support GDPR compliance. Capgemini has built their own frameworks to make sure they are able to deploy workloads and make use of clouds, while still being able to fulfil those compliance needs. It is specific for the sector and for the country and they work closely together with the customers to help specify requirements. Because they are such a big global company with a large footprint in different regions, they are able to fulfil whatever compliance needs there are in any location.
Environment and sustainability performance	Capgemini's sustainability-focused offerings put a strong emphasis on environmental topics such as decarbonization — both internally and externally. Capgemini assists clients with green IT–related efforts (e.g., reducing carbon footprint of IT assets and services and advice on how to decarbonize and digitize the business as well as enable new business models through the introduction of circular economy propositions). Capgemini considers green computing as a a "hygiene factor": they make sure to sell a service fulfilling customers' needs in this domain. For example, by guaranteeing the use of renewable energy sources and helping customers minimise their energy consumption footprints, for example turning off computing resources when they are not needed. Most of the cloud providers have kind of a similar proposition on being Green, because it's just been demanded by the market. There are other considerations that are related to why you use Cloud in the first place: only using resources when you need them, and turning them off when you don't need them. Those are the kinds of the controls that you are given when you are the customer of a Cloud Service Provider. In a proprietary data center you have to over commit or over buy resources that stay there doing nothing for 80% of the time. Moving to Cloud really takes out all of that unneeded capacity and a lot of the savings are also around just the general facilities that you need to put in place to run and protect your data centre. That is a lot more efficient at large-scale.
Focus on SME	Capgemini clients are mostly large enterprises and big international companies, SMEs clients are a minority.

Obstacles/Barriers		
Technical barriers	The main <b>technical barriers</b> are more on the <b>people</b> side, so they concern making sure that you have the right knowledge within the organization, especially if you want to make the transformation towards a DevOps kind of culture. Capgemini tries to help their customer organisations by bringing in their people, to help, support and provide the capacity to make the transformation. The <b>technical barriers</b> are solvable, sometimes they are used as an excuse by customers who may not be ready to really transform their mainframe infrastructures to move to a cloud environment. Technical hurdles can make a project difficult, but they are generally not the main cause of failure or missed achievement in a project.	

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Obstacles/Barriers	
Legal barriers	Generally, companies are more afraid of compliance to the legal framework than they need to be, but it is important to determine which control mechanisms need to be put in place to guarantee compliance and be confident of the outcomes. For example, GDPR (Global Data Protection Regulation) compliance must be managed in detail, analysing in depth what is the situation of the company, what does data protection means for the specific company, how you can achieve it, which controls do you need. If you follow this approach and work through the specifics, generally it is possible to solve the related problems. This effort requires local knowledge because legal frameworks and conditions are different by country and industry. Nevertheless, normally legal barriers can be overcome by investing the appropriate time and effort.
Economic barriers	Economic barriers tend to concern the investment needed upfront to invest in digital transformation. To reduce the costs for your IT organisation, you probably need to do more than just lift & shift applications into the Cloud. If you do not change the other applications, resize them, optimize them for Cloud, it may not make economic sense to move to Cloud. Companies need to be at least a bit ambitious about the amount of transformation to be done, but the investment required can be a barrier.



### City Network\*

Identification	
Organisation	City Network
Country and location	Sweden
Sector	Cloud service provider

Initiative	
Description of the initiative	City Network is a European cloud service provider headquartered in Sweden. City Network provides scalable and cost-effective cloud services from its own data centres around the globe. With City Cloud, which is the company's public cloud platform, customers get instant access to cloud computing power and complete control over where and how their data is stored. For industries operating under specific regulations, City Network
	The company's managed services span all of its operations and enables customers to build public, private, and hybrid cloud solutions.
Timing of the initiative	City Network was founded in 2002
Key stakeholders	City Network is a European-headquartered cloud service provider operating globally. City Network is very active in the OpenStack community.
Funding	No EU funding. City Network is a private company.
Technical solution	City Network offers a public cloud service called City Cloud; a hosted private cloud service; compliant cloud services for regulated industries, such as finance, healthcare, and the public sector; and compliant-office services. In addition, City Network offers managed cloud services, professional cloud services, and cloud training services.
Relation to H-CLOUD key areas	Cloud
Business model	City Network is an independent private company that is heavily engaged in the OpenStack community. The business model is similar to that of hyperscalers, whereby infrastructure and cloud services in general are sold at a per-second-of-usage rate. By offering public, compliant, and private cloud, all regulatory levels can be satisfied, from banking and healthcare to government agencies.





Impacts	
Business success	<ul> <li>Success is defined through:</li> <li>Revenue growth for the business</li> <li>new customers, especially in regulated industries such as the public sector, healthcare, and finance</li> <li>Customer success stories: One bank went from implementing 50 user stories per month to 700 user stories per month on the City Network platform using infrastructure as code and automation tools made available through the City Network platform.</li> <li>Helping to develop skills, knowledge, and insight in Europe by educating employees and customers in the latest cloud-native technologies, conducting R&amp;D in Europe, and creating partnerships with leading European companies in related areas, such as Al/ML</li> </ul>
Technology innovation	City Network drives technology innovation internally by building leading cloud services, especially for highly regulated industries. The focus is on open-source technologies, infrastructure as code, and adherence with GDPR and industry regulations. Investment into AI is through partnerships with European AI companies.
Governance / Organisational structure	Governed as a private company
Data governance	City Network is ISO 9001, ISO 14001, ISO 27001, ISO 27010, ISO 27013, ISO 27015, ISO 27017, and ISO 27018 certified – internationally recognised standards for quality, sustainability, and information security. The company's services are available from more than 20 data centres around the world. With its compliant cloud, City Network ensures that customers comply with demands originating from specific laws and regulations concerning auditing, reputability, data handling, and data security, such as Basel, Solvency, and GDPR. City Network also engages in the GAIA-X process and will support the GAIA-X initiative.
Focus on SME	City Network customers range from SMEs to large enterprises.

Obstacles/Barriers	
Technical barriers	Using open-source technologies like OpenStack is a good way to build skills and competencies with employees and customers. Participating in cloud federation would require investment in infrastructure, but there is no customer demand at present that would justify this investment. Potentially, the GAIA-X initiative

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Obstacles/Barriers	
	could provide an interesting technology to implement and to ensure greater data sovereignty across Europe. City Network provides a compliant version of Microsoft Office for
	European public sector organisations.
Legal barriers	For City Network, it would be very beneficial if the EU would enforce GDPR and if the data protection authorities across Europe would enforce the recent Schrems II ruling about the inadequacy of the EU-US Privacy Shield as a mechanism for data transfers to the US. City Network also believes that greater awareness of the impact of the US CLOUD Act on European organisations is needed. This would lead to greater demand from European customers for data localisation and storing data within the EU with European cloud providers. City Network specialises in highly regulated industries like the
	public sector, healthcare, and finance, so regulation is actually good for City Network, as it creates complexity for the customers, which City Network helps to solve.
Economic barriers	European cloud providers like City Network would benefit economically if European companies – especially European public sector organisations – bought from European- headquartered cloud providers instead of large cloud providers headquartered outside the EU. There is a significant buying power in the European public sector, which could be used to create demand for European-provided public cloud services. That demand would in turn lead to further investment in and the growth of European cloud service providers, which would make them more competitive and enable them to develop more services.



#### Cloud28+\*

Identification	
Name of interviewee	Xavier Poisson Gouyou Beauchamps
Title	Vice President, Service Providers and Cloud28+ Worldwide
Organisation	HPE
Country and location	France, Paris
Sector	IT
Company size	Large enterprise

Initiative	
Description of the initiative	Cloud28+ is a worldwide cloud computing community and marketplace where cloud service providers can federate and showcase their cloud offerings and thought leadership; build new partner alliances; create new services; and take advantage of digital marketing services to avoid advertising costs while accelerating visibility. It was developed and is sponsored by Hewlett Packard Enterprise (HPE).
Timing of the initiative	Cloud28+ was originally launched in Europe in March 2015, with the aim of accelerating cloud adoption in Europe. It opened up to members worldwide in November 2016, at which point it had around 330 member companies and offered around 1,300 infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS) services.
Key stakeholders	HPE and cloud service providers that are interested in federating their services and amplifying them on the market
Funding	Cloud28+ is funded by HPE and Cloud28+ members
Technical solution	Cloud28+ is a digital business platform where service providers can publish their cloud services and find partners with which to to create new solutions, promote themselves, and exchange information. Customers can find cloud services, software products, professional services, and deployable applications. Cloud28+ is based on an HPE-developed cloud-native, API- driven digital business platform, which can be deployed in public or private cloud. Cloud28+ taxonomy is available and licensed under the Creative Commons Attribution 4.0 International License (CC BY 4.0).
Relation to H-CLOUD key areas	Federation



Initiative	
Business model	Cloud28+ is financially supported by HPE, with contributions from its members. The aim of the platform is to promote cloud service providers that are building local and regional cloud services built on HPE technology.

Impacts	
Business success	Since its launch in 2015, the cloud28+ community has expanded beyond Europe and is now a global initiative. It now has more than 1,200 partners in more than 100 countries, with 85,000 services published and federating 790+ datacenters.
Technology innovation	Cloud28+ enables its partners to offer innovative technologies based on underlying HPE technology. Cloud28+ is actively participating in GAIA-X and working on cloud-edge solutions.
Governance / Organisational structure	Cloud28+ is an active community of cloud service providers from around the globe.
Focus on SME	Partners of all company sizes can join Cloud28+: Most partners are medium-sized local or regional service providers.

Obstacles/Barriers	
Technical barriers	It is important to decide at which level federation should take place: at the infrastructure level or the service level. Cloud28+ has decided to create a service catalogue so that local and regional service providers can advertise and federate their services, applications, and professional services.
Legal barriers	The platform guarantees regulatory compliance so that individual members must align their technology solutions and services.
Economic barriers	It takes a substantial marketing budget to market a digital platform like Cloud28+. After four years, the platform became self-funded through the offering of partner marketing services and solutions tied to the core intellectual property underlying it.



#### Cloud+Heat

Identification	
Name of interviewee	Dr. Ronnie Reinhardt
Title	Team Lead Business Development
Organisation	Cloud+Heat
Country and location	Dresden, Germany
Sector	IT
Company size	Small CSP

Initiative	
Description of the initiative	C+H is a startup created to take advantage of the fact that computer servers generate heat, and rather than spending money to "get rid" of this heat, use it productively.
Timing of the initiative	C+H was founded 2011. RR was working there as an "intern" before founding. Founders are: physics, informatics professors. Idea is to generate useful heat from cloud servers, use it to heat water, buildings. Make it into a business. Initial concept was to put servers into homes as heat sources. Similar to Qarnot in France. Pivoted business model between 2014-2016. Found that a highly distributed server fleet was too difficult to implement. Now the company is more traditional CSP but with a focus on high energy efficiency, reuse.
Key stakeholders	Funding structure: founders, angels, family offices, later VCs, an ETF from London, plus strategic investors (e.g., a Czech energy company).
Funding	Venture funding until this year. Participating in EC projects: starting Jan 1 2021: AISprint project (which also includes IDC)
Technical solution	<ul> <li>The company has some proprietary solutions. They have some patents for allocating loads relative to requirements for heating. They have developed the Krake orchestration tool as a Prototype, K8S based.</li> <li>Now applying for another project, multi-stage <ul> <li>Al company is the user, thinking about shifting workload timing to optimize CO2 impacts.</li> <li>looking to take advantage of excess (stranded) wind energy.</li> </ul> </li> <li>Cloud+Heat has unique capabilities: Very few companies can control the whole stack from hardware to software to orchestration.</li> </ul>





Initiative	
	They are custom fitting servers with cooling kits. Direct Liquid to chip (DLC) retrofit of air-cooled servers. It is a closed system using heat exchangers to transfer heat to other liquid systems (e.g. district heating systems). They offer a water heating solution that is effective in colder climates. In general they take an integrated, holistic approach.
Relation to H-CLOUD key areas	Cloud+Heat is involved in cloud, green. They are looking at federation. Krake orchestration tool is a component of this.
Business model	<ul> <li>Revenue sources: <ul> <li>cloud service provider IaaS using openstack, PaaS through managed Kubernetes</li> <li>Project based funding.</li> <li>Data Centre infrastructure consulting and services for initial build, ops, service.</li> <li>White label provider to others (e.g. energy companies moving to other infrastructure). They have Pilot projects (e.g. with Vattenfall), but too soon to talk about success.</li> </ul> </li> <li>There is growing focus by customers on the CO2 impacts related to energy use. For example, they have a project with a large telco looking at specific projection of CO2 savings/avoided.</li> <li>Their experience is that interest in such projects depends a lot on the individual who is sponsoring projects, and whether they have personal performance expectations around CO2, etc.</li> <li>They have collaborated with the following businesses: <ul> <li>Vattenfall (SE),</li> <li>Secunet (DE, Essen open stack distribution SecuStack),</li> <li>Schwartz (DE retailer, e.g. Kaufland cloud business StackIt),</li> <li>Akila (investing → DC market)</li> </ul> </li> <li>Their Cloud customers include: AI4BD, Nyris (visual search). Currently they have not federated their services with other businesses. They would be interested partnering in order to expand services and expand customer services capabilities also spanning data centres.</li> </ul>

Impacts	
Business success	Cloud+Heat was founded in 2011 and has since grown to over 100 employees and raised over 10 million euros from venture investors. Given the company's focus on "green ICT", which in 2011 was quite revolutionary, this represents significant business success, with continued growth in basic business lines as well as exploration of the many points of intersection between "cloud" and "green" business.
Technology innovation	Cloud+Heat was founded on the novel idea that there should be a way to use the heat generated by compute servers

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Impacts	
	<ul> <li>productively, instead of paying extra money to remove it from the data centre and "waste" it into the atmosphere or water supplies. The company has continued to explore at novel approaches and applications including: <ul> <li>bitcoin miners, hot water-cooled mining container (actual container), with a specific mining chip vendor, 2.4MW of power required</li> <li>Al customers (high value target for C+H), looking at predictive maintenance internal use.</li> <li>They have developed edge solutions (highly distributed sites, containers, high density solutions), but have not seen much traction yet. Some use cases are moving: shop floor, etc. AWS Outpost implementations.</li> </ul> </li> </ul>
Governance / Organisational structure	Cloud+Heat is a private company, with funding from external investors, so they take a traditional approach of an external board of investors and founders, which directs the activities of the management team and the company overall. There are no special provisions for "stakeholder" inputs.
Data governance	As a cloud service provider, they operate in a shared responsibility model, where the customers are responsible for the security, privacy and governance of the data processed in Cloud+Heat infrastructure.
Environment and sustainability performance	Rather than considering the company's ESG performance as a "secondary" concern, environmental and sustainability performance are tightly linked to the vision and mission of the company and are considered in all of their business decisions.
Focus on SME	They are an SME themselves, and have worked with a number of other SMEs, but no specific focus in this area.

Obstacles/Barriers	
Technical barriers	One technical approach they have taken is to use hot water- cooled systems with heat re-use. The business case is not easy, not a clear payback of investment. not more profitable than air-cooled, so if customers want to go in this direction, they need incentives. E.g. City of Amsterdam imposed a requirement of heat re-use for new data centre. Alternatively, impose CO2 pricing, and then the hot water from a data centre is CO2 "free" and therefore more attractive to potential customers. Cloud: There is continued interest in the "heater" business, it Still resonates with people. However, Cloud+Heat could not find enough customers on the CSP side to use the servers. Al demand is helping. Still have challenges being a "trusted" CSP. OpenStack and similar open-source projects seem essential to establish credibility with customers. Sovereign Cloud Stack is attractive

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Obstacles/Barriers	
	to C+H; they are in discussions about adopting their approach. Customers are interested in both OpenStack AND containers/K8S. Customers need some hand-holding, and C+H is prepared to offer this. Customers also need to invest in their own people. It would be useful if cooperation among providers could be facilitated to serve customers better. The IPCEI (Important Project of Common European Interest) could be significant for C+H.





#### **Cloudferro REVISE**

Identification	
Name of interviewee	Klaudia Bielińska, Stanisław Krzyżanowski
Title	Marketing Content Manager, Business Development Specialist
Organisation	CloudFerro
Country and location	Warsaw, Poland
Sector	IT services
Company size	100 employees

Initiative	
Description of the initiative	CloudFerro is a European public cloud provider based in Warsaw, Poland, where has its laboratory and main datacenter. CloudFerro presence is disseminated across Europe and worldwidely It focuses on the space sector. The core activity is operating CREODIAS public cloud disseminating and processing Earth Observation data as part of Copernicus the European Union's Earth observation programmeby European Commission. The cloud platform makes very easy access the spatial data. Copernicus satellite images and services are by default public and accessible by anyone, nevertheless, there is a high degree of complexity in gathering, managing and operating the data, and the supporting infrastructure, making it barely impossible for small stakeholders. The initial focus has been to bring data observation to processing chains for ESA (European Space Agency). As part of the first contract with ESA, CloudFerro developed Cloud services (especially IaaS). Another important project was to develop CODE-DE - a German Copernicus Data and Exploitation Platform for German Aerospace Center – DLR for managing climate data).
Timing of the initiative	CloudFerro started in 2015 as cloud infrastructure provider, starting with EO Cloud project - a powerful Earth observation data repository established in Poland. In 2018 company developed cloud infrastructure under the CREODIASproject for storing and disseminating Copernicus programme Earth Observation data and servicesto everyone. Then developed other services as Public Cloud providers. Next step is to be financial independent from the initial European funding.
Key stakeholders	Key customers are European governmental/public entities, R&D institutions, academia, commercial companies representing space sector and others, for which CloudFerro act as cloud services supplier. Examples are: European Space Agency (ESA), the European Centre for Medium-Range Weather





Initiative	
	Forecasts (ECMWF), Mercator Ocean International, German Aerospace Centre (DLR), the EGI and many others
Funding	CloudFerro's capital is 100% Polish. It was created with private funds. CloudFerro has been awarded a contract on commercial terms by ESA (European Space Agency), under EC's Copernicus Programme. Which is funded from European Union budget.
Technical solution	CloudFerro runs cloud services on datacenter infrastructure in 7 different locations (3 in Warsaw, 2 in Frankfurt, 1 in Darmstad, 1 in Reading) CloudFerro also builds its own hardware infrastructure in its Warsaw laboratory. When located in other datacenters, CloudFerro always manages the datacenter infrastructure to deliver the cloud services.
	The location of the datacenter infrastructure is always functional to clients' requirements. Some clients want to leverage their own premises, while other ask CloudFerro to deploy the service on datacenters sitting on the same country as they want to be data- independent and self-reliant.
	CloudFerro's solutions are based on open-source technologies. That are further developed and optimized in-house to answer challenges coming with operating big data Earth Observation focused infrastructure and public and private clouds.
Relation to H-CLOUD key areas	Cloud
Business model	CloudFerro delivers cloud services in various models. Major part of CloudFerro's offer is the CREODIAS public cloud – a DIAS platform hosting more than 21 PB of Earth Observation data. Additionally, CloudFerro delivers private and hybrid cloud solutions.The delivery is always with an "as a service" approach, managing all the infrastructural complexity, data management and security operations. CloudFerro has the possibility to deliver a cloud managed service also when leveraging the customer infrastructure, locating the cloud service in the client's datacenter infrastructure.

Impacts	
Business success	There are different ways CloudFerro uses to measure success, and usually depends on the activity. CREODIAS activity has been growing fast as follows:
	<ul> <li>Users and growth of usage KPIs: despite being crucial, these KPIs are not always indicative of revenue success as some user could be non-paying users or very immature users looking only for few images for communication purposes. In 2020 CREODIAS number of users exceeded 6.100 users (+80% vs 2019) and CloudFerro delivered 18.2 PB of earth observations data to users (+91% vs 2019).</li> </ul>





Impacts	
	<ul> <li>Data KPIs (amount of data storage and managed). Locally available earth observation data has already exceeded the number of 20 PB of data, gathering up to 2PB of observation data each day and 20.4 PB of data available on CREODIAS in December 2020 (+40% vs December 2019).</li> </ul>
Technology innovation	CloudFerro manages and constantly develops innovative solutions for earth observation data storage and dissemination, based on Open-Source technology. It operates data repository that has exceeded 21 PB in the beginning of 2021. Recently performed tests has proved that CloudFerro can provision over 2PB of data daily to users, with a clear path to double that number in near future. To be able to do that, CloudFerro developed extensive know-how and best practices how to index, store and disseminate EO data, using variety of interfaces. In the development process CloudFerro is continuously reviewing its developments against user requirements and state-of-the-art in relevant fields of technology. CloudFerro's innovation is mainly linked to IoT and AI on the images collected.
Data governance	Copernicus data public, open and free, making somewhat easier the task, since CloudFerro is paid to store and disseminate the data. As a public cloud provider CloudFerro, manages data according to GDPR and respect Cloud certifications. Main source of data stored in CloudFerro's repository is the Copernicus programme, under which available data is free, open, full and with no restrictions. CloudFerro acts in accordance to those regulations. For other data, specific regulations are in place. CloudFerro manages user data in accordance to GDPR and is certified in accordance to ISO 9001:2015 and 27001:2013. ClaudFerro is in the process of obtaining PSI cloud certification
	CloudFerro is in the process of obtaining BSI cloud certification.
Focus on SME	startups and SMEs such as conferences, workshops and webinars. For which prizes such as access to the platform, expert prizes and credits are offered for participants.

Obstacles/Barriers	
Technical barriers	Since CloudFerro leverages open technology, sometimes standardization is hard to reach and could be difficult selecting and sourcing with different versions of the technology, with many developed solutions that haven't reached full maturity yet. An internal team is always dedicated to evaluating these technical aspects
	Capacity scaling is especially tricky for large, distributed storage clusters, such as the EO-Data cluster, where each capacity increase triggers a data rebalancing to ensure even distribution of data in the cluster.

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Obstacles/Barriers	
	Monitoring and alerting. In order to ensure smooth operation of cloud services alerting system had to be reorganized, eliminating doubles, adjusting thresholds and introducing more sophisticated triggers. It is especially required when number of monitored parameters grows.
	Organizing product-oriented software development. CloudFerro has decided to clearly separate products from projects and make sure customers and stakeholders' requirements are implemented only once – in the appropriate component.
Legal barriers	More than pure barriers, this could be a missed stimulus. The European bodies could do more to drive the attention to technology and cloud use on many aspects, issuing policies that favor awareness and the use of European Cloud providers, at least for public European activities and agencies (e.g. Sen4CAP).
	It is crucial for the decision makers on national and European levels to support European industry in the competition with hyperscalers. Such support can be expressed as funding opportunities, incentive for European industries to leverage European infrastructure and know-how in their activities.
	It is important to raise awareness in European cloud infrastructure and providers for not being reliant on global providers.
Economic barriers	CloudFerro aims at achieving financial sustainability of its public platform – CREODIAS – by the end of 2021. For it to be possible the continuous connection with developments and projects of European entities is vital. This will allow CloudFerro to expand on existing infrastructure and capabilities offering more and more advanced solutions, responding to challenges set by international initiatives like Digital Twin Earth and similar ones.
	CloudFerro believes that open-source based solutions should be supported, due to its accessibility, lack of vendor lock-in and transparence.



#### CloudSME\*

Identification	
Name of interviewee	Andreas Ocklenburg
Title	CEO
Organisation	CloudSME
Country and location	Germany
Sector	IT
Company size	5 employees

Initiative	
Description of the initiative	CloudSME is a competence centre for cloud-based HPC simulation. Its vision is to provide vendor independent cloud technology to support sustainable growth and digitalization in Europe and to increase Europe's competitiveness in the worldwide economy.
Timing of the initiative	The CloudSME project ran as a European funded project from 2013 to 2016. It was funded by the European Union under grant agreement No: 608886. Since 2016, CloudSME has been operating as an independent commercial company.
Key stakeholders	CloudSME is a private company that works very closely with research institutions, universities, and participates in EU-funded projects.
Funding	CloudSME receives EU funding through its participation in EU projects, such as DIGITBrain, CloudiFacturing, and, previously, the COLA project.
Technical solution	<ul> <li>CloudSME is commercializing MiCADO technology developed through the COLA project. The MiCADO framework supports the autoscaling of applications on two levels:</li> <li>Scaling at container level (based on Kubernetes)</li> <li>Scaling at virtual-machine level (originally based on Occupus, but now based on Terraforms)</li> </ul>
Relation to H-CLOUD key areas	Cloud, federation
Business model	CloudSME is collaborating with a number of service providers that are using MiCADO technology. CloudSME is commercializing MiCADO technology. CloudSME operates on an





# Initiative

open source model, offering the technology under an open source license and offering commercial support services.

Impacts	
Business success	CloudSME works with a number of European cloud service providers that are using MiCADO technology.
Technology innovation	CloudSME works with open standards and open source technologies that enable organizations to use multiple cloud providers and move their workloads and data between them.
Governance / Organisational structure	CloudSME is a private company.

Obstacles/Barriers	
Technical barriers	MiCADO technology needs to be matured/developed into a 1.0 version.
Legal barriers	No legal barriers
Economic barriers	CloudSME mostly experiences economic barriers: While EU funding is available for the development of technologies like MiCADO, not enough funding is available to commercialize the technology. Commercialization and getting the right certifications, such as from CNCF, is costly and takes two or three years, which needs to be financed if the money does not come from paying customers.





#### Comarch

Identification	
Name of interviewee	Lukacz and Marek
Organisation	Comarch
Country and location	Poland
Sector	IT & Software

Initiative	
Description of the initiative	Comarch provides loyalty software for enterprises. Comarch started as a provider for very large enterprise customers, but with the advent of SaaS, Comarch has built a product for the midmarket that will be available in a cloud-based SaaS model. The new software will offer additional functionality to the loyalty program and will become a complete marketing software package with data analytics for midmarket organisations.
Timing of the initiative	Comarch was founded in 2000, and the initiative to create a SaaS-based loyalty product for the midmarket started in 2018.
Key stakeholders	Private company
Funding	No EU funding used
Technical solution	Comarch has been providing loyalty software solutions for large enterprises for 20 years. In 2018, the company decided to develop a completely new cloud-native SaaS solution, which is targeted at the midmarket and evolves the loyalty software product into a complete marketing solution with data analytics included. It codifies buying best practices into a standard service. The standardisation of the service provides great cost savings for Comarch in running the platform, which makes it possible to offer the services at an attractive price to midmarket customers. Comarch's SaaS product is platform independent and can be deployed on any cloud. It runs on a standardised container platform in a distributed architecture, which makes it easy to deploy and operate. Another business unit in Comarch is also an ICT service provider based on its own cloud/hosting platform. The IaaS part of Comarch is working on providing a container layer and a serverless architecture option so that customers can develop aloud pative applications on the platform.
Relation to H-CLOUD key areas	Cloud
Business model	Software-as-a-service (SaaS) provider, private sector company





Impacts	
Business success	<ul><li>Business success is defined by:</li><li>Number of users of the SaaS service</li><li>Competitive pricing because of cloud architecture and standardisation</li></ul>
Technology innovation	Comarch is a very innovative company, with many technology innovation initiatives on the road map. AI/ML: Comarch has invested a lot in AI/ML in the past three or four years and has already undertaken some successful implementations – fraud detection, marketing optimisation, algorithms for message/promotion timing, customer service, sentiment analytics (including sentiment analysis based on customers' descriptions on social media), and chatbots. IoT: Location-based services that can locate people indoors or outdoors and send promotions related to their location. Connected Devices: Device usage, including vehicles. Mobile Payments: Blended with loyalty tools, centre of customer knowledge and interactions.
Governance / Organisational structure	Private sector company
Data governance	Comarch ensures that all applications are compliant with data privacy regulations globally, such as GDPR in Europe and data privacy regulations in the United States (California). The application provides tools for customers to be compliant with GDPR, but the customer is ultimately responsible for their own GDPR compliance. The application allows users to perform certain data-governance actions such as applying the right to be forgotten; customer service agents are authorised to anonymise the data and generate a full report of client activity. European customers are requesting that data is stored in Europe.
Environment and sustainability performance	Comarch operates highly virtualised data centres, uses renewable energy sources, and uses energy-efficient technologies.
Focus on SME	Focuses on SMEs with SaaS model.



Obstacles/Barriers	
Technical barriers	Lack of specialists and specialised knowledge on the market, lack of resources that know the new cloud-native technologies.
	Comarch is on its own learning curve and needs to develop these skills internally; training staff internally and providing them with an environment for attaining this knowledge slows down the development process in the short term.
	Easier access to skilled resources would help.
	Customers need more education about what cloud means for SMEs.
	A key cloud-provider selection criterion is whether the provider has a cloud region where the customer is.
Economic barriers	Companies are in a bidding war for talent; some companies can offer better terms than others.





### CS Group

Identification	
Name of interviewee	Sylvain D'hoine
Organisation	CS Group
Country and location	Headquarter in France, Germany, Holland, Romania, UK, Canada and the US
Sector	Private
Company size	2,100 employees

Initiative	
Description of the initiative	CS Group has been working with cloud for several years. The software they develop is also in the cloud, they have built their own internal cloud for their developments. They are also using external cloud providers. The company won several projects in the cloud context and the interviewee's team works in the Space business. In this unit they have a lot of experience in using the Cloud and developing and integrating on top of the Cloud for their customers. When CS Group talks about space, they are talking about big data, big loads of images coming from space that need to be processed and stored. They are mainly software developers but based on cloud, as software developers, they are an integrator of open-source software. Their strength is that they defined a cloud strategy 10 years ago, and they developed a software as intellectual property. Today they are open-source promoters. They have deep knowledge of the open-source ecosystem. They encourage all their software developers to contribute to open-source software. Thanks to this strategy they have a lot of knowledge of Open-Source software, and this is very important when customers integrate using the Cloud because they are reusing a lot of Open-Source software for each function. They have defined what they call a landscape, where they categorize what software and what methodologies to use and make sure they use the best software for each function. They are now using microservices and docker everywhere. With this open-source strategy they won several projects. What is key for them, is that they make sure for their consumer that they will not have any lock-in. For that open-source is one of the keys of this strategy, and the customer is neither locked to them as a software provider.





Initiative	
	They build a software C-Scale, which is an open-source multi- cloud management system, and they make sure the application developed can be portable in other cloud software. They are also able to build a network of different cloud infrastructures, enlarging the power of the European cloud infrastructures, where CS Group talks about sovereignty they want to make sure not to use Hyperscalers.
Timing of the initiative	From 2 months up to 18 months.
Key stakeholders	The company is mainly private, and they work for several institutions, some of them private and others public.
Funding	They are involved in several 2020 EU projects, where they develop and improve their software.
Technical solution	Kubernetes/Docker, Kafka and Spring.
Relation to H-CLOUD key areas	Cloud federation: CS Group already mentioned C-Scale, and they are leading the Space Dataspace of Gaia-X, so they can say they promote a lot of federation. Green: their objective is to write software that provides optimization of the cloud. They are clearly convinced to be green and their mission as software developers is to make sure they optimize the cloud power. They usually build the system in the Cloud but are linked to other infrastructure on-premises of their company. They employ Edge Computing everywhere.
Business model	As Integrators they have business with cloud providers and they are paid by their customers.

Impacts	
Business success	<ul> <li>They have a lot of KPIs, the major ones are: <ol> <li>to deliver on time</li> <li>meeting the cost of their customers</li> <li>high-quality software</li> </ol> </li> <li>Their key competitive factor is the choice to use open-source software and be an actor in the open-source ecosystem, so that their customers run no risk to be locked-in by proprietary technologies. In the context of the Cloud, they think they meet the requirements when they can optimize the Cloud infrastructure, thanks to the good architecture and software they define.</li> </ul>
Technology innovation	AR/VR, Blockchain, AI, IoT, Edge, next-gen security: They are everywhere. They use edge, AI, and they are starting a new project certifying images using Blockchain. Plus, they do Virtual Reality (VR) and Enhanced Reality in their human-machine interface. The process is based on their teams, on what they call internal R&D investment. They have a virtual lab internally, and they

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Impacts	
	make sure to give time to their engineers and architects to think of new technologies and make sure they are up to date with all these new technologies. Then they look for funding at the EU level or the national level. Their objective is to present these ideas to their customers to see if they are interested in using them in their applications.
Data governance	They have a specific business unit called cybersecurity business unit, which they use and integrate with all their projects dealing with data sovereignty. Today, data is coming from everywhere. They have solutions to merge all these data and to add this trustability, thanks to blockchain. The main goal is to be able to add this trustability, to make sure that when the user is using one data, is the same exact one that it was when it has been generated.
Environment and sustainability performance	CS Group is not directly measuring the power consumed by the cloud infrastructure as they are not a cloud provider. Indeed, this is the mission of cloud infrastructure providers to optimize the infrastructure. Their job is to make sure they minimize the processing power and the data storage. They are thinking to introduce in their multi-cloud management system information, C-SCALE, about how cloud providers are greener than others, but the information has to come from the cloud provider.
Focus on SME	They work with both SMEs and Enterprises on several projects. They are an intermediate company, and they built consortiums with other SMEs, to share the knowledge and fill the gaps. They also work for SMEs that are using their services.

Obstacles/Barriers	
Legal barriers	The US Cloud Act which allows US authorities to access information and data on the cloud creates new risks for EU providers like them on how to retain their and their clients Intellectual Property.





# Geva Group REVISE

Identification	
Name of interviewee	Matthias Fauth
Organisation	Geva Group
Country and location	Germany, Aachen
Sector	Finance
Company size	40+ employees

Initiative	
Description of the initiative	Geva Group provides payment solutions for financial sector and public sector organizations as well as commercial clients. They started their cloud journey in 2019, as customers wanted to consumer software rather than operate software themselves. Today, customers can choose between a dedicated hosted solution and a SaaS solution, both are running on the IBM cloud for banking and financial services. They also want to become an ISV solution on the IBM cloud for financial services marketplace.
Timing of the initiative	2019
Key stakeholders	Geva Group focuses on the German, Austrian, Benelux, Italian markets and with some customers in Spain and Portugal. Geva group can be considered a good practice in the areas of business success and technology success.
Funding	No EU funding
Technical solution	Involved in the financial sector and especially in payment solutions. If you send money, the money goes from bank to bank, so they offer solutions for customers to handle payments between people and companies, provide software for banks to process payments, software solutions and services. Instant payments in the European market are very short (average in 10 seconds). Two years ago, they started with cloud. Customers can decide their software. Running in cloud. Focus on the German, Austrian, Benelux, Italian markets and possible customers in Spain and Portugal.
Relation to H-CLOUD key areas	Cloud and green to a smaller extent. End of 2018, beginning of 2019. Their goal is to grow, based on compliance and are partnering with IBM as well as their customers. Only IBM could suit their needs for now as they would like to offer customers a kind of hosting, used to ship software to customers, but customers want to consume it as a service, need to connect to customers datacenters and run the software and services for the customers, so they use it.





Initiative	
	Customers can choose between dedicated hosted solution or can consume as SaaS while offering cloud environments either shared or dedicated, SaaS with dedicated implementation. Currently have technology that is more similar with classic
	hosting in IBM cloud datacenter. They use IBM cloud for financial services.
Business model	They have partners for some components, but they are restricted by compliance and cannot just open solutions for others to use but can only do that if others have the same compliance standards.
	They use their partners for solutions.
	They plan with IBM cloud for financial services and want to be a component in IBM cloud for financial services as part of catalogue, payments from Geva. This is a catalogue / marketplace for additional services, especially approved and certified for regulatory compliance, tailored for the needs of financial ecosystem, ISV.
	European banking cloud from IBM since 2018, IBM offers EU cloud since 2018 with banking addendum, dedicated EU datacenters and support. Within this context, datacenters are within each local IBM company, which is independent from US headquarters legally. Thus, US government cannot request data from IBM.

Impacts	
Business success	Geva Group continues to grow its customer base, as customer are keen to consume payment solutions as a service. Geva Group also has a significant pipeline of new customers due to the demand for their solutions. They can offer the services at a competitive price, because a lot of the legal certifications are already taken care of by IBM cloud for financial services. They are covering the full spectrum of customers from SME banking customers to large organizations in the public and private sector. Their market strategy focused on customers' needs is their competitive advantage.
Technology innovation	Geva group has successfully developed a dedicated hosted offering and a SaaS solution built on a cloud platform. These services run on a fully encrypted database. They are currently re- architecting their entire application stack to make it available on a container-based infrastructure in the future.
Environment and sustainability performance	Moving into cloud was a decision because of environmental side, would have to build at least two independent datacenters, re-use something with higher standard and certification is much better. Sustainability was not the main focus but did consider it





Impacts	
Focus on SME	Concentrate on Sector 3 and 4 banks, which are smaller banks, but also have some big customers with both banks and commercial customers.
	They struggle to build an IT infrastructure

Obstacles/Barriers	
Technical barriers	Technology is a challenge but not a limitation. It is always a solution. decision to go on cloud seems to be right, many customers from financial sector will move to cloud as well.
Legal barriers	Compliance with EZB, BAfin, deutsche bundesbank and SWIFT as payment ecosystem. They need a design application to fulfill these.
Economic barriers	Financial sector is in a change. Many are trying to outsource IT and focusing on the main business of banking. They look for partners and offerings that they can use, but many customers search for local offerings as many German banks only want German providers.





### Keepit

Identification		
Name of interviewee	Signe Schouboe, Frederik Schouboe	
Organisation	KeepIT	
Country and location	Copenhagen, Denmark	
Sector	IT	

Initiative	
Description of the initiative	KeepIT is a software company specializing in Cloud-to-Cloud data backup and recovery. Deriving from 20+ year experience in building data protection and hosting services, Keepit is pioneering the way to secure and protect cloud data at scale. KeepIT comes in two flavours, first generation and second generation. The first gen (2005) would get digital cameras and memories, but consumers were not up for pay the backup and then turn around to B2B. Second gen starter in 2007 and ran the first version of KeepIT, through hosting companies in Denmark, till 2014. Developed the whole technology stack for the future. Prefer to use servers than buying it. So developed everything from scratch (file system, object store, etc.). Having ownership of the stack enable them to have control on it. In hosting: everything was moving to the cloud and customers wanted to consume as a service while moving to Office365. In 2016, they launched the first version of KeepIT and, since they come from hosting background, they have a deep understanding of cloud. However, they also focus on software-defined components, software-defined storage, and, now, they want to be a platform that users can trust for archiving and data protection.
Timing of the initiative	In 2016, they launched the first version of KeepIT.
Funding	They used growth fund money and have implemented their own technology to create their own solutions. This gives them more power.
Technical solution	For the moment, they are present in four worldwide regions (Australia, Europe with the UK, USA, and Canada) but soon they will be six. Their headquarter is in Copenhagen, Denmark, but they are building one in the USA as well. Keepit also has technology development in Kiev, Ukraine. They believe open source attracts technology talent, but they did not decide to implement them in their portfolio yet.





Initiative	
Relation to H-CLOUD key areas	Cloud and edge. But edge is the last mile to collect data. Developed one of the fastest monitoring systems.
Impacts	
Business success	Revenue is the main measure of success, especially in SaaS, where they have around \$12million revenue now with a growth of 130% last year, 100% this year, and probably 70% next year. Another measure of success is the number of users, but this is not public.
Technology innovation	Most existing vendors have retrofitted their different products while KeepIT is designed for SaaS and scales both horizontally and vertically.
	Object store is architected around a Merkel tree, like github, gittree
	Merkel tree is initial thinking, a lot of serialization of data that comes in.
	They provide deduplication of any data object that comes on - board and across the entire storage island that you will be sitting on. There is no extra cost to do deduplication and optimized storage costs is also provided.
	Based on hash changes, data cannot be manipulated with blockchain. Here, customers can manage their own keys and, once data have been written, they stay there without overwriting data points, but it is possible to see who changes configuration. The hash chain / blockchain will no longer compute, and data cannot be seen.
	Only thing is that KPI infrastructure needs to be added.
Environment and sustainability performance	Yes, they are trying to convince customers to not run things on- prem. This gives much greener footprint.
	KeepIT uses scalable systems in multitenancy context to be greener and they are leveraging Equinix from the green side. They are also trying to buy the most capacity and densest equipment while using the same power but storing more data.
Focus on SME	Their go to market strategy is to point towards enterprise customers where it is extremely simple to operate. They believe this is the future.
	They also focus on simplicity where it is easier for SME customers to operate in the platform. They do that through channel partners. Average customers size is 100 employees.

Obstacles/Barriers	
Technical barriers	Security issues.










### Green Data Center AG

Identification	
Name of interviewee	Roger Süess, Susanne Felice-Tanner
Title	CEO - Head of corporate communications
Organisation	Green Data Center AG
Country and location	Switzerland
Sector	П

Initiative	
Description of the initiative	Green Data Center AG is a Swiss data centre, hosting, and cloud service provider.
Timing of the initiative	Green Data Center AG was founded in 1995 as part of a farmer's union to provide affordable internet access to everyone in Switzerland. Entered the data centre business in 2002.
Key stakeholders	Privately owned company
Funding	Privately held, local banks, and big international banks
Technical solution	Today, Green Data Center AG operates 5 data centres at three different sites in Switzerland, offering cloud services through partners, as well as its own IaaS cloud services. The company is currently investing in two new campus sites with high-density computing. Green Data Center AG also cooperates with local IT services providers, which develop their cloud services on top of Green Data Center AG hardware. Green Data Center AG is currently developing a whole cloud ecosystem, mainly targeted at Swiss customers.
Relation to H-CLOUD key areas	Cloud
Business model	Green Data Center AG manages its entire IT internally, having learned from hyperscalers hosted in its data centres how to run them most efficiently. Now trying to attract European cloud providers in addition to the hyperscale cloud customers they already serve. Key services include social media, streaming, and gaming, as well as vertical-specific services.





Impacts	
Business success	Business success is measured against business goals like turnover, EBITA, and projected growth.
	Other measures are also included, like:
	- Number of partners in the cloud ecosystem
	- Sustainability – annual project to optimise data centre operation, customer satisfaction, employee satisfaction, and alignment with corporate values.
Technology innovation	Green Data Center AG has separate offerings for retail customers (SMEs) and for enterprise customers.
	For retail/SME customers: webhosting, M365, smaller form factors.
	For enterprises: accompanying customers' journeys to cloud; complementing/supporting customers' journeys to cloud; multiple data-centre form factors – single racks, cages. Help customers to set up hybrid cloud.
	Can integrate with/connect to different public cloud services: Microsoft Azure Arc, Google Anthos, AWS outposts for webservices.
	Green Data Center AG also offers a private cloud solution, which is truly an OPEX model (pay per use).
	It also offers an IaaS solution with VMware-layer or Kubernetes- layer. Edge computing: AWS outposts, wavelength (have been exploring, but have not yet deployed), still at the start of smart cities.
Governance / Organisational structure	Privately owned company
Data governance	Data governance is the responsibility of the customer.
Environment and sustainability performance	Sustainability is a key focus area for Green Data Center AG: - The company offers hyperscaler campuses: carbon-neutral buildings, sustainable materials, optimised free cooling, high energy efficiency, low PUE, equipe d with solar panels, office buildings with photovoltaic elements.
	consuming heat from the data centre in other facilities; city participation, with excess heat used elsewhere, such as for electrical vehicles (bikes, cars)
	- New technologies: solar- and wind-powered lighting





Impacts	
	- Expansion capacity: all services fully powered with renewable energy (solar and water renewable energy), with a constantly optimised data centre, with data-centre temperature limits
	- Carbon recovery project: with a technical university in Zurich
	- Won an award for energy effectiveness and efficiency
	- Water: all water systems running at a high-containment level
	- Oil and gas: no waste petrol created
	- ISO sustainability certification — ISO 50001
Focus on SME	Green Data Center AG serves all customer segments, ranging from SMEs to large enterprises and hyperscalers.

Obstacles/Barriers	
Technical barriers	Customers need be aware that the PUE of their own data centre is most likely much higher than the PUE of the data centres of a focused company like Green Data Center AG, which is very close to No. 1 in this regard.
Legal barriers	Data centre providers cannot control how efficiently customers are running their infrastructure within the data centre. They can only control the part that they are responsible for. Data protection law: Switzerland and EU regulations are closely aligned (non-alignment would be a problem). Always looks to comply with GDPR and other European regulations. Swiss industry also operates in the EU and needs to be compliant on both sides.
Economic barriers	Public opinion and acceptance: The general public is not very keen on data centres, so a lot of education needs to happen about the usefulness and eco friendliness of data centres. Green Data Center AG constructs very attractive buildings that use solar power and integrate well into their surroundings. Another challenge is the speed at which the company needs to build. It does not want to build before the demand is there, but once it is, construction must be as fast as possible. That creates some economic challenges about the timing of investments. In addition, authorities generally want longer lead times.





#### Insentis

Identification	
Name of interviewee	Robert Duisberg
Organisation	Insentis
Country and location	EU - German multinational
Sector	ІТ
	Not a good practice

Initiative	
Description of the initiative	Insentis GmbH is an IT management consulting company implementing end-to-end solutions for service providers. They started from a strategic initiative to project the real integration cloud. They are 100% neutral in the cloud choice.
	situation, and then they make aware their clients of the Gaia-X initiative and advocating the usage of it, as they think this is the right time to avoid further delays in the cloud field.
Timing of the initiative	1 to 2 years, divided into two parts, shorter strategic stage before (~3 months) and longer implantation later.
Key stakeholders	Commercial and public
Funding	Private
Technical solution	Transition to microservices
Relation to H-CLOUD key areas	Edge is considered but not yet implemented, in some way they also implement federation of clouds.
Business model	Their clients are service providers usually.

Impacts	
Business success	They think it is quite difficult to use KPIs in their environment as traditional KPIs are not utilized nowadays. However, a key success measure is the ability to do something better than before by defining KPIs for that. With all the new strategic technologies, it is just a success to be able to introduce them, bring together the technology, the people and the processes to enable them.



Impacts	
Technology innovation	In big initiatives, Insentis is mainly looking in the IoT and edge environments. The company provides coaching for the client's employees to help them introduce and manage IoT and edge computing solutions. In case some knowledge is missing, Insentis can also provide experts with the appropriate skills to the client.
Governance / Organisational structure	Insentis has around 20 employees. They currently address the German speaking countries in Europe: Germany, Austria, and Switzerland (DACH region).
Data governance	Data governance is always very important, especially In Europe, and their strategy is to look at what Gaia-X is doing.
Environment and sustainability performance	Sustainability is a central point to build a solution for their customers. Electricity prices are very high in Germany because of taxes, which forces the cloud provider and developers to provide efficient solutions. Robert is quite sensible to this topic, as a member of the steering committee of an association has also had exposition to the thematic.
Focus on SME	Yes





# Leading EU car manufacturer\*

Identification	
Country and location	Poland
Sector	Automotive
Company size	1,000+

Initiative	
Description of the initiative	<ul> <li>UPS real-time monitoring and management system</li> <li>The CEE-country-located factory of a leading European car manufacturer is equipped with about 50 UPSs, placed in rack cabinets, located in different places in the factory, and two heavy-duty Galaxy-class UPSs supporting both data centres (DCs). The DCs host all IT infrastructure for the office and production parts of the factory.</li> <li>The initiative tied to the new UPSs was driven by the following challenges: <ul> <li>The very difficult management of dispersed infrastructure – a lack of visibility and UPS status information collected manually by administrators</li> <li>Lack of predictive maintenance – service work often performed after breakdowns</li> <li>The instability of UPSs operating in an emergency state</li> <li>Alerts only displayed on the UPS panel</li> </ul> </li> </ul>
Timing of the initiative	The initiative took place in Q2 2020 and is now completed.
Key stakeholders	This initiative has been driven entirely internally, in collaboration with the UPS provider.
Funding	Only company funds
Technical solution	The IT department was the initiator of the project – namely, the replacement of business-critical UPSs. All UPSs can now gather sensor data, enabling status monitoring, basic analysis, data visualisation on monitors, and data transmission via LAN and dedicated VLAN infrastructure. The UPS manufacturer provided the company with the UPS management application, which helps IT administrators detect failures and potential threats. All data transmitted from all the UPSs is collected and analysed in data centres for a holistic view of the overall power infrastructure.
Relation to H-CLOUD key areas	Edge





Initiative	
Business model	Purely internal initiative
Impacts	
Business success	Several KPIs have been used to measure the success of the project. The benefits are as follows:
	• No downtime due to power failure (Power failures have been eliminated.)
	A massive reduction in failure time
	<ul> <li>The removal of reliance on battery power in emergency status</li> </ul>
	Information visibility
Technology innovation	Edge and IoT. UPSs are equipped with sensors and the ability of analyse data and generate alerts and triggers from insights gathered locally, at the edge.
Governance / Organisational structure	Not for this initiative
Data governance	The company decided not to share the data with the UPS vendor due to a restrictive security policy.
Focus on SME	No

Obstacles/Barriers	
Technical barriers	None. There were some challenges with shutting down individual UPSs, as the IT system needed to be available all the time. This was therefore only done during production downtimes.
Legal barriers	None. All data is collected and analysed in the factory.
Economic barriers	None. The project was financially predictable, calculated well, and financed from the IT budget. It was supported by an integrator and technical specialists from the UPS provider.



# Polymore\*

Identification	
Name of interviewee	Josef Art
Title	Business Director
Organisation	Polymore
Country and location	Germany
Sector	Plastic industry
Company size	n/a

Initiative	
Description of the initiative	A new B2B online marketplace for the procurement and sale of compounds, masterbatches, recycled materials, and post-industrial materials in Europe. Polymore connects compounders and plastic processors for simple and secure trade in products.
Timing of the initiative	Planning started in mid-2018, and the project was launched in 2019.
Key stakeholders	Owner: KraussMaffei Technologies
	<b>Market side:</b> plastics converters, suppliers of plastics materials, plastics users, and registered partners
	Other marketplaces: plastics producers and their shops
	KraussMaffei is a machinery company, so it is not a competitor of plastics producers.
	The plastics market is fragmented.
	The steel market is very regulated, with very clear standard steel types. Different companies deliver exactly the same kinds of steel. In plastics, there is no standardisation or catalogue of plastics.
	I have this problem, and I need a solution – find technical experts.
	I do know my technical requirements, but I need these material parameters – descriptions of the properties needed and/or the problem to be solved.
	Suppliers:
	A buyer purchases material, and a supplier delivers it.





Initiative	
	Both have to register. A 'matchmaker' solution is used to assess all registered suppliers manually to find the perfect match or to provide the best solution. The requirement is to automate manual matchmaking using AI.
Funding	Only funded by Krass Maffei. Public funding is too slow; the procedure is too slow and does not work with the timeline, which is relatively short.
Technical solution	Run on AWS, with many microservices; now moving beyond this to virtual and to server option such as VSL virtual storage. The main service runs on AWS cloud, with shared services and microservices.
Relation to H-CLOUD key areas	The business model is green (following the trend in business). The plastics industry is moving to a circular economy to reduce the CO2 footprint of plastics. The portfolio contains reusable materials and post-industrial waste. Mother company KM is active on the lobbying side.
Business model	The initiative is in a ramp-up and data collection phase. Collaboration to scale the business model could involve bringing together market information, deal by deal, collecting a lot of information. The model is a combination of people and data collection. The value of the database is massive. In a year from now, there could be huge business opportunities from combining data and services.

Impacts	
Business success	Success is measured through unique website visitors and online marketing services – impressions, clicks, registrations, active users dealing with us.
	The situation now:
	<ul> <li>60,000 tons requested – 80% recycled</li> </ul>
	<ul> <li>200–300 unique visitors per week</li> </ul>
	Click through rate: 2–3%
	Several hundred sellers in the portfolio of traders and producers.
	Subscription fee, membership fee for suppliers, safe channel for suppliers
Data governance	GDPR: personal customer data sharing between Polymore and machinery not allowed





Impacts	
	Data security: external audit from data security specialist, procedural rules
	The project uses AWS, as AWS also provides security.
	Customers and partners agree to terms and conditions on data protection.
	Huge value of data.





# **Reply Spa**

Identification	
Name of interviewee	Marco Cusinato
Organisation	Reply Spa
Country and location	Italy, Germany and United Kingdom
Sector	Consultancy, System Integration, Digital Services.
Company size	9,000 employees

Initiative	
Description of the initiative	Reply Spa has worked on cloud since 2008 with AWS. The objective of the company is to help clients in the whole path of digital transformation (DX). They are a network-company, the head of many operative companies, approximately 150 legal entities, dislocated mainly in Italy, Germany, UK and the US. Each company has its own specificity, where around 20 are specialized in cloud, typically each one is bound to a single vendor (Microsoft, IBM, Oracle, Google, Amazon), mainly in the IaaS and PaaS space. Other dedicated to specific markets, or to vendors that are offering SaaS like Salesforce and Oracle. Summing up consultancy if needed, implementation which includes moving on-premises datacenter in the cloud, with the transformation aspects, not just IaaS but also transforming to PaaS and containers, but also implementing integration with legacy services starting from trivial email to core services like CRM etc In 2008, Reply relieved Motorola centre of research in Turin, Italy, and started a new business in internet of things (IoT), to leverage cloud computing to connect IoT sensors and objects. For example, the Connect car platform requires coverage but also a backend platform for collecting data and sending back information. They have a series of companies working in the industrial IoT, to IoT and connected products.
Timing of the initiative	Reply works for 95% with enterprise companies, with one year and above, or minimum 6 months, for very scoped projects. Clearly, customers need to dominate the technology, but it is not just a technological challenge, as enterprise organizations are going to use the cloud, even the migration of electronic mail from on-premises to cloud can be complex in specific situations. The challenge can be not technological, but organizational because users need to integrate with different tools and they need to change their behavior, because things done on premise cannot always be done in the cloud, backup, data retention and policies need to change, and it is especially true in highly regulated markets.





Initiative	
	This clearly has an impact on the time to market. The most common case is a migration to the cloud keeping some local resources in a hybrid mode, with a first deliverable in one year, then the project goes on.
Funding	Private founding for 90%-95%. In 2009, when the Motorola business was acquired, they had a project financed by Italy, and in that project, a private cloud has been developed. This private cloud is still internally in use.
Technical solution	They are just driven by the market and provide the full technology spectrum. Today their focus is moving to PaaS. They are interested in the concept of federated clouds to avoid lock-ins by specific providers. In the PaaS definition, customers can see the services offered by the cloud provider (like queue services or pub-subscribe services) and microservices on managed clusters of containers, and more on the Server-less side (AWS lambda or Azure functions). The trend is in general going to be more agile and to offer services that are detached from having an underneath server infrastructure, instead of focusing on the applicative logic and functionalities. Overall containers and sever-less are the main trends.
Relation to H-CLOUD key areas	Reply is developing a platform for managing multi-cloud in a project in partnership with Lutech and Almaviva in Italy on behalf of the Lombardy Region IT services company ARIA (previously known as Lombardia Informatica). Several clients are demanding to develop a service layer allowing multi-cloud, that is moving workloads between different cloud providers. Today, this can be managed through the container technology approach, which means using Kubernetes or Docker. These solutions allow to move "containers" from a cloud provider to another or to on-premises, building federated clusters of containers. There are several projects around that, it has a concept of a federation of identity, and the ability to orchestrate in functions of peaks, reaction to failures etc. The company is also developing a function monitoring the financial management of these services (FinOps), so that clients can always monitor costs and optimization results.

Impacts	
Business success	The company identifies two main key competitive success factors:
	1. time to market - the shortest possible time for the IT to provide new functionalities and satisfy business needs.
	2. Cost efficiency - how much organizations can optimize in terms of costs, without giving up on performance or operational
	efficiency. Reply's approach is to replicate the original services
	and taking gradual, incremental steps introducing innovation and optimizazion, measuring results at
	each steps. The cost savings depend on two main aspects: lower spending with cloud providers, typically around minus 5-

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Impacts	
	10% (for example by using less disk or different types/hierarchy of disks, or different type of services); the second concerns the benefits of automation, taking advantage of the native programmatic nature of cloud to automate processes previously done manually, this can yield savings up to 30%-40%.
Technology innovation	Reply has embraced almost all recent technologies: AR/VR, Blockchain, AI, IoT, Edge, next-gen security. They often use the computational power of the AI offered by the cloud providers. For example, they are typically using Image recognition for an insurance company, which recognizes damages on cars for low- value incidents as it is used by the insurance company to save the operative costs of professionals doing the checks. That has been achieved by training the AI system and ML (Machine Learning) algorithms offered by the cloud provider. With proper training, the precision in the results can be over 95%.
Governance / Organisational structure	Reply is made up of a network of highly specialized companies. Each company is completely autonomous inside a defined mission. By design, they are autonomous in pursuing the mission, which is going into the market, developing the offer to the clients, and implementing it. Coordination is done at the level of heads of groups, by the executive partners, which are responsible for a group of companies. Companies are grouped in networks, and networks are grouped quite homogeneously. Executive partners cooperate with each other to satisfy clients' needs. The interviewee Marco Cusinato is an executive partner who has always dealt with the network of companies working in the cloud and mainly in the cloud infrastructure.
Data governance	Reply has a company specialized in data management, including data governance aspects. They provide support to the group about the legislative framework and compliance needs for data protection, privacy and security. The staff is composed mainly by IT experts trained in legal aspects (not lawyers).
Environment and sustainability performance	Not very relevant for cloud integrators. A new business they are working on is how to do System Integration in a sustainable way, or better how to write software that consumes less energy (rather than simply trying to minimize energy costs).
Focus on SME	No

Obstacles/Barriers	
Technical barriers	There are always technology challenges, but they believe that they can and will be solved. Some time ago clients wondered whether to move to cloud computing also because of the difficulty of the technology transition. But the market has changed and





Obstacles/Barriers	
	today no company can do without cloud, so barriers are being overcome.
Legal barriers	There are legal problems, especially in the past there was for a long time a hole in the legislation, i.e. where data can be stored, or US privacy shields.





# Sovereign Cloud Stack

Identification	
Name of interviewee	Kurt Garloff
Title	Open data cloud chief architect
Country and location	Germany
Sector	IT

Initiative	
Description of the initiative	Sovereign Cloud Stack, part of the GAIA-X infrastructure workstream
Initiative website	https://scs.community/
Timing of the initiative	Started in November 2019 based on an open-source approach to the GAIA-X infrastructure stack. Sovereign Cloud Stack was accepted into GAIA-X in 2020.
Key stakeholders	The agency for software innovation in Germany SPRINT program from the German government Community of volunteers, including Plusserver and Betacloud, which are already running cloud services based on Sovereign Cloud Stack architecture
Funding	Grant from German government through the SPRINT program
Technical solution	Sovereign Cloud Stack provides a reference architecture for IT infrastructure based on commonly used open-source components. It is a platform that exposes infrastructure through APIs, targeted at the developer community. The goal is to create a foundation for cloud federation. All the companies (both end-users and cloud providers) who operate clouds based on sovereign cloud stack will be able to federate their services and become a node of the same cloud because they are running on the same software stack. That way, companies can build a continuum from small edge clouds to internal clouds to public clouds, all running on the same software stack. Key components include: • CEPH for storage
	<ul><li>Open vSwitch for networking</li><li>OpenStack core services</li></ul>





Initiative	
	CNCF projects: Kubernetes, Helm, Prometheus, etc.
	Sovereign Cloud Stack also wants to encourage the sharing of cloud operations best practices throughout the community.
	The next step is to create a PaaS layer.
Relation to H-CLOUD key areas	Cloud federation is a key design point. The edge use case will need much more research before it can be implemented in Sovereign Cloud Stack.
Business model	Sovereign Cloud Stack is a non-profit organisation, funded by BMWI, the German Ministry for Finance. They will build a small team, 10–12 people, who will be able to coordinate a larger opensource community. Longer term, the aim is to create a foundation with a membership piece.

Impacts	
Business success	<ul> <li>Business success is measured by:</li> <li>The number of contributors to the project that help build technology</li> <li>The number of instances running</li> <li>Customer adoption: Sovereign Cloud Stack is currently adopted by two German cloud providers, Betacloud and Plusserver.</li> <li>Key to success is going to be adoption because developers only</li> </ul>
Technology innovation	Sovereign Cloud Stack is building an opensource-based cloud
	software stack with a focus on cloud federation at the infrastructure layer by putting the right networking and technical interfaces in place.
	The plan is to provide a container layer by the end of 2021. In addition, sovereign cloud stack also wants to deliver templates for the self-description of services built on it.
	In addition, Sovereign Cloud Stack is trying to increase the knowledge of best practices in the space of IT operations/cloud operations and to create a knowledge-sharing community.
	Service management and commercial management still need to be addressed.
Governance / Organisational structure	Non-profit organisation, open-source community
Data governance	Data governance is not covered by Sovereign Cloud Stack. Sovereign Cloud Stack provides encryption and key





Impacts	
	management via standard interfaces, which can be used by the data layer, but they don't provide data management per se.
Environment and sustainability performance	Sovereign Cloud Stack is designed to be as sustainable as possible. IT waste comes from having dedicated systems per company and application. Once you have a flexible infrastructure, you have higher usage of IT. Sovereign cloud stack also integrates with the power saving technology provided by the hardware manufacturers.
Focus on SME	Sovereign Cloud Stack works for both SME and large enterprise customers. Sovereign Cloud Stack is adopted by mix of both.

Obstacles/Barriers	
Technical barriers	Many companies are building technology in house to construct their own stacks internally to solve the problems they have. But the opensource sharing model is not very well adopted, so others can learn from their experiences, which leads to a lot of duplication.
Legal barriers	There are no legal barriers as such, but there is still a lot of discussion within GAIA-X about intellectual property. Opensource communities have very well defined processes for intellectual property sharing.
Economic barriers	To start as a non-profit organisation based on government funding took longer than anticipated, as it takes time to apply for the funding and until the funding is granted.





### Talentsoft

Identification	
Company	Talentsoft
Country and location	France
Company size	501-1000
Sector	Software
Name of interviewee	Joel BENTOLILA
Title	СТО

Cloud-related activities	
Description of the initiative /company	Talentsoft, Human Capital Management Software / SaaS
Timing of the initiative/company	Talentsoft was founded in 2007, providing efficient processes for HR managers and directors (salary reviews, training programs). After four or five years, the company added solutions for the strategic part of HR (talent acquisition, talent management).
Key stakeholders	Private company
Funding	No EU funding used
Technical solution	Talentsoft offers a full portfolio, covering learning, core HR, talent acquisition and management, and employee experience. Talentsoft is both a system of records for employee data and a system of experience for employees. Talentsoft wants to use multiple cloud infrastructure services in the backend and wants to access them via APIs/infrastructure as code. Offers the SaaS solution both from its own private cloud and based on one global cloud-service provider and one European cloud-service provider. Running on a Kubernetes/container layer enables portability across different cloud services in the backend and enables Talentsoft to offer a choice to its customers.
Relation to H-CLOUD key areas	Offer their software as a service (SaaS) (cloud)
Business model	Talentsoft's business model is to charge a standard price per employee because all employees have access to the system through a self-service portal.



Impacts	
Business success	<ul> <li>Talentsoft measures its success through several KPIs:</li> <li>Revenue</li> <li>The number of users: 11 million users in 2020 and steadily growing</li> <li>Traffic: the number of pages or HTTPS transactions over a period of time, reflecting the usage of applications</li> <li>For the last 10 years, traffic has been growing faster than revenue.</li> <li>Revenue is based on the number of people managed; traffic growth is based on more intensive usage of Talentsoft by the various users, spanning more of the offered modules.</li> </ul>
Technology innovation	Talentsoft uses AI technologies built into their processes.
Governance / Organisational structure	A private company organisational structure
Data governance	<ul><li>Talentsoft manages data in compliance with regulations and best practices.</li><li>The implementation of data sovereignty for stakeholders where possible.</li><li>Talentsoft enables effective and efficient data sharing across its platform and has efficient and effective data security built in.</li></ul>
Environment and sustainability performance	Sustainability for a software company mainly depends on the underlying infrastructure it runs on, and Talentsoft chooses sustainable infrastructure providers. There is a need to develop metrics to understand the efficiency of software code.
Focus on SME	Talentsoft focuses on two customer segments at the moment – the midmarket (1,000 to 15,000 employees) and large accounts. Talentsorft is working on developing a self-service solution for the SME segment.

Obstacles/Barriers	
Technical barriers	Talentsoft would like to participate more in publicly funded R&D initiatives.
Legal barriers	GDPR is a driver for new-feature development and digital sovereignty in Europe, but it also requires more effort to implement.



### **ThreeFold Grid\***

Identification	
Name of interviewee	Chris Hutton & Geert Machtelinckx
Title	Cofounder
Organisation	ThreeFold Tech
Country and location	Belgium
Sector	Autonomous and Federated Peer-to-Peer Internet Technology
Company size	Approximately 60 employees

Initiative	
Description of the initiative	ThreeFold Grid is a peer-to-peer network of storage and compute capacity powered by ThreeFold autonomous cloud technology and developed by ThreeFold Tech (TFT).
	TFT has developed its own stateless operating system (ZERO- OS), which is hardware agnostic and enables a fully decentralised, autonomous, and secure resource pool of compute, storage, and networking capacity. ZERO-OS federates all stakeholders, including enterprises, service providers, and government agencies, which can contribute their digital assets to a meshed utility of compute and storage capacity.
	ZERO-OS secures all participating infrastructure by removing all human interfaces and presenting a zero-hacking surface. Interfacing with the system is only via 3BOT, a virtual systems administrator. All workloads are recorded on a blockchain database (BCDB) to ensure an immutable record and consensus for every workload. Commissioning a workload is only possible with the use of a private key (through an automated 'smart contract for IT' process), which ensures data privacy and sovereignty in every case.
Timing of the initiative	The evolution of ThreeFold technology started almost 20 years ago with the inception of core elements created in iterations over time that now amount to the autonomous and decentralized cloud platform available today.
	TFT was spun off from its incubator in 2018 and saw the inception of ThreeFold Grid. Today, this key flagship project bears testimony to the technology delivering on its promise, with nearly 90PB of storage and 24,000 CPU cores across 21 countries, having encompassed nearly €20m in infrastructure.
	The next phase focuses on the onboarding of an extensive partner ecosystem and an extensive marketing campaign to raise further market awareness in target industries.





Initiative	
	Further, the expansion of ThreeFold Grid into emerging markets and more distributed locations is the focus as ThreeFold seeks to embrace new and existing industry stakeholders to contribute/invest in infrastructure and grow the footprint of available decentralised capacity.
Key stakeholders	Industries include IT, public sector, and education. The partner ecosystem consists of CISPE, ThreeFold Foundation, Hewlett Packard Enterprise, DigiByte, Stellar, TomoChain, Harmony, Selfkey, Dash, WaykiChain, and Skale, Stellar, Crystal Twin, Tag, Solidaridad, Beliive, Seeds, Artheon VR Museum, Join Plus Idea, Green Edge, LZW, Crystal Home, Earthproject, Genblue, Money of Good, Vlinder, Covid Fighters, Crystal, Shareitt, Social, Cicolab, FlowGen, Kleos, Cloud28+, and Jimber, among others.
Funding	No EU funding at present, but TFT has responded to a few strategic RFTs and is preparing for others. TFT is actively engaged with the European Commission.
Technical solution	<ul> <li>A 3-layered approach, as follows:</li> <li>Capacity layer/ZOS: enables decentralised, privacy-focused, and ultra-secure stateless capacity, presenting millions of HW resources – anywhere, any form factor – as one federated, meshed cloud utility; any Linux IT (containerised) workload can run on the ThreeFold grid.</li> <li>Autonomous layer/3BOT: virtual sys admins and digital self: <ul> <li>Sys admin ensures capacity is autonomous and minimises human intervention – deployed anywhere, lower costs, and reduced risk/improved security.</li> <li>Digital self: represents you and me in the digital world, offering all needs for a digital life, guaranteeing our privacy and sovereignty, and ensuring equality and that everyone can take part in the internet economy.</li> </ul> </li> <li>Experience layer: taking full control of your digital life – peer-to-peer applications as use cases (social media, video chat, office,)</li> </ul>
Relation to H-CLOUD key areas	All, cloud, federation, edge, green Plus: peer to peer, decentralised, sovereign, and autonomous
Business model	<ul><li>Circular economy, supply and demand:</li><li>Farmers:</li><li>Private/Company</li></ul>





Initiative	
	<ul> <li>Existing service/cloud providers</li> </ul>
	<ul> <li>OEMs (that missed the cloud race)</li> </ul>
	<ul> <li>Community networks</li> </ul>
	<ul> <li>Property developers</li> </ul>
	<ul> <li>Solar generators</li> </ul>
	• Etc.
	Capacity users:
	<ul> <li>Blockchain partners</li> </ul>
	<ul> <li>ACI partners</li> </ul>
	<ul> <li>Decentralised apps (dapps)</li> </ul>
	<ul> <li>New app trends/industries: IOT, VR, big data, AI 5G, etc.</li> </ul>
	<ul> <li>Any user that needs either decentralised infrastructure (telecom, gaming, etc.) or decentralised data (healthcare, education, finance, etc.)</li> </ul>
	Overall peer-to-peer model with the following economic model:
	<ul> <li>Circular economy</li> </ul>
	<ul> <li>Farmer instead of miner</li> </ul>
	<ul> <li>When you contribute capacity to their blockchain, you are rewarded with a ThreeFold token.</li> </ul>
	• ThreeFold Token (TFT) = s digital medium for the exchange of value within the ecosystems; farmers receive two incomes:
	<ul> <li>Farming tokens: rewarded monthly with x number of tokens, depending on how much capacity they provide</li> </ul>
	- Cultivation tokens: income when reservations are made
	<ul> <li>TFT are traded publicly as they are needed by capacity users for making reservations</li> </ul>
	• TFT are only minted as a result of commissioning capacity to ThreeFold Grid meaning each token is backed by the capacity itself. TFT are designed as a utility token to buy capacity on ThreeFold Grid and are not intended as speculative.
	Farmers are measured and rated on the market in an Uber-like system.
	Two types of farming:



Initiative	
	• DOI farming: Anyone can provision capacity, but with no secure boot process; infrastructure is not secure because it is not booted.
	<ul> <li>Certified farming: This is securely booted capacity supported by ThreeFold with an SLA.</li> </ul>

Impacts	
Business success	The interviewee defines success as follows:
	• Firstly, the largest P2P cloud available today
	<ul> <li>The first and only, now coming to market (stats) with no Initial Coin Offering (ICO)</li> </ul>
	Growth and adoption to follow
	<ul> <li>Growth: country-level farming projects to come on board with sovereign decentralised internet capacity – MEA SP, UK Solar Generator, HPE Strategic Alliance, and Smart Africa Alliance including HPE</li> </ul>
	<ul> <li>Adoption: +30 BC partners to come on board and +30 ACI partners already on board, including a large social media platform</li> </ul>
	Reasons to consider the initiative successful:
	<ul> <li>Our reason for being resonates with a large and quickly growing audience.</li> </ul>
	<ul> <li>The timing is perfect for the EU data landscape, with a major push from the EC.</li> </ul>
	• Social awareness relating to data privacy and sovereignty is growing fast.
	• To our knowledge, no tech addresses the problem to this extent.
Technology innovation	The initiative includes blockchain as an innovator accelerator.
	Ecosystem $\rightarrow$ 2 entities:
	<ul> <li>A not-for-profit foundation spearheads the ThreeFold Network as the primary use case for our technology – governed by multiple councils, a truly decentralised organisation.</li> </ul>
	• A Belgian for-profit tech company with traditional governance structure that focuses on tech innovation based on community and market feedback
	The ThreeFold Grid is our first major use case to prove our technology and the opportunity to deliver a meaningful impact for





Impacts	
	humanity (socially and economically) and for the planet (environmentally).
Governance / Organisational structure	The organisational structure successfully supports the active collaboration and participation of stakeholders. There is a fast-growing partner ecosystem and an expanding community (farmers, ambassadors, token holders, etc.).
Data governance	<ul> <li>Individual users have full control over all aspects of their digital lives (data and applications, generating permanent streams of data), protected by their own private keys.</li> <li>Data is not visible to capacity owners and can be encrypted and dispersed (a mechanism also used in RAID systems).</li> <li>The full network is secured (the private overlay IP-network part of ZOS).</li> <li>GDPR by design, as the owner remains in full control of the data; third parties have no access unless by consent.</li> </ul>
Environment and sustainability performance	<ul> <li>High energy efficiency achieved by reducing layers of complexity.</li> <li>A very efficient storage system has improved energy efficiency by 50–100 fold (depending on the workload). Unused HDD capacity can be turned off (under test, released in August 2020), reducing the energy need for less-used/unused nodes by 80–90%.</li> <li>Local capacity reduces the distances traversed by data, as most is stored locally, which reduces dependency on network infrastructure.</li> <li>No need to concentrate hardware in hyperscale data centres: The density of hardware can be low, reducing the need for cooling infrastructure and reducing power density.</li> <li>The autonomous design reduces the need for skills and human dependency, which is traditionally the biggest cost and risk factor in delivering ICT systems.</li> </ul>
Focus on SME	Have you conducted activities related to SMEs? Equality is a key driving factor, which means all levels of society and business are included and are able to participate in the digital circular economy.

Obstacles/Barriers	
Technical barriers	<ul> <li>Everything had to be built from scratch because a traditional IT stack could not address this challenge due to the following:</li> <li>Unscalable</li> <li>Insecure</li> </ul>





Obstacles/Barriers	
	Too costly
	Too complex (layers)
	Tech providers too centralised
	Technology back doors
	Question: How can we deploy capacity anywhere, in any size, and resolve the support/operational and security problems resulting from this decentralisation? Autonomy is the critical success factor. Reducing the human factor in operating and securing IT systems ensures capacity can be deployed anywhere, on demand, in any form factor, with no dependency on people to operate the infrastructure and secure the data. We had to rearchitect the solution from the ground up. But that gave us the opportunity to address issues such as energy efficiency and privacy.
Legal barriers	No legal showstoppers yet, as the platform design empowers all necessary stakeholders, the first being society itself.
	By design, government, GDPR, AML, KYC, etc. are all addressable and possible in the platform itself (work in progress).
	For the ThreeFold Grid use case, the legal status of cryptocurrencies is still a barrier in parts of the world, but the design of the token (backed by true capacity) and the benefit that the technology brings from the privacy, AML, and GDPR perspectives will help to address the reservations expressed by regulators.
Economic barriers	The importance of cloud, and the compute and storage digital infrastructure itself as the substrate of the digital economy, is undisputed.
	Global economies now realise the value of data in this economy and that the economic value is being exploited by just a few large organisations. There is now global awareness that data sovereignty is a must for economic growth and that the digital infrastructure that empowers this economy needs to support this key attribute.
	Furthermore, industry trends such as IoT, artificial intelligence, virtual reality, and machine learning all required distributed and decentralised infrastructure at the edge of the network, in close proximity to users (i.e. edge computing). ThreeFold technology enables exactly this.
	To answer your question, economic barriers are overcome with a solution that directly addresses the above agenda and ensures sovereignty, scale, cost efficiency, sustainability, security, etc. and thereby dramatically reduces entry costs.
	The extraordinary times we find ourselves in with COVID-19 only serves to amplify our dependency on the internet and the role it





#### **Obstacles/Barriers**

plays in our digital economy; it is our only way forward as humanity.





# **T-Systems**

Identification	
Name of interviewee	Jurry de la Mar
Organisation	T-Systems
Country and location	Germany
Sector	ICT

Initiative	
Description of the initiative	T-Systems is an IT service providers and suppliers of digital services. It supports more than 1,000 clients, including all DAX 30 companies in Germany and 100 of the Fortune 500 companies globally. As a subsidiary of Deutsche Telekom, T-Systems provides all important building blocks for innovative information technology and digitalization. This includes development, implementation, integration, and sale of private and public IT infrastructures and applications, including strategic digitalization and the transformation solutions that accompany this. They also provide consultancy services, drawing from their deep knowledge of the industry and with the help of over 4,000 SAP experts around the world.
Timing of the initiative	Founded in 2000
Key stakeholders	T-Systems clients come from all regions and sectors, including the automotive industry, retail trade, logistics and transport sector, and healthcare.
Funding	To ensure companies remain in tune with the latest developments in the fast-moving digital age, T-Systems has designed an integrated portfolio with a focus on the four cornerstones – connectivity, digitization, cloud & infrastructure, and security
Technical solution	T-Systems is a multicloud provider with a broad cloud portfolio ranging from private to public cloud. To ensure companies remain in tune with the latest developments in the fast-moving digital age, T-Systems has designed an integrated portfolio with a focus on the four cornerstones – connectivity, digitization, cloud & infrastructure, and security.
	T-Systems is running Daimler and Shell datacenter. In the last four years, T-Systems has growth and developed a lot with its own public cloud, open telekom cloud, open-stack and open- source cloud solutions. They got interest from science and government, but also other cloud platforms such as Microsoft Azure, AWS, GCP, which are their official certified partners as well as all the other hyperscalers. Their own offering is the fastest growing in the last year and started 4 years ago in 2016. In those

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Initiative	
	4 years, they have grown to manage 500 petabytes of customers data.
Relation to H-CLOUD key areas	Cloud, Multicloud
Business model	They are federated with existing datacenters and cloud services of customers. They provide hybrid cloud computing, connecting customer cloud in science and run across both clouds. They are federating with other commercial cloud providers through Gaia- X. Indeed, this will provide industry grade federation.
	Their services can communicate each other (machine to machine). This will enable processes that can talk to each other while using standards in cloud world.
	They believe cloud is revamping the IT world, making it much easier to use. Security is the main menu in the cloud while devices are behind.
	The European Commission runs their applications but cannot run on single cloud. This always require high redundancy, diversity, and the need to run across multiple clouds.

Impacts	
Business success	T-systems is a profitable company
Technology innovation	Edge is very close to telco and is very important. They cover edge and know all elements of edge computing, mobile networks and edge network. They process data locally and are key providers for the automotive and manufacturing industry. They are working with several companies that have dedicated a company division for this product portfolio. They follow European regulation on how edge computing is done and how data is treated. They need to understand what happens to data end-to-end.
Environment and sustainability performance	They are part of the group program for Deutsche Telekom as a whole and have a WeCare program, which sets monitored KPIs. T-Systems is aligned with the Paris agreement on climate change. They use volunteer employees to contribute to sustainability in their free time. They also change packaging of goods and how they send out products to customers and get rid of every single piece of plastic that they don't need. They look at sustainability from many aspects beyond CO2 emissions.
	The measurement usually considered for energy efficiency, PUE (Power Usage Effectiveness), is not sufficient, because it only measures what you use in additional energy to run the datacentre, but it does not say anything about efficiency of the datacentre itself. For example, how much data can I process per kilowatt? How efficiently do you store or process?

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Impacts	
	Efficiency is the most important thing but the biggest problem in Europe is fragmentation, there are so many small datacentres, which are super inefficient, with a utilization rate of 25% at maximum. T-Systems believes datacentres can achieve 60% of utilization.
Focus on SME	Most of T-Systems customers are based in Germany and their cloud offerings are focused on SMEs. T-Systems has also a partnership with Bitkom on different platform strategies for SME and many European automotive exchange network partnerships like Volkswagen and Audi, but also industry platform for agriculture area to help SMEs to use the cloud. They have a techboost program, especially startups can benefit from cloud, because it saves them CAPEX in early days of company, and a program where startups can apply where they get credits to buy cloud services (up to 100K euros), store and process data, and AI developments. However, they cannot spend the money for expensive resources to compute.

Obstacles/Barriers	
Technical barriers	No technical barriers as they are way ahead of what users can understand and use nowadays. However, they have barriers in terms of education as education programs are not really supporting innovation that is already there. They believe education system is important.
Legal barriers	No legal barriers, better regulations and guidelines are there.
Economic barriers	Economic barrier is not in a level playing field in terms of competition. For example, the US government is acting very differently from EU governments, and this will not change.





# Vivacity Labs\*

Identification		
Name of interviewee	Peter Mildon	
Title	СОО	
Organisation	Vivacity Labs	
Country and location	UK, London	
Sector	Private, technology	
Company size	45 employees	

Initiative			
Description initiative	of	the	The company provides artificial intelligence-based products and services to support municipalities in traffic management, leveraging images and videos to gather anonymous movement data. The company provides both AI-enabled sensors (cameras) and the platform for data communication, storage, and management. The cameras run AI at the edge, leveraging edge computing platforms (edge GPUs) to do the image detection and analysis and to extrapolate anonymous insights that are sent out to the software platform. Insights are about how roads are being used, classifying different types of road user (car, truck, pedestrian, cyclist,) and how they are interacting on the road. This more recently includes measuring social distancing and interaction between people. The company has more than 3,000 sensors deployed around the world, but it is mainly active in the UK.
			The initiative to integrate data into sign traffic control has two different orders of benefit:
			<ul> <li>Society benefit – limiting traffic and time spent in traffic</li> </ul>
			<ul> <li>Environmental benefit – for example, minimising time at conjunctions and facilitating pedestrians and cyclists, depending on the policies the customer wants to implement</li> </ul>
			Edge is used in conjunction with CLOUD:
			<ul> <li>Edge is needed at the sensor level to implement AI and support low latency use cases, reducing bandwidth and connectivity costs, and to have privacy by design, deleting personal information before it leaves the sensor</li> </ul>
			<ul> <li>Cloud is usually the choice for running the software platform and data management</li> </ul>





Initiative	
	<ul> <li>Decision making (policy implementation) can be done at different levels (sensor, cloud, hybrid), depending on the case</li> </ul>
Timing of the initiative	The company started with these initiatives in 2015. Since then, the technology has evolved, as has the company's capability to design AI algorithms. First step was to look at single conjunctions. But, to achieve the full benefit on traffic control, the next step is to enable different conjunctions in the same city at the same time governed by a single policy. This is now a prototype and is demonstrating journey time saving and the ease with which policies for environmental issues can be changed.
Key stakeholders	Local governments and municipalities are the usual clients. Central government is usually a key stakeholder, as it provides financing. Transport authorities are also a key stakeholder, especially from the policies and standardisation standpoint. Finally, road users are stakeholders, as they are analysed (anonymously) and benefit from the solution (efficient journeys). Data has also been provided to academic institutions to help them model human behaviour.
Funding	Projects are usually funded by central government (e.g. Innovate UK), but the company also gained funding under Horizon 2020 project SynchroniCity for gathering the data of active travellers during IoT trials in multiple European cities (including Eindhoven and Helsinki).
Technical solution	The solution uses edge GPUs with ML and AI algorithms to extrapolate insights from images and video signals, classifying different road-user types (car, truck, pedestrian, cyclist,) and how they interact. The insights are sent to a cloud platform and delivered via a dashboard available for the customer or as an API to integrate into other platforms (e.g. Smart City platforms).
Relation to H-CLOUD key areas	Edge
Business model	The company provides the sensor (camera, hardware device) and a software (service) model. So, ideally, the customer has a capital purchase and a recurring license (or SaaS) for the data management platform. The solution is flexible enough to meet clients' requirements (e.g. no capital outlays and the rental of hardware sensors on top of the data service subscription). Often, public administrations prefer capital expenditures to recurring revenue models, so flexibility is needed. The software running at the edge can be a capital purchase, which adds further complexity to licencing, as the other part of the software is licensed or paid as a service.

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Impacts		
Business success	Levels of success vary. Revenue growth (doubled revenues each year and planning to reach 3M by end of 2020), but also a number of different KPIs.	
	Number of sensors active and running: 3,000 devices all over the world.	
	Looking at smart junction initiatives, the KPI is achieving and improving traffic throughput and saving costs through more efficient traffic (e.g. the number of cyclists using the junction).	
	Sensor only: Success can be quantifying the benefit of something else, such as the construction of a new pavement: Is this investment paying off as expected as regards usage, user types, traffic, etc.?	
	Client adoption and use: KPIs are the number of accesses to our data on the dashboard/in the API, the number of customers buying more sensors (60% now), and the number of cities adopting sensors (increased from 20 to 30 in 6 months, from January 2020 to July 2020).	
Technology innovation	Leveraging technologies such as AI, IoT, edge:	
	Edge is critical for the following features: data protection by design (personal data deleted before leaving the sensor), latency to support real-time use cases, and bandwidth saving (avoiding sending large video streams).	
	Innovation is driven by the internal development of technology and the deployment of AI algorithms designed to improve the use of edge hardware to address the new needs of the market.	
	Edge has relevance for business processes, as it is fundamental to the solutions provided.	
	Being a small company, Vivacity Labs' involvement in the technology ecosystem started with the company's founders.	
Governance / Organisational structure	Stakeholders are local and central governments, industry bodies and standardisation authorities, transport departments, and investors in the industry – all of which gather industry data.	
Environment and sustainability performance	Overall, the company and project consume a small amount of CO2 (net, i.e. output vs consumption). In terms of sustainability, we need to develop an algorithm to improve edge and server efficiency. Using algorithms that perform at twice the speed of their predecessors means we consume less power. But hardware is developing more slowly than software.	
Focus on SME	No	



Obstacles/Barriers		
Technical barriers	Standards are not keeping pace with innovation, which opens room for innovation (i.e. lack of constraint). When challenged by standards, we need to establish confidence in the market; we need to prove that we can more than meet standards.	
	Talent attraction is also linked to technical barriers, and we try to find talent in universities.	
	From a supply-chain standpoint, having a partner may result in lock-in, as we have to deploy software for a given technology platform. This is problematic if we want to try a new platform.	
	Finally, demonstrating how technology works (e.g. reinforcement learning) to customers is always challenging. You always have to prove the solution will work in any possible scenario.	
Legal barriers	Challenges in government procurement. This is less an issue for small government bodies. Bigger government organisations present barriers regarding evidence of financial stability, the longevity of the company, etc. In such cases, we either work with partners (consulting, large entities) that can meet such requirements for us or provide detailed financial documentation to support our case.	
Economic barriers	Local governments tend to have capital available for capex rather than budgets for recurring service fees (opex). Our team focuses on edge software deployment, so predictable revenues would be preferable. In those cases, we try to embed a part of the future service fee into the capital expenditure for the sensor.	



# Worldsensing\*

Identification	
Name of interviewee	Albert Zaragoza
Title	СТО
Organisation	Worldsensing
Country and location	Spain, Barcelona
Sector	Private, Technology
Company size	Approx. 100 employees

Initiative	
Description of the initiative	Worldsensing designs and builds sensing solutions to remotely monitor critical assets (and the structural health thereof) within mining, construction, and rail networks. The company offers a suite of products to wirelessly connect a wide range of 3rd-party geotechnical sensors. Solutions include edge gateways capable of data collection, data analysis, and network management at the edge. Data is then sent to a cloud location for further analysis. Worldsensing solutions help engineers monitor and anticipate geotechnical incidents, such as ground movement and landslides, to ensure the safety of workers, passengers, and citizens.
Timing of the initiative	The company started commercialising its products over 10 years ago. Edge processing has been a key part of Worldsensing's portfolio since the beginning and the launch of the first geotechnical monitoring product, in 2016. Since then, Worldsensing has continuously included new features and edge capabilities.
Key stakeholders	Worldsensing has mostly private sector customers in the construction, mining, and transportation sectors. It has developed a broad network of local technical partners (i.e. engineering service providers) that deploy and use Worldsensing solutions to provide monitoring services to end customers. Government and public bodies are often stakeholders, as they provide regulation. The reliable, objective instrumentation and monitoring data that is collected using Worldsensing's solutions offers transparency to insurance companies, public agencies, infrastructure funds, and asset owners, who/that increasingly require automated monitoring to be a standard part of safety programs around the
	service providers) that deploy and use Worldsensing solutions to provide monitoring services to end customers. Government and public bodies are often stakeholders, as they provide regulation. The reliable, objective instrumentation and monitoring data that is collected using Worldsensing's solutions offers transparency to insurance companies, public agencies, infrastructure funds, and asset owners, who/that increasingly require automated monitoring to be a standard part of safety programs around the globe.





Initiative	
Funding	A venture capital (VC)-backed company
Technical solution	In general, the sensors used to monitor the condition of geotechnical and physical assets are analogue and are widely dispersed across remote and hard-to-access locations. The company's solutions include data loggers that are compatible with analogue and digital sensors. These feed the collected data to edge gateways. The dataloggers are battery powered and have limited capabilities and computing power. They connect wirelessly to an edge gateway using standard IoT connectivity (e.g. LoRaWAN). The edge gateway is equipped with computing and storage capabilities and is able to gather data, translate different formats, manage the network, perform basic data analysis and visualisation, and, in some cases, generate alerts. The gateway is then connected to public or private cloud for central data analysis, storage, dashboard, and alarms using different types of connectivity, depending on availability.
	The edge devices are resistant to harsh environmental conditions (water, dust, temperature, and vibrations) and consume very little energy. Edge is needed to ensure continuity of service in remote locations where connectivity is unreliable.
	The core edge processing device is the gateway. But, as hardware capabilities improve (storage, computing, and battery efficiency) over time, new edge features in the dataloggers will be enabled. Cloud is mainly used as the aggregation layer for companies with many sites, but a large part of computing will remain at the edge.
	The latest evolutions in connectivity, such as 5G, will contribute to increasing edge capabilities moving forward. Worldsensing's core industries will benefit from new connectivity technologies. Currently, it is difficult to ensure power and connectivity at many construction, railway, and mining sites.
	Worldsensing's main technological differentiation is experience: The company has worked with edge computing technologies since long before they became a trend. Worldsensing's focus on industrial sites and harsh environments has pushed the company to explore the limits of industrial IoT technology to deliver the best solutions to customers and partners.
	For industrial environments, edge can be defined as the place where end devices such as Worldsensing's dataloggers and gateways compute, deliver services, and access the rest of the monitoring network. As edge devices, these nodes are capable of computing and storing data onsite without directly sending data to the cloud, which is especially important in remote locations. Worldsensing designs and builds all of its dataloggers from scratch, which enables the company to control power consumption and ensure rugged hardware components. Worldsensing partners thus work with networks that can operate for up to 10 years without intervention, networks that are resistant to all weather conditions (from -40C to +80C). Such networks



Initiative	
	offer significant ROI for industrial companies, where installation and maintenance costs tend to be high compared with those in other industries.
Relation to H-CLOUD key areas	Edge
Business model	Worldsensing sells to a global network of local partners, such as engineering service providers, that deploy and use Worldsensing solutions to provide monitoring services to end customers. Until now, the business model has been based on selling network infrastructure to engineering service providers and/or end customers. The company is now moving to a service-based approach, whereby a customer pays for the devices, plus software and services.

Impacts	
Business success	Being a product company, our key metrics have always been driven by the number of devices sold in a given period. Revenues have been increasing since 2016. Another interesting KPI is how much money our customers/partners save by deploying our solutions, which adds to the other measured benefits derived from the real-time availability of geotechnical data, such as the increased safety of workers, citizens, and the environment. The overall result is usually high ROI, depending on the project setup.
Technology innovation	Our technology solutions are at the crossroads between IoT (the dataloggers) and edge (where the data is processed). Our solutions rely on a centralised (cloud) platform to which all data is sent from the dataloggers, so edge is critical in delivering value. The company invests a lot in R&D to develop new solutions and to leverage the latest technology trends on the market – LoRa and 5G on the connectivity side, batteries for sensors, and new edge servers/gateways with increased computing and storage capabilities.
Data governance	Being a European company has pushed Worldsensing to align its internal processes with GDPR principles and various national legislations around Europe. These high privacy requirements are a unique business opportunity, since many other countries worldwide are adopting GDPR-related practices as a standard in data governance and security.
Focus on SME	No


Obstacles/Barriers	
Technical barriers	The most important technical barrier that edge computing overcomes lies in its ability to perform low-power computing operations – in this case, enabling long battery life for dataloggers in situations in which power is limited.
	Technology has been developing fast for such solutions, and Worldsensing invests heavily in R&D to maintain its lead over its competitors.
	New connectivity deployments, worldwide, such as 5G, have been slower than expected, and this has had a technological impact in terms of balancing edge and cloud in remote areas. The evolution of new connectivity standards and ecosystems (e.g. LoRaWAN) and their adoption are key to enabling Worldsensing to integrate its solutions with those of other players in the industrial market.
Legal barriers	As our products operate in the free ISM radio bands, worldwide, we are subject to various governments' decisions. Public authorities are usually slow to define clear certification frameworks to regulate wireless communications in their territories. For instance, Israel has not yet established a clear set of rules for the different frequencies, making the commercial exploitation of such technologies difficult.
Economic barriers	We are a VC-backed company. As such, we are constantly investing in our growth. Expanding our commercial footprint worldwide and R&D investments are our core practices.



# 1.3 R&I Initiatives

Table 3 List of R&I Initiatives

Name	Туре
COLA	R&I
LightKone	R&I
Morphemic	R&I
OCRE	R&I
Pledger	R&I
RADON	R&I
RestAssured	R&I
SUNFISH	R&I



# COLA\*

Identification	
Name of interviewee	Tamas Kiss
Title	Professor in distributed computing
Organisation	Westminster University, coordinator of the COLA project
Country and location	United Kingdom
Sector	Academia

### Initiative

Description initiative	of th	SMEs and public sector organizations increasingly investigate the possibilities to use cloud computing services in their everyday business conduct. Accessing services and resources in the cloud on demand and in a flexible and elastic way could result in significant cost savings due to more efficient and convenient resource utilization that also replaces large investment costs with long-term operational costs. Nevertheless, the uptake of cloud computing among SMEs and in the public sector is still relatively low due to limited application-level flexibility and security concerns. The Cloud Orchestration at the Level of Application (COLA) Innovation Action project aims to increase the adoption of cloud computing services in the above-mentioned two strategic target communities. Typical industry and public sector applications require resource scalability and efficient resource utilization in order to serve a variable number of customers with dynamic resource demands and to suitably optimize resource consumption and costs. However, the dynamic and intelligent utilization of cloud infrastructure resources from the perspective of cloud applications is not trivial. Although several efforts have been made to support intelligent and coordinated deployment and, to a lesser extent, the run-time orchestration of cloud applications, no comprehensive solution has emerged until now that could be applied in large-scale near- operational-level industry trials. The overall objective of the COLA project is, by building on and extending current research results, to define and provide a reference implementation of a generic and pluggable framework that supports the optimal and secure deployment and run-time orchestration of cloud applications. COLA will demonstrate the applicability and impact of the solution via large-scale near-operational-level SME and public sector pilots and demonstrators and will define a clear pathway for the innovation to be delivered to the market.
Timing of the	initiative	The COLA project ran as a research project between 2016 and 2019. The outcome of the project is MiCADO technology, which





Initiative	
	is now being taken to market by CloudSME, a commercial start- up from Germany. The principles are also being used in current EU-funded projects like DigitBrain and Asklepios.
Key stakeholders	The consortium <sup>12</sup> includes 10 companies and four research organisations from six European countries – the United Kingdom, Hungary, Sweden, Switzerland, Spain, and Germany. The coordinator of the COLA project is Dr Tamas Kiss, the University of Westminster (UK). Project structure: The core technical team developed MiCADO technology. The key stakeholders were: the University of Westminster, MTA Sztaki (Hungarian Computer Science Institute), CloudBroker, ScaleTools, SISC Swedish ICT AB, CloudSigma, Balasys, Inycom, Sarga, Brunel University London, Saker solutions, Outlandish, CloudSME, and The Audience Agency. The project developed three application case studies to prototype the solution: 1) Inycom (Spain), Sarga (the local government of Aragon): a social-media data-mining solution for the analysis of Twitter feeds; the service had a very imbalanced load and needed an autoscaling solution. 2) Brunel University London and Saker Solutions: a simulation consulting company that ran an evacuation simulation with thousands of replications concurrently, using MiCADO to allocate the right numbers of resources in cloud. 3) UK-based software company Outlandish and The Audience Agency, collecting ticket sales data from events, analysing demographic data, and providing information to venues about who to target with marketing campaigns; a huge database that is growing exponentially; dynamically changing application capabilities.
Funding	Project COLA is an Innovation Action that is funded by the European Commission as part of the Horizon2020 Programme.
Technical solution	Project COLA (Cloud Orchestration at the Level of Application) aims to increase the adoption of cloud computing services among SMEs and public sector organizations. Typical industry and public sector applications require resource scalability and efficient resource utilization in order to serve a variable number of customers with dynamic resource demands and to suitably optimize resource consumption and costs. However, the dynamic and intelligent utilization of cloud infrastructure resources from the perspective of cloud applications is not trivial. Although several efforts have been made to support intelligent and coordinated deployment and, to a lesser extent, the run-time orchestration of cloud applications, no comprehensive solution has emerged until now that could be applied in large-scale near- operational-level industry trials. The overall objective of the COLA project is, by building on and extending, current research results to define and provide a

<sup>12</sup> http://project-cola.eu/cola-project-consortium/





Initiative	
	reference implementation of a generic and pluggable framework (the MiCADO framework) that supports the optimal and secure deployment and run-time orchestration of cloud applications. COLA will demonstrate the applicability and impact of the solution via large-scale near-operational-level SME and public sector pilots and demonstrators and will also define a clear pathway for the innovation to be delivered to the market.
	To overcome the problem of the manual allocation of resources for applications, the MiCADO framework has been developed as part of the COLA project.
	The MiCADO framework supports the autoscaling of applications on two levels:
	<ol> <li>Scaling at container level (based on Kubernetes)</li> <li>Scaling at virtual-machine level (based on Occupus)</li> </ol>
	The application will be defined in a TOSCA-based application description, which is divided into three parts:
	<ol> <li>The specification of the services</li> <li>The specification of the virtual machine</li> <li>The specification of the scaling rules for both levels</li> </ol>
	After commissioning the service, it can be controlled and maintained in various ways.
	Through the integrated dashboard, various aspects of the application can be visualized in their production environments.
	The dashboard is encrypted by means of self-signed or provided TLS/SSL and is secured via login.
	Via a secured REST interface, applications can be started, stopped, updated, or listed.
	All components have detailed logs, which are stored centrally for more experienced users.
Relation to H-CLOUD key areas	Cloud and federation
Business model	MiCADO is now an open source community, with two universities and CloudSME contributing to it.
	CloudSME is a start-up that emerged from another EU project, which is tasked with the commercialization of MiCADO and provides value-added services on top of MiCADO. The commercialization effort is through open source routes to market: building an open source community and providing value added services on top.
	The next step would be to register MiCADO with the Cloud Native Computing Foundation when funding is available to do so.



Impacts	
Business success	We need to differentiate between project success and business success.
	What matters is that the COLA scored 6 out of 7 in a technological-outcome evaluation, which is a very high score for a European project.
	With regards to the long-term sustainable business success of MiCADO technology, we will have to see. Currently, the number of clients using the software is limited, but the product has a future. The route to reaching more customers is clear – through the MiCADO-scale.eu commercial website and through the marketing efforts of CloudSME targeted at prospects.
	MiCADO is also used in new EU-funded projects like DigitBrain, Conversatile, and Asklepios.
	It would be beneficial for maturing and commercializing MiCADO technology if it were used by a larger number of European funded initiatives, but also by European cloud service providers.
Technology innovation	Additional technology innovation will be added to MiCADO technology, especially in the area of edge computing.
	In new research initiatives Askeplios, Conversatile, and DigitBrain, MiCADO technology is used with industry sensors and edge solutions, deployed within an edge-cloud ecosystem. MiCADO will support edge technologies, and significant funding has been secured to do so.
	MiCADO is also extending to graphical user interfaces, like Jupiter Hub and Jupiter Notebook
	In addition, MiCADO will be extended with AI logic to create optimization patterns, which can move MiCADO technology from reactive scaling based on monitoring data to predictive scaling, concentrating on requirements from AI applications.
Governance / Organisational structure	The consortium includes 10 companies and four research organisations from six European countries – the United Kingdom, Hungary, Sweden, Switzerland, Spain, and Germany. The coordinator of the COLA project is Dr Tamas Kiss, the University of Westminster (UK).
Environment and sustainability performance	MiCADO optimizes resource utilization in the cloud.
Focus on SME	MiCADO can be used by all company sizes.





Obstacles/Barriers	
Technical barriers	The biggest technology challenge was the very quick change of technology. In 2016, Kubernetes was in its infancy. The COLA project started with Docker Swarm and then switched to Kubernetes half-way through the project, as Kubernetes emerged as the de-facto standard. The lesson learned is that you need to design your application in a modular way so you can make changes easily. Towards the end of the project, open source virtual orchestrator Occopus was replaced by the Terraform orchestrator tool because Terraform is also emerging as a de-facto standard for orchestration. This work only took two or three weeks, even though Occopus was a major component of MiCADO's architecture.
Legal barriers	In the COLA project, we tried to overcome legal barriers from the beginning, keeping it open source to reduce legal challenges.
Economic barriers	The economic barriers to the commercial success of MiCADO are significant. The EU funding available is not enough to drive commercialization and to market the product. You need a huge marketing budget to make MiCADO known to customers, which does not exist at this point.



# LightKone\*

Identification	
Name of interviewee	Peter Van-Roy
Title	Department of Information Engineering
Organisation	Université Catholique de Louvain, partner of LightKone project
Country and location	Belgium, Louvain-la-Neuve
Sector	Academia

Initiative	
Description of the initiative	LightKone is inspired by the vision of 'lightweight compensation for networks at the edge'. The idea is we are looking at the exponential growth of the internet of things.
	We're looking at edge computing architectures, and we noticed that existing big companies have already invested a lot in cloud and are pushing out, towards the edge. But this is actually complex because the edge is very large; it is actually moving faster than cloud. Our goal was to help it along by improving data management – by making the data management more automated, adding abilities to make data transfer simpler between the edge and the cloud.
Timing of the initiative	LightKone is a H-2020 Research and Innovation action that ran from the beginning of 2017 to end of 2019. It was the successor of another project, called Sync-Free, which ran from 2013 until 2016.
Key stakeholders	The stakeholders are four companies and five academic partners.
	Accademia partners: UCL, INESC TEC, UPMC, NOVA LINCS, and TUK
	Industry partners: Scality, Peer Stritzinger GmbH, Gluk Advice BV, UPC, and Guifi.net
	It's a very classic organisation, with five academia partners and four industry partners.
	Project organisation: We start by finding what industry partners need. Then we make technology in cooperation with them, and they implement and evaluate it.
	This represents classic collaboration between academia, research, and industry.
	The four partners cover most of the cloud-edge spectrum, from heavy-edge very-cloud-oriented Scality to extreme edge Gluk





Initiative	
	agriculture and Stritzinger manufacturing architecture, with the Guifi community network in between.
Funding	Horizon 2020
Technical solution	The development of Artifacts for data consistency at the edge and in the cloud. Principle: lateral data-sharing and convergent data management using automatic forms of data consistency between the edge and the centre so that programmers don't have to spend all their time sending data back and forth.
Relation to H-CLOUD key areas	Edge, green, cloud
Business model	The industry partners are extending their core businesses. For example, Stritzinger is doing automatic manufacturing using RFID tags. Stritzinger actually already has tools that it sells to Bosch, in Germany, for automated manufacturing. Bosch used our technology to integrate partial information to achieve consistency, and it is now part of Bosch's core technology inside its next-generation product.
	Stritzinger created a start-up company, called Concordant.
	This work started during the last year of the project, in 2019. Three of the partners (Sorbonne University, Kaiser State University, and Nova University, in Lisbon) got together and are working on a start-up. We have development engineers and investors, so this is wrapping up right now, in 2020. This is a start- up company that using the technologies developed.

Impacts	
Technology innovation	The initiative included edge and IoT technologies that impact business processes.
Governance / Organisational structure	The number participant organisations and their types are described below. Academic: • UCL (Coordinator) – Belgium • INESC TEC – Portugal • UPMC – France • NOVA LINCS – Portugal • TUK – Germany SMEs:

03



Impacts	
	<ul> <li>Scality – France</li> <li>Peer Stritzinger GmbH – Germany</li> <li>Gluk Advice BV – The Netherlands</li> <li>UPC – Spain</li> <li>Guifi.net – Spain</li> </ul>
Data governance	No sensitive data is directly managed.
Environment and sustainability performance	Edge computing in general is very green. Anything you push away, push to the edge, will reduce energy consumption.
Focus on SME	All the industry partners are SMEs. There's a lot of opportunity now for SMEs outside of the cloud – without necessarily using cloud. Big companies, of course, have a lot of money invested in cloud, so they want to make it profitable. But SMEs don't have that, so there's an opportunity to do things that don't necessarily need cloud, which is actually much cheaper. For a lot of the SMEs, it's much cheaper to try to do computations outside of the cloud. In our project, we found that you can do many things completely outside. Of course, cloud can give you additional functionality, but it's not essential. You can do many things without cloud. My view is that SME and garage-style computations now offer a lot of opportunity in IoT



Obstacles/Barriers	
Economic barriers	SMEs sometimes have problems with liquidity and local strategy problems.
	For Stritzinger, in the original project, there was no GRiSP or extreme edge computing. Stritzinger invented that during the project. Then four of the partners immediately started using this new technology. That was not the original plan, which helped Stritzinger a lot of course. Many SMEs are small companies without huge marketing budgets that generate business mostly by reputation and from references.





### **MORPHEMIC**

Identification	
Organisation	7bulls.com Sp. z o.o.
Country and location	Poland, Szucha 8 street, 00-582 Warsaw
Sector	IT
Company size	SME
Name of interviewee	Katarzyna Materka
Title	Manager of the Cloud Solutions Department

Cloud-related project	
Project name	MORPHEMIC
Project website	https://www.morphemic.cloud/
Description of the project	MORPHEMIC is a unique way of adapting and optimising Cloud computing applications. The project is an extension of <u>MELODIC</u> , which is a multi-cloud platform developed in the H2020 project.
Timing of the project	01.01.2020 31.12.2022
Key stakeholders	<ul> <li>The MORPHEMIC project targets any cloud aware customer, with no limitations to the entity's size or area of expertise.</li> <li>MORPHEMIC potential users can be grouped by: <ul> <li>(1) Level of Cloud experience</li> <li>(2) Size – SMEs and large enterprises</li> <li>(3) Most promising based on certain characteristics: e.g. start-ups in the healthcare sector that perform CFD simulations and offer 5G cloud-RAN or large companies with a significant number of IT systems</li> </ul> </li> </ul>
	<ul> <li>MORPHEMIC mainly focuses on data and computation-intensive organisations. These are the companies that are already operating one or more cloud applications with a need to optimise the architecture and resources.</li> <li>MORPHEMIC aims to target in the short to medium term: <ul> <li>Bioinformatics-related companies</li> <li>Successful start-ups and start-up accelerators</li> <li>Large enterprises</li> </ul> </li> </ul>





Cloud-related project	
	Fintech companies & financial institutions
	<ul> <li>Communication service providers and 5G solution providers</li> </ul>
Funding	MORPHEMIC addresses topic ICT-15-2019-2020, 'Cloud Computing', of the 'Leadership in Enabling and Industrial Technologies (LEIT)' work programme, under Research and Innovation Actions. Topic: H2020-EU.2.1.1. – INDUSTRIAL LEADERSHIP – leadership in enabling and industrial technologies, information and communication technologies (ICT).
Technical solution	MORPHEMIC is based on the underlying frameworks: the MELODIC platform, developed within the MELODIC project, and ProActive Scheduler, provided by Activeeon (community edition).
Relation to H-CLOUD key areas (cloud, federation, edge, green)	Key Area: Cloud
Business model	MORPHEMIC's value proposition in the market:
	Small, medium-size, and large companies using IT systems. Any branch, any IT system technology, no limitations.
	Two groups of companies:
	<ol> <li>With no previous cloud experience, wanting to start a new project using cloud or to migrate to an existing cloud application</li> </ol>
	2. With cloud experience but using non-optimal architecture and infrastructure with possible vendor lock
	For the SMEs we focus on:
	<ol> <li>Preparation of overall IT systems development and architecture strategy with the full utilisation of the benefits of cloud</li> </ol>
	<ol> <li>Preparation of the architecture of the system (or systems) to be deployed to the cloud – current systems and new ones</li> </ol>
	3. Support in developing and migrating systems to the cloud
	4. Project planning and management
	5. Quality assurance with a focus on testing
	The outcome of the project will be the cloud optimised architecture of ICT systems managed and optimised seamlessly by MORPHEMIC.
	For the large enterprise, we focus on:
	<ol> <li>Planning the overall IT architecture with the full utilisation of cloud benefits, especially addressing the vendor lock- in issue, disaster recovery and HA, the diversification of</li> </ol>

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Cloud-related project	
	cloud providers, and the hybrid model (cloud and on- premises deployment)
	<ol> <li>Support in the preparation of the IT program to handle migration to the cloud</li> </ol>
	<ol> <li>Support in the development and deployment of applications to the cloud</li> </ol>
	4. Support in project management and project planning
	<ol> <li>Support in physical architecture design for the transition period and final architecture</li> </ol>
	6. Quality assurance of overall project and quality assurance of migrated applications
	The outcome of the project will be the cloud optimised architecture of the ICT systems managed and optimised seamlessly by MORPHEMIC.
Output	Exploitable assets of the MORPHEMIC project:
	(1) Modelio Camel Designer
	(2) CAMEL 3.0 Framework
	(3) Matcher
	(4) EMS – Event Management System
	(5) ProActive Scheduler & Resource Manager
	(6) Metadata Schema
	(7) Performance Modelling
	(8) Persistent Storage
	(9) AutoML for Time-Series Predictions
	(10) MELODIC Upperware
	(11) MORPHEMIC Pre-processor
	(12) Brain Processing Workflow
	(13) Distributed and Federated Brain ML
	(14) Software Repositories Crawler
	(15) FPGA Cluster Resource Manager
	(16) SD-RAN
	(17) Stochastic Solvers

Impacts	
Business success	<ul> <li>The MORPHEMIC project offers its customers:</li> <li>A complete set of cloud computing services, from analysis, design, and development to maintenance</li> </ul>



Impacts	
	<ul> <li>Optimal usage of ICT resources thanks to the automatic management and deployment of applications and their proactive adaptation in time</li> </ul>
	• Improvements to the efficiency of IT applications: Their performance and usability are maximised by deployment in the best environment; application up-time is improved due to the predictive analysis of the application's future state.
	<ul> <li>Cost savings – on cloud resources and lower operation and DevOps costs</li> </ul>
	<ul> <li>Avoidance of vendor lock-in – offer the advantage of using multi-cloud environments seamlessly</li> </ul>
	<ul> <li>More dynamic development – increasing the number of customers and services thanks to increased flexibility to address different vertical markets</li> </ul>
	• The improved reliability and security of applications – by using the security features of candidate infrastructures as a decision parameter to select the most appropriate deployment environments
Technology innovation	The MORPHEMIC platform supports the multicloud, edge, hybrid, and IoT deployment models in an automatic and optimised way, increasing the effectiveness of the deployed applications in the multicloud domain.
	It is used for deployment and optimisation – particularly AI-based applications – as MORPHEMIC incorporates support for GPU and FPGA hardware accelerators. It significantly reduces the cost of application usage.
Governance / Organisational structure	The organisational structure supports active collaboration and the participation of stakeholders.
Data governance	The MORPHEMIC project builds upon and extends the H2020 EU MELODIC project. From a technical perspective, many MELODIC OSS components in the architecture will be reused, extended, and/or improved upon. This means that a number of selected infrastructure monitoring datasets generated during the course of the MELODIC project may be reused in the development phase of MORPHEMIC by members of the consortium.
	Regarding use-case-collected data sets:
	<ul> <li>The e-BrainScience use case by CHUV will be used to input images from the freely publicly available anonymised MRI data sets – OASIS, UK Biobank, and IXI. The extent of their use concerns only the development phase of the MORPHEMIC platform.</li> </ul>





#### Impacts

•	The Computational Fluid Dynamics Simulation use case by ICON will use publicly available geometric data for the CFD simulation's execution.
•	Regarding data generated and published from the use

 Regarding data generated and published from the use case application validation phase, Virtualised Base Station for 5G Cloud-RAN use case by IS-Wireless will publish the RAN performance validation data set, which could be useful for simulating network performance over time for a cloud-RAN deployment for further research purposes.

The collected data content may be of interest to both the commercial sectors, from which the data was collected, and to a wider community of data scientists, including students of data science, to carry out machine learning research. DevOps operators may be interested in application and infrastructure monitoring data as a means of comparison with their own practices.

The usefulness of other derivative execution data to be published – as well as the platform performance data included in scientific journal publications, conference paper submissions, and other scientific dissemination activities – will resonate more with researchers and organisations looking to expand their understanding of some technical challenges in hybrid cloud computing.

The MORPHEMIC project consortium is not directly responsible for matters related to the privacy rights of the data subjects, as described in Regulation (EU) 2016/679, Chapter 3. Since each validation procedure is performed solely and independently by use-case partners, each sensitive data procedure is subject to each use-case partner's privacy policy.

All of the publicly available data derived from the MORPHEMIC project will be made accessible through the MORPHEMIC OpenAIRE page, as well as through the project's website. Additionally, data will be made available through Zenodo, an open research repository created and supported by OpenAIRE and CERN.

Closed-source tools will not be required to access the data. Opensource solutions, such as docker, git, and web technologies, are utilised (e.g. several software components will be released as docker images that can be pulled by interested parties; git repositories will be utilised, as will the website for the respective datasets).

The opensource contributions are one of the key goals of the MORPHEMIC project. All opensource software components developed and enhanced by the consortium members for the MORPHEMIC project will become publicly available as docker images.



Impacts	
Environment and sustainability performance	The project does not directly address energy efficiency considerations.
Focus on SME	<ul> <li>The MORPHEMIC project focuses on three use cases that will better define and evaluate the MORPHEMIC platform. The three use cases belong to different application domains, covering a wide range of usage possibilities:</li> <li>1. <i>Virtualised Base Station for 5G Cloud-RAN</i>, proposed by <b>IS-Wireless</b>. IS-Wireless is a leader in the development of algorithms, protocols, and tools for 4G and 5G mobile networks. IS-Wireless provides licensable NFV-compatible (network function virtualisation) software implementing standard-compliant radio-access-network (RAN) protocols ready for evolution to 5G.</li> </ul>
	This use-case, proposed by IS-Wireless, focuses on 5G software-defined RANs.
	The MORPHEMIC platform will ensure close to an optimal balance between performance and cost for ISW's SD-RAN product. On one hand, it will be able to optimise the deployment costs (CAPEX) related to the design phase of network slices, which will be automated and simplified by adopting the CAMEL formalism and Modelio design tool. On the other, operational costs (OPEX) will be reduced due to the flexible and optimised choice of deployment form (VM, unikernel, container, FPGA, etc.), as well as real-time adaptation to the changing environment, including both computing realm (monitoring and acting upon cloud platform behaviour) and application realm (monitoring and acting upon application-specific events). In addition, thanks to the rich modelling and performance optimisation capability of MORPHEMIC, it will be possible to design custom application descriptors (through the CAMEL model) for different verticals with a myriad of specific scenarios. As a result, MORPHEMIC will help ISW to address and expand quicker to new markets.
	2. <i>e-BrainScience</i> , proposed by <b>Centre Hospitalier</b> <b>Universitaire Vadois (CHUV)</b> . CHUV is one of five Swiss University hospitals. Specifically, the use-case can be applied to the work of the <i>Laboratoire de Recherche en</i> <i>Neuroimagerie</i> (LREN), which consists of a cross- disciplinary team of basic and clinical neuroscientists with an interest in the role of human brain structure and function in neurological disorders and healthy aging.
	The objective of the case is to analyse data on populations of patients for diagnosis and research. Currently, part of this task is performed through software solutions that clinicians, neuroscientists, and epidemiologists can run on their laptops or desktops or, in the case of large patient cohorts, on HPCs. However, the increased complexity and data available will make necessary the use of cloud computing and GPUs to achieve the

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#### Impacts

desired results in a reasonable amount of time. For this reason, MORPHEMIC will be used to make more efficient the use of computing and storage resources to obtain the same results while maintaining a high level of security.

e-BrainScience's architecture is conceived to advance fundamental and digital knowledge on healthy brain aging and neurocognitive disorders. Specifically, the provided functionalities will be:

- To establish a framework for federating clinical data within and across data sources (hospitals, clinics and cohorts)
- To develop **benchmarking technology** that respects **anonymity** requirements
- To evaluate AI-based diagnostics
- To derive the biological signatures of brain diseases

The use case concerns the analysis of a large amount of data from different data sources. As well as any healthcare data, this data is often sensitive data with stringent requirements in terms of security and anonymisation. MORPHEMIC will not manage these aspects, but it could be possible to deploy an application covering these requirements.

3. Computational Fluid Dynamic Simulation, proposed by ICON. ICON Technology & Process Consulting Limited operates in the high-tech field of computational fluid dynamics (CFD) and provides blue-chip multi-sector engineering companies, their suppliers, and their consultants with the ability to predict fluid flow using 3D computer simulation.

This use-case, proposed by ICON, regards CFD simulation. Specifically, MORPHEMIC will support the deployment of three CFD scenarios that differ in terms of requested resources.

The benefits of the project for ICON are:

- (1) Easy deployment
- (2) No further custom setup for each cloud provider, machine type, etc.
- (3) The reduction of cost by using the best offer
- (4) The reduction of cost by reducing administration and maintenance efforts
- (5) Ensuring simulations are done in a given timeframe
- (6) Simple application specification/definition with CAMEL



Obstacles/Barriers	
Technical barriers	Barrier:
	The potential domination of the biggest cloud provider
	Strong competition from container solutions
	Complex cloud application modelling effort required the first time the MORPHEMIC platform is used
	<ul> <li>Competitors with large client portfolios and expertise coping the business model and offering similar solutions</li> </ul>
	How to address:
	• The MORPHEMIC approach allows organisations that use cloud solutions to choose the best service provider for a given application.
	• The MORPHEMIC platform enables optimised costs and increases the security and stability of the solution by diversifying contractors.
	• The MORPHEMIC platform optimises data-intensive applications to run within defined security, cost, and performance boundaries seamlessly on geographically distributed and federated cloud infrastructures.
	• MORPHEMIC enables the selection (optimisation) of the best combination of offers from different cloud providers, depending on the client's requirements for the application.
	• The cloud-centric approach of MORPHEMIC is unlimited regarding specific business models (use cases) and, as such, is easily adapted.
	• MORPHEMIC enables flexible and resilient monitoring, which is appropriate for applications deployed across cloud continuum resources.
Legal barriers	Barrier:
	• It may be in the interests of suppliers to engage clients as deeply as possible to discourage them from moving to another supplier (vendor lock-in).
	How to address it:
	Constantly increasing capabilities of hardware resources (i.e., accelerators and edge devices).
	• The diversity of cloud offerings and providers creates the need for an advanced and resilient monitoring system, which MORPHEMIC can provide (individual component exploitation).
Economic barriers	Barrier:
	<ul> <li>Cloud solution providers have a very diversified offer, different ways of using it (API2), and various</li> </ul>





Obstacles/Barriers	
	incomparable price lists, which may prevent the use of the MORPHEMIC solution.
	<ul> <li>A lack of marketing budget to compete with biggest players.</li> </ul>
	<ul> <li>A lack of visibility on the market.</li> </ul>
	How to address:
	<ul> <li>The MORPHEMIC approach allows organisations that use cloud solutions to choose the best service provider for a given application.</li> </ul>
	<ul> <li>The MORPHEMIC platform enables optimised costs and increases the security and stability of the solution by diversifying contractors.</li> </ul>
	<ul> <li>The MORPHEMIC platform optimises data-intensive applications to run within defined security, cost, and performance boundaries seamlessly on geographically distributed and federated cloud infrastructures.</li> </ul>
	• MORPHEMIC enables the selection (optimisation) of the best combination of offers from different cloud providers, depending on the client's requirements for the application.
	<ul> <li>The cloud-centric approach of MORPHEMIC is unlimited regarding specific business models (use cases) and, as such, is easily adapted.</li> </ul>
	<ul> <li>MORPHEMIC enables flexible and resilient monitoring, which is appropriate for applications deployed across cloud continuum resources.</li> </ul>
	<ul> <li>Businesses using multi-cloud environments are increasing.</li> </ul>
	<ul> <li>Vendor lock-in can open new opportunities for innovative big-data service providers.</li> </ul>
	The unlimited extension of the MORPHEMIC solution through other projects funded publicly or privately.
	Constantly increasing capabilities of hardware resources (i.e., accelerators and edge devices).





# OCRE

Identification	
Organisation	GÉANT
Country and location	The Netherlands, Amsterdam
Sector	R&E
Company size	200
Name of interviewee	Dave Heyns
Title	Cloud Services Manager

Cloud-related project	
Project name	Open Clouds for Research Environments (OCRE) project
Project website	https://www.ocre-project.eu/
Description of the project	The Open Clouds for Research Environments (OCRE) project aims to accelerate cloud adoption in the European research community by bringing together cloud providers, Earth Observation (EO) organisations, and the research and education communities through ready-to-use service agreements and €9.5 million in adoption funding.
Timing of the project	<ul> <li>Started in January 2019</li> <li>Delivered commercial cloud services framework in late 2020 (https://www.ocre-project.eu/services/cloud-suppliers)</li> <li>Initial open funding calls for cloud and EO services complete</li> <li>Procurement of cloud services on behalf of awarded research projects, beginning in May 2021</li> <li>The registration of the Dynamic Procurement System (DPS) for EO services expected in June 2021</li> <li>Further open calls to be published in Q3 2021</li> </ul>
Key stakeholders	<ol> <li>European Commission – project funding</li> <li>EOSC – services to be catalogued and consumed via the EOSC Future project (OCRE to deliver a portfolio of case studies/best practices)</li> <li>European suppliers of commercial cloud and digital services (including resellers of hyperscale services) – suppliers compete for service delivery to the research</li> </ol>





Cloud-related project	
	community; compliant procurement process managed by OCRE; services tested against CERN's test suite and onboarded onto eduGAIN interfederation
	<ol> <li>EO marketplace – DPS registration and services provision based on compliant competition</li> </ol>
	5. European research community – adopt and consume commercial services (including commodity cloud and platform in support of ML and AI) to improve agility and outcomes with regards research activities
	6. GÉANT and NRENs – provide community support for service consumption
Funding	OCRE is a Horizon 2020 project.
Technical solution	OCRE uses Negometrix as its procurement platform.
	Each of the commercial providers of cloud services will peer with the GÉANT network and register on GÉANT's eduGAIN inter- federation.
	Each of the suppliers will provide credits in support of standard research workload testing.
	The represented platforms include Orange, CloudSigma, Cloud Ferro, AWS, Azure, Google, Oracle, and IBM, to name a few.
Relation to H-CLOUD key areas	<ul><li>Cloud services (IaaS, PaaS, SaaS)</li><li>Federation services</li></ul>
Business model	OCRE delivered 473 cloud framework contracts across 40 countries in Europe based on 1,100 competing bids awarded based on security, privacy, support, and price discounts.
	The OCRE project will distribute €9.5 million as adoption funding through a series of funding calls focused on the broader research community in Europe.
Output	Commercial cloud marketplace for researchers
	Earth Observations Marketplace (start-ups and SMEs)
	OCRE will distribute cloud/EO adoption funding to the research community.
	OCRE will deliver a portfolio of compelling case studies and best practices to be used by the EOSC Future project and other EOSC initiatives.
	OCRE will explore synergies with other cloud initiatives, such as GAIA-X.





Impacts	
Business success	The OCRE framework attracted an unprecedented 1,100 bids from the market and signed 473 contracts across 40 countries in Europe. The project has high visibility and has resulted in extensive outreach from the market to the research community in Europe. Activities include webinars, training, and other forms of enablement. The first open calls for funding for cloud and EO services attracted 70 compelling proposals from significant research projects across the region, indicating significant demand for commercial digital services within the community.
Technology innovation	Each of the commercial platforms on the OCRE framework offers a range of platform services that are complementary to the base infrastructure (IaaS) offering through a marketplace. These services include platforms in support of blockchain, ML, AI, the abstraction of data from connected devices (IoT), and more. We have seen explicit requirements from the research community for a number of these in response to the open calls for funding. The suppliers have all agreed to driving innovation through their outreach and the demonstration of commercial services. A good example of this would be a semantic mining tool developed by a supplier to interrogate research data workloads and assist the researcher in the auto-generation of standardised metadata in support of FAIR data principles. The OCRE consortium partners (GÉANT, CERN, Trust-IT, and RHEA) all have outreach mechanisms that promote rapid, agile innovation and improved outcomes. I personally participate in various forums and evangelise the consumption of commercial services in support of agility and innovation.
Governance / Organisational structure	GÉANT and NRENs provide extensive support to the European research community and cloud marketplace through the OCRE and the GN4-3 (WP4) projects. This support is aimed at driving collaboration between the R&E community and suppliers by means of webinars, tools training, conferences, etc. Trust-IT assists in driving collaboration across the EOSC landscape based on its role in OCRE communication.
Data governance	<ul><li>All suppliers are registered operators within Europe and are therefore GDPR compliant.</li><li>All suppliers have local European data centres and allow the R&amp;E community choice in terms of where their data is stored.</li><li>All suppliers support dual encryption with the second key known only to the consumer.</li><li>Most suppliers offer cold storage in support of cost-efficient FAIR data storage.</li></ul>





Impacts	
	All suppliers have their own security operations centres (SOCs) and have unparalleled capacity in terms of threat surveillance, identification, and resolution.
	All platforms will peer with the GÉANT network and waive most data ingress and egress charges.
Environment and sustainability performance	All suppliers were scored based on their power usage effectiveness (PUE) and claim carbon neutrality.
Focus on SME	OCRE's outreach into the immature EO marketplace focuses specifically on the commercialisation of services supplied by the SME community.
	Large cloud platforms provide extensive support for start-ups, SMEs, and enterprise ISVs.

Obstacles/Barriers	
Technical barriers	Based on the maturity of commercial cloud services, there have been no technical challenges thus far. This is supported by early platform testing using CERN's test-suite. GÉANT's eduGAIN federation services required some development in support of a centralised registration model.
Legal barriers	OCRE cannot distribute adoption funding easily and must procure services on behalf of the institutes. This is based on the structure of the grant agreement, which does not allow an 'Article 15 – distribution to a third party' to be invoked. This procurement route is considered voucher funding within Europe and has consequences regarding in-country VAT resolution. The GÉANT association has applied to the Dutch tax authority for a ruling that will prevent incurring double VAT. GÉANT and the NRENs have legal advisors that focus on
	compliant procurement regulations, GDPR, and the Schrems 2 ruling to ensure that the research community can consume services within local legal boundaries.
Economic barriers	The OCRE project believes that the consumption of commercial digital services should provide for agility, flexibility, and cost reduction in terms of research activities. The OCRE tender ensured that suppliers of these services needed to compete to provide the most cost-efficient offering to the European research community.





# PLEDGER

Identification	
Organisation	Atos Spain SA
Country and location	Spain (Santander)
Sector	IT
Company size	Big company (+100K employees)
Name of interviewee	Lara López
Title	Senior Business Consultant

Cloud-related project	
Project name	PLEDGER
Project website	http://www.pledger-project.eu/
Description of the project	PLEDGER represents a new architectural paradigm and a toolset that will pave the way for next-generation edge computing infrastructures.
Timing of the project	December 2019. The project is now releasing the first version of its core components. A more intensive dissemination phase is starting in order to reinforce the creation of community of interest around the project's results. External stakeholders will be contacted and use case-related webinars are planned to show how PLEDGER works and the benefits it can bring to different vertical partners.
Key stakeholders	The PLEDGER consortium consists of industrial and academic partners. Industrial partners play a twofold role developing technology, but also providing the underlying infrastructure, while academic partners act as technology developers. Three industrial partners and one public administration provide the three project use cases, mainly on VR/XR, mobility, and manufacturing design. All partners are also charged with actively promoting the project's results.
Funding	PLEGER is an EU-funded project in the H2020 programme. The funding is used to develop cutting-edge technologies, promote results, and contribute to standards.
Technical solution	One of the main drawbacks and hindering factors in the process envisioned by PLEDGER is the lack of cross-layer knowledge (and an inability to exchange it) enforced upon the roles involved:





Cloud-related project	
	<ul> <li>IaaS providers, which require improved awareness of the types of applications executed by their customers</li> </ul>
	<ul> <li>Adopters/Consumers (e.g. SaaS providers) of infrastructure services, which require improved awareness of the types of physical nodes on which their applications will be executed</li> </ul>
	PLEDGER has introduced the necessary improvements across this value chain by following a black-box approach in all the involved layers in order to adapt to the specifics of the ecosystems in question and the corresponding lack of knowledge. Thus, the proposed approach does not assume any kind of adopter-provider interaction, but all the necessary information is extracted via non-intrusive methods, abiding to the role separation imposed by the cloud business model.
Relation to H-CLOUD key areas	Cloud and edge, as the project combines the benefits of low latencies on the edge and the robustness of cloud infrastructures.
Business model	Mapping is ongoing with OS community projects to identify gaps and potential contributions/collaborations. Due to the current low TRL, at this stage, there is no planned collaboration with other businesses. However, initial discussions have continued between consortium members regarding offering different MVPs.
Output	PLEDGER provides a software platform for executing third-party services based on their specific needs (in the cloud and at the edge using blockchain and big data technologies). It also offers trust mechanisms for IaaS selection.
	Furthermore, a TOSCA implementation is ongoing to standardise orchestration and deployment, and potential contributions to the standard have been identified and are under development.

Impacts	
Business success	Success is a long-term run. It's not only about making one big sale, but plenty of them. For this reason, PLEDGER is focused on providing high-quality tools and services that can attract customers for more than one sale. The aim is to increase their satisfaction and become a reliable provider.
Technology innovation	One of the PLEDGER use cases is a VR/XR application, which helps to make the final offering more attractive, although it is not directly related to the PLEDGER platform.
	The PLEDGER platform includes blockchain technologies for securing microtransactions and developing smart contracts at the user level. It also provides mechanisms for operating at the edge, including the deployment and execution of applications. Finally, security mechanisms are implemented to beat a cloud-adoption





Impacts	
	pain point – data privacy and security when executing applications in the cloud.
Governance / Organisational structure	Apart from the common collaboration in any research project, the project has created a User Group. This is an initiative that external stakeholders can join by signing a MoU. In this way, external stakeholders can make limited use of PLEDGER resources, including software, infrastructure, and documentation, with the compromise of not sharing any confidential information or providing feedback about the proposed solution. PLEDGER partners provide support and guidelines and make any information or resource needed available. There is an ongoing discussion with two external entities so that they can test project results and develop their own use cases based on them.
Data governance	The PLEDGER solution is mainly focused on smart manufacturing and smart cities, although it can be extended to any other domain. In these two domains, privacy and security are the most important aspects to deal with. Although PLEDGER is not dealing with personal data, it is important to ensure they are compliant with at least GDPR. Ensuring data protection when moving data analysis to the cloud is also important.
Environment and sustainability performance	PLEDGER does not directly address energy efficiency considerations. However, a proper service placement on the edge or in the cloud can also improve energy consumption at software level. Energy efficiency at the software level is the next step to be performed when everything has been done at the infrastructure level. The use of renewable sources or implemented energy efficiency measures can also be included as a part of the infrastructure provider profile and can be included in trustworthiness mechanisms so the final user can also make a decision based on green considerations.
Focus on SME	One of the project use cases is provided by a SME. In this way, PLEDGER can measure how costly is to use the proposed solution and to adapt the existent software to it. On the other hand, PLEDGER plans to provide its results licensed under opensource schemes, which will make them cheaper, thus making them more affordable to SMEs, which generally have less economic power.



Obstacles/Barriers	
Technical barriers	Services continue to evolve, so solutions must be adapted to support not only services but also microservices and even FaaS. Now the first release, with basic functionalities, is finished, new developments are ongoing to cover this new type of service.
Legal barriers	We have not found any legal issues.
Economic barriers	Just after the start of the project, the pandemic hit, and it affected business at all levels (slower recruitment processes, impossibility to travel, etc.). This is something all organisations are dealing with. PLEDGER, however, was not directly affected by the pandemic, as all organisations remained fully committed to the project.





## **RADON\***

Identification	
Name of interviewee	Giuliano Casale
Title	Academic in the Department of Computing
Organisation	Imperial College London, coordinator of the Radon project
Country and location	UK
Sector	Academia

Initiative	
Description of the initiative	The focus is providing development tools to improve the adoption of function-as-a-service (FaaS) microservices in the cloud. FaaS is seen as improving performance and efficiency (e.g. better utilisation of compute resources), but implementing applications with FaaS is at best an art at this point. Stakeholders include engineering and software development companies, as well as companies with use cases. For example, one use case is converting hardware controllers to software. An engineering firm needs a robust development environment to create quality software alternatives to well-tested hardware solutions.
Timing of the initiative	RADON is an EU funded project. It is now halfway through its implementation.
Key stakeholders	<ul> <li>Focusing on service computing: FaaS, microservices (one of the first focuses of the project), and applicability</li> <li>Use case providers: <ul> <li>Ingegneria Informatica (IT)</li> <li>ATC (GR) (medium sized)</li> <li>Praqma (bought by Fcode, not previously involved in R&amp;D) – software engineers, developers, CD/CI → SME involvement</li> </ul> </li> </ul>
Funding	100% EC grant
Relation to H-CLOUD key areas	Function as a service Clouds, (FaaS), federation (potentially), edge Also enables the adoption of FaaS, which improves utilisation – therefore, green





Initiative	
Business model	The success of the project will depend on the successful adoption of tools to develop real-world software solutions using FaaS, but also identifying practical issues for adoption and next steps for the improvement of the development environment.

Impacts (how to identify a best practice)	
Technology innovation	The project includes IoT/edge to some extent, as well as exposing and mitigating security issues in FaaS-based architectures. It should accelerate the adoption of FaaS, which should make software development more effective.
Governance / Organisational structure	Traditional EC-funded project structure, research partners, development partners, SMEs, and end-user partners
Data governance	The project is not focused on innovative data management technologies and uses
Environment and sustainability performance	The project addresses green computing/energy efficiency and highly virtualised data centres.
Focus on SME	n/a

Obstacles/Barriers	
Technical barriers	Too soon to define (project ongoing)
Legal barriers	Too soon to define (project ongoing)
Economic barriers	Too soon to define (project ongoing)



### **RestAssured\***

Identification	
Name of interviewee	Eliot Salant
Title	Researcher
Organisation	IBM Research Israel, coordinator of RestAssured project
Country and location	Different EU countries
Sector	n/a

Initiative	
Description of the initiative	Providing E2E security solution for data in the cloud
Timing of the initiative	Finished in December 2019
Key stakeholders	End-user companies, 2 use cases (SME: Dactenx, University of Southampton, Oxford Computer Consultants, Thales)
Funding	EC funded project
Technical solution	The objective was to demonstrate the overall solution – exploitation by use-case partners. There was not a good solution for protecting data at rest. A focus on Apache Parquet files with SPARC, which are not protected at rest. Created a solution for encryption of Parquet files – encrypted columnar data, different keys by column. Dr. Ygon Goshinsky (IBM) is the principal researcher on this. Apache Parquet is now adopting this encryption approach as a community standard. Also requires secure enclave, used for data processing – Intel SDX (also AMD), plus secure communication using Transport Layer Security. Allows E2E security in this particular case. Created a toolkit for the attestation of software for compatibility with SDX. University of Southampton: modelled configurations and performed static risk analysis – allowed users to refactor the application to be more secure based on risks. Mike Surridge from U Southampton (IT innovations?
	spinoff/consulting) has a black box that implements this risk assessment – still a research capability.
	University of Duisburg-Essen: want to automatically reconfigure architecture to mitigate risk (found by University of Southampton tool) – perhaps not as feasible as originally thought.
	FOG Protect – next project – addressing added concerns about data leakage from microservices. Based on K8s-based IBM data





Initiative	
	mesh. The data mesh is based on Istio: The focus is to better control envoy sidecars (the part of Istio architecture that manages communication flows). Protecting against attacks injected into workflows.
	<b>E. Salant:</b> My personal view is that this will have limited capability at the edge; it requires stronger security, such as Transport Layer Security (the updated version of SSL, or Secure Sockets Layer).
Relation to H-CLOUD key areas	Cloud
Business model	As project coordinator: aiming for a PoC that gets people thinking about what is possible. Create the REST Assured framework, which is a collection of open-source code. There are some proprietary products, but design documents are openly available. A focus on building technical knowledge.

Impacts	
Business Impact	<b>Oxford Computer Centre:</b> They use risk analysis tools in their consulting business.
Technology innovation	The Parquet encryption community standard was a good outcome: It allows encrypted files in the cloud. Parquet encryption is widely employed. Follow-on FogProtect project: IBM is working to improve the performance of the data mesh. Another follow-on ProTego project (in healthcare) – working with HL7 'FHIR' data standard objects encrypted in Parquet and featuring Azure Active Directory (AAD) protection and tamper protection. The project started 1.5 years ago.
Governance / Organisational structure	No federated governance model.
Data governance	The project scope on data security means that data governance was a critical priority. Data management needs to be dealt with at two levels: at the infrastructure level it is necessary to develop good solutions for data at rest/in motion/in processing. The second aspect concerns the management of data privacy, which requires to identify potential/actual leakage points and deal with them and have clear policies. The challenge is the policy enforcement point (PEP): Data queries must be evaluated against policy. It is an open research issue to decide whether a query is acceptable.
Environment and sustainability performance	While security was achieved, there are concerns about the performance overhead of Parquet encryption so that energy efficiency was not maximised.





Impacts	
Focus on SME	No specific focus on SMEs
Obstacles/Barriers	
Technical barriers	There wasn't a good solution for protecting data at rest, but the project created a solution for a limited case.





### SUNFISH\*

Identification	
Name of interviewees	Francesco Paolo Schiavo; Vladimiro Sassone
Organisation	Italian Ministry of Economy; University of Southampton
Country and location	Italy; UK
Sector	Public authority; academia

Initiative	
Description of the initiative	SUNFISH prototyped and demonstrated the secure interoperation of separate cloud systems using a "federation-as- a-service" approach. This approach extends beyond the adoption of interoperability standards, since those standards are still a work in progress. The approach also avoids creating a separate entity to manage the federation; instead, robust peer- to-peer protocols are set up, enabling a federation to be created, operated, and eventually dismantled.
Timing of the initiative	Started in January 2015 and completed in December 2017
Key stakeholders	Public administrations
Funding	An H2020-funded project
Technical solution	Sunfish architecture is built on a variety of tools/functions that address security and privacy in particular and SLA compliance in general. These capabilities are fundamental to the Sunfish architecture ("privacy by design"), rather than being "bolted on", as is sometimes seen in other efforts.
Relation to H-CLOUD key areas	Cloud federation, edge
Business model	Sunfish is contemplating the future use of blockchain and distributed ledger technology (DLT) as a way of ensuring the verifiability of communication among federation partners, to manage compliance with contractual terms (smart contracts), and to register the status of resources across the federation. DLT would also pave the way for cultural and organizational changes, allowing hierarchically "equal" departments to collaborate on projects without problems of rivalry or territoriality. Unfortunately, the computational burden and latency of "proof of work" DLT prevented adoption at the time of the project, but emerging "proof of stake" schemes should enable this ability in planned future implementations.

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Impacts	
Business impact	Sunfish started a new path to private cloud and has strengthened activities with the Ministry of Defence. This is a great opportunity to improve knowledge in the cloud space.
	Blockchain is also seen as a success story, especially for public administration, starting with the Ministry of Defence and agencies for social security and pensions. Indeed, Sunfish realized a common blockchain for the whole public administration. Other ministries are now willing to cooperate with Sunfish.
	Sunfish also thinks that change management in the ministry is very successful; employees are thinking and working differently.
	Sunfish tried to solve public administration problems – data security, data control, and democratic governance – through a decentralised platform.
Technology innovation	Sunfish is realising a completely new cloud-based system that uses distributed computing across various administrations. Under this system, each cloud is interoperable with the other clouds from the other public administrations.
Governance / Organisational structure	A standard agreement was then drawn up on federation participation. Smart contracts typical for democratic governance were used to define federation entry and exit, the computational parts to be federated, and the environments to remain segregated. The platform itself was used to manage requirements.
	Sunfish focused on several public-administration use cases:
	• Federation of application (payroll calculation) - Italy: The Ministry of the Economy and Finance (MEF) handles payroll processing for over 2 million public sector employees. Payroll taxes are calculated based on the employee's home address. MEF requires access to the home addresses of police staff employed by the Ministry of the Interior (MIN), but these addresses are personal information, and Italian law prevents their disclosure outside of the Ministry of the Interior because of possible threats against police. Sunfish's secure federated cloud services enabled the correct calculation of payroll taxes without exposing sensitive home-address information (even to another ministry of the Italian government).
	• Federation of data (taxation) - Malta: Maltese businesses submit payroll, financial statements, and accounting records to Malta's Taxation Department to calculate tax payments and refunds. Large organizations have internal IT resources to manage the electronic submission of this data. But, for small organizations, this is an onerous requirement. Sunfish's secure federated cloud services make it easy for some small organizations to link their SaaS financial accounting services to the Taxation Department.

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Impacts	
Data governance	The project developed solutions enabling secure data sharing between stakeholders. For example in the following use case:
	<b>Data secrecy (police investigation) - UK:</b> The UK's efforts against cybercrime are organized into nine regional cybercrime units, each of which is required to independently manage and store the data and evidence collected in its investigations, while also enabling authorized access to this data from other units as investigations proceed. Transferring data outside of each unit was not possible, nor was the merging of all units' data into a separate entity to enable search, analysis, or processing. Sunfish's secure federated cloud services enabled cybercrime units to search other units' data without actually exposing or transferring that data to the other units.
Environment and sustainability performance	This project is not focused on Green IT.
Focus on SME	This project is not focused on SMEs

Obstacles/Barriers	
Technical barriers	The project had performance problems, but the research project was able to help with this, with cloud federation under consideration as part of the solution. Blockchain could also help to solve specific problems.
Legal barriers	Sunfish believes one federation is not sufficient, as a European- wide federation of clouds is needed, as are a high level of agility and an ability to carve out areas of this federation for specific groups of interests.
	In the UK, the Police has 32 different independent forces, regulated by very tight laws. For example, it might be illegal for one police force to ask a specific question of another.
	Brexit is likely to create new legal barriers.
Economic barriers	Sunfish expected far more interest from the Italian government and public administrations in solving a real problem – too many small, inefficient, and insecure data centres.


## **1.4 Public-Private Partnerships**

Table List of Public-Private Partnerships

Name	Туре
Errore. L'autoriferimento non è valido per un segnalibro.	PPP
Helix Nebula	PPP
IDS	PPP





## GAIA-X\*

Identification	
Name of interviewee	IDC interviewed executives of the GAIA-X program management office at the German Federal Ministry of the Economy and Energy (BMWi), as well as executives at participant companies in the launch of GAIA-X.
Country and location	Started in Germany, but extended to other European countries
Sector	Cross industry

Initiative	
Description of th initiative	<ul> <li>At its digital summit on October 29, 2019, the German Ministry for Education and Research – together with the Ministry of Economics – unveiled its vision for connected cloud-based data infrastructure for Europe. GAIA-X has two main goals:</li> <li>To win back sovereignty for European citizen and</li> </ul>
	company data by ensuring that data does not leave European soil unintentionally
	<ul> <li>To reduce dependency and the risk of lock-in by enabling service and data portability</li> </ul>
	By delivering on those two strategic goals, GAIA-X expects to encourage cloud-sceptic European organisations (particularly SMEs) to take advantage of cloud while maintaining control over their data and to foster the creation of an open digital innovation ecosystem in which data can be collected and shared securely, while adhering to European privacy regulations. It is not intended to compete with global hyperscalers; it will be a layer on top of their services.
Timing of the initiative	2019 – ongoing
Key stakeholders	The GAIA-X program is led by the German Federal Ministry for Economic Affairs and Energy (BMWi), which initiated it with German industry giants like SAP, T-Systems, Siemens, and Bosch. GAIA-X has proactively involved governments and industry
	players from other European countries, starting with France and, more recently, adding Italy, the Netherlands, Finland, Austria, and Spain. The French government and BMWi have already issued formal joint communication about collaborating on the GAIA-X roadmap.
	Participation has quickly grown – from 20 companies in October 2019 to over 150 in the first few months of 2020.
	The 22 founding members are: 3DS OUTSCALE, Amadeus, Atos engineering, Beckhoff Automation, BMW, Bosch, CISPE, DE-





Initiative		
	CIX, Deutsche Telekom, Docaposte, EDF, Fraunhofer Gesellschaft, German Edge Cloud, IMT, International Data Spaces Association, Orange, OVH, PlusServer, Safran, SAP, Scaleway, and Siemens.	
Funding	Sponsors: government and members	
Technical solution	GAIA-X plans to transform decentralised infrastructure services, such cloud and edge, into a homogeneous, user-friendly system. It is planned as a peer-to-peer network in which GAIA-X certified organisations – known as 'nodes' – can rent server capacity to each other. It is also intended to offer machine learning and artificial intelligence as a service to organisations – especially to SMEs through standardised APIs. The GAIA-X framework will operate at the SaaS and PaaS layers, and, depending on use cases, at the laaS layers, where the market does not already offer a solution.	
	the digital sovereignty of cloud service users, as well as the scalability and competitive positioning of Europe-based cloud service providers.	
	GAIA-X federation services are grouped into four domains:	
	<ul> <li>Identity and Trust: Includes federated identity management, access management. and trust</li> </ul>	
	• Federated Catalogue: Contains concepts and results concerning core architecture elements and their relationships with each other, such as self-description, service governance, and monitoring and metering to ensure interoperability	
	<ul> <li>Sovereign Data Exchange: Ensured by usage control mechanisms and an overarching security concept</li> </ul>	
	• Compliance: Includes a definition of the relationship between service providers and consumers, the rights and obligations of participants, and onboarding and certification processes to implement security and data protection requirements	

Impacts	
Technology innovation	Technical implementation of GAIA-X Federation Services will focus on the following areas:
	• The implementation of secure federated identity and trust mechanisms (security and privacy by design)
	<ul> <li>Sovereign data services, which ensure the identity of source and the receiver of data and which ensure access to and usage rights for the data</li> </ul>





Impacts	
	• Easy access to the available providers, nodes, and services, with data provided through federated catalogues
	• The integration of existing standards to ensure interoperability and portability across infrastructure, applications, and data
	The establishment of a compliance framework and certification and accreditation services
	• The contribution of a modular compilation of open source software and standards to support providers in delivering a secure, federated, and interoperable infrastructure
Governance /	Governance has two tiers:
Organisational structure	• <b>Tier 1:</b> During the first year after launch, the central program management office was led by BMWi, which coordinated the work of founding members. This central project management office made the final decisions about long-term strategy, operating model, business model, and rules for other entities participating in the program and be certified as GAIA-X nodes. On September 15, 2020, the 22 founding members co-signed the incorporation papers for GAIA-X AISBL, a non-profit association that will be responsible for securing funding and commitment from members to fulfil the initiative's vision.
	<ul> <li>Tier 2: There are several workstreams – technical architecture, use cases, operating model, data sovereignty policy, and regulation – in which a larger number of institutions are participating, such as German regional government data centres, European vendors like OVH, and global cloud providers such as IBM.</li> </ul>
	The GAIA-X project is divided into different workstreams for specific topics:
	<ol> <li>User ecosystems and requirements</li> <li>Technical implementation</li> </ol>
	There is also a cross-functional unit known as the 'joint requirements' expert tribe. This unit consists of two groups, which convene on a flexible basis and that deal with topics where there is a strong interdependency between the workstreams. The project structure is agile, can be adapted over time in line with framework conditions, and guarantees collaboration across separate topics.

Obstacles/Barriers		
Economic, technical, and legal barriers	<ul> <li>If GAIA-X is to succeed, the German government and other stakeholders in the initiative must answer tough questions in detail.</li> </ul>	

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<b>Obstacles/Barriers</b>	
	It must start with a clear vision. What is the real purpose of GAIA-X? If the main issue is data sovereignty, then GAIA-X should focus on strengthening existing data governance and identity management regulations that can be laid on top of existing cloud services (from hyperscalers or others). If the aim is to reduce lock-in or dependency, then data exchange and interoperability services should be the primary focus. If the goal is to foster the adoption of cloud services among European SMEs, then its instruments need to be policy related. This should include increasing IT literacy or offering tax credits to incentivise the creation of the aggregators and orchestrators of cloud services to make them more accessible and affordable for SMEs. If the goal is to foster an innovation ecosystem, then GAIA-X will need to act as a data exchange broker. It will need to coordinate with programs that fund R&D and accelerate the commercialisation of cloud services through technology transfer and demand pooling across countries, industries, and other policy instruments.
	The vision must align with a service strategy. The document published by the German government describes various services, including a repository of software components, identification services, node exchange services, certification, and standards. These are well-aligned with the vision of data sovereignty and reducing data dependency. However, providing these services across industries will take a gargantuan effort, particularly with the proliferation of data sources, including the Internet of Things (IoT) and edge devices. A data exchange for all industries would require too much mapping of different IT and OT data formats. To reduce the effort, an option would be to build industry-specific data exchanges. To be sustainable, it would need to attract one or two other large European countries to pool enough market demand.
	The service portfolio must be supported by state-of-the- art architectural capabilities and delivery models. One of the advantages of hyperscalers is their continuous cycle of innovation, which offers customers a wide range of choices in terms of capabilities for different workloads. The published plan states, 'The project creates added value by placing itself above existing hyperscaler/cloud providers as a type of multilateral administrative layer; this connects the production infrastructure and clouds with higher-level semantics and data exchange services, thus simplifying interface management.' It does not aim to compete with existing service providers, but it does not explain how the 'multilateral administrative layer' will be developed or delivered or by whom. Will the GAIA-X 'central organisation at the European level' have its own developers? Will it develop capabilities externally, but



Obstacles/Barriers		
		then manage them? Will they contract out the delivery (operations, maintenance, helpdesk, etc.)?
	•	The capabilities will be delivered efficiently and effectively and will ensure continuous innovation only if the <b>operating and governance model</b> defines clear responsibilities. If GAIA-X is to be a federation of nodes, what will the role of the GAIA-X central organisation be, which the plan indicates could take the form of a European cooperative society? Where will the organisation be located? If more EU member states beyond Germany and France join to grow the critical mass of the initiative, will they want to have the power to appoint executive roles in exchange for having it located in Germany? Who will fund central organisations? Who will pay for services? Will cloud service providers be asked to pay to connect to it? Will enterprises that want to exchange data have to pay a fee to the central organisation or only to the ecosystem of app developers that will create services on top of GAIA-X? The list of organisations and experts that contributed to the current plan is German-centric, so these questions will arise up as new countries join.
	•	The final and perhaps most difficult question relates to the <b>reaction of hyperscalers</b> to such a move. The reaction so far has been muted from AWS and Microsoft, but it is clear that the move would be viewed as restrictive, perhaps acting as an anchor to growth in the sector by drawing dividing lines along geographic boundaries for those opting into Gaia-X and those that are not. Most large-scale cloud providers already have in-country infrastructures that are subject to national and international laws on data governance and sovereignty. Building a dedicated cloud infrastructure, regardless of its eventual shape, that is free from potential data sovereignty issues would require procurement that excludes vendors not subject to such inter-territorial legislation. If a vendor that was part of such an infrastructure was acquired by a U.S. company, would they then need to be excluded from the project? The procurement challenges of Gaia-X alone are not insignificant and need to be clearly thought through.

1.2



## Helix Nebula\*

Identification		
Name of interviewee	Robert Jones	
Title	Senior member of the scientific staff	
Organisation	CERN, partner Helix Nebula Science Cloud initiative	
Country and location	Multiple locations/countries	
Sector	Research	

Initiative	
Description of the initiative	The Helix Nebula Science Cloud (HNSC) initiative is a partnership between industry, space agencies, and science to establish a dynamic ecosystem, benefiting from open cloud services for the seamless integration of science into a business environment. Today, the partnership counts over 40 public and private partners. The interviewee works at the European Organisation for Nuclear Research (CERN), a partner of the initiative.
Timing of the initiative	<ul> <li>The work started in 2016 and was completed at the end of 2018.</li> <li>Next steps:</li> <li>Open Cloud for Research Environments (OCRE)<sup>13</sup>: The OCRE project provides the main near-term procurement opportunity for the public research and education sector to exploit the results of HNSciCloud in the context of the European Open Science Cloud (EOSC).</li> <li>Archiver project<sup>14</sup>: The experience gathered and lessons learned from Helix Nebula are being applied in the execution of the ARCHIVER project.</li> </ul>
Key stakeholders	Research organisations and academic institutions are the main stakeholders. Researchers, research groups, and research infrastructure players are also users, as are codevelopers of technology (including suppliers).
Funding	An EC funded project (70% from EC funding, for the procurement budget, and 30% from buyers) Precommercial procurement (PCP)

<sup>&</sup>lt;sup>13</sup> https://www.ocre-project.eu/ <sup>14</sup> https://www.archiver-project.eu/



Initiative	
Relation to H-CLOUD key areas	Cloud services integration (laaS plus some other services, e.g. identity management and data management)
Business model	Collaboration with other businesses was done through commercial proposals (potentially, from commercial consortia) to offer services to the 10 members of the buyers' group.
	Helix Nebula is not a federation. Services are integrated by the bidding consortia, as per their own agreements, and then offered to the buyers' group, as per defined terms of service. For instance, IBM was one consortium. Some consortia included universities and research communities (but not from the buyers' group). None of them was led by a research organisation. The consortium needs to have commercialisation capacity and the intent to offer resulting services to others.
	The precommercial procurements entailed a framework agreement among 10 procuring organisations. It followed fixed phases focused on the co-development of infrastructure as a service, plus a few other services, like data management.
	10 reasonable tenders were submitted to the initial request for tenders (RFT); 4 were selected for co-development/design; 3 were selected for prototyping; and then 2 finalists were selected to implement the pilots (2, not 1, to avoid lock-in).
	There was only one interaction between the buyers' group and the market before the HNSC RFT was released.
	Under PCP (due to being limited to R&D), 50% of the activities must be performed in Europe.
	The process ended up very fit for purpose. From the 2 finalists (T-Systems and the RHEA consortium), services are now being used in various contexts. (Commercial exploitation was an RFT requirement.)
	T-systems: Mundi Web Services is a part of DIAS, supporting access to Copernicus data.
	RHEA: SixSquared got additional business for their Nuvla cloud brokerage platform, but Nuvla has pivoted to edge.
	The Nuvla broker is being used by Exoscale (RHEA's underlying CSP).
	The Nuvla broker was better for smaller jobs – too complicated for CERN.
	Lessons learned: A financial broker like Booking.com is needed for cloud services:
	• To support 'put' options, etc. (reserving capacity for possible needs)
	<ul> <li>To deal with public money procurement hoops – an ability to change suppliers without month-long procurement delays</li> </ul>





<ul> <li>To provide better support for SWIPO and make it an integral part of the concept</li> <li>Archiver project opportunities exist for the other 8 bidders from the HNSC project – long-term data preservation services (4 procuring organisations).</li> <li>HNSC might be considered a small marketplace, since the resulting services are made available to others, but it is not nearly as broad as G-Cloud.</li> <li>Lessons learned from Helix Nebula Science Cloud: <ul> <li>More time is needed for market preparation.</li> <li>Lessons learned from Archiver so far: <ul> <li>A very country-centric market organisation</li> <li>VAT registration issues hitting OCRE</li> <li>Lead procurer (CERN) not subject to VAT</li> <li>Not a full DSM in the EU – VAT, associate member states (EU GDPR legislation).</li> </ul> </li> </ul></li></ul>	Initiative	
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Impacts	
Business success	PCP itself was successful: 2 conformant offers are up and running. More use cases than initially perceived. Pent-up demand in the research community to use cloud services.
	Project has identified a number of trends and issues and has gained advanced knowledge from the stakeholders.
	<ul> <li>Keeping up with trends: GPUs: more available to lease than to buy:</li> </ul>
	<ul> <li>But Obstacle: NVidia licensing issues – data centre license, gamer license, capacity licensing, time to access/flexibility to access</li> </ul>
	<ul> <li>9 months from purchase decision to commissioning/GA – vs. 1 month</li> </ul>
	<ul> <li>Evolution in buyer's understanding:</li> </ul>
	<ul> <li>Total-cost-of-ownership (TCO) studies – things have changed</li> </ul>
	<ul> <li>Now at CERN – concerted effort to develop more accurate costing for these resources</li> </ul>
	<ul> <li>Costing framework from ECAR in US – power and rent frequently missing</li> </ul>
	<ul> <li>Compared costs to rented data centre; Wigner in HU (comparison from 2 or 3 years ago); comparable prices for compute, but in-house</li> </ul>

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Impacts	
	cheaper for huge quick-access storage; mapped to workloads; simulations cheaper commercially
	<ul> <li>Networking – use GEANT; federated ID management</li> </ul>
Technology innovation	The initiative included machine learning as an added use case (continues today).
	• Perform ML training offsite. Train the model and deploy internally.
	<ul> <li>However, triggering systems (for LHC) have to be in house.</li> </ul>
	The inclusion of high-performance computing (HPC) should allow for process acceleration, but this is still a small proportion of CERN's needs.
	How do you drive innovation? Who is involved within the organisation and across the partner ecosystem? (Also related to governance)
	<ul> <li>Developed new approaches and now implementing in OCRE – working to procure large-scale commercial cloud capacity for research use, ~€10M.</li> </ul>
	<ul> <li>It may take until 2024 for this to really work due to other challenges and pressures – legislation (GDPR compatibility, ISO 27000 certification, etc.)</li> </ul>
	<ul> <li>Note: CERN is not subject to GDPR (intergovernmental organisation); EMBL; WHO; Archiver (consortium of buyers); GSuite. (CERN tools have undefined statuses with regard to GDPR.)</li> </ul>
	• GDPR is one of the selection criteria for HNSciCloud (certification); data had to be hosted in EU MS.
	<ul> <li>Learnings captured in EOSC innovation cycle – separating EOSC core from EOSC exchange. Core should be stable. Exchange marketplace – allows steady innovations.</li> </ul>
Environment and sustainability	Green computing/energy efficiency was not present in HNSciCloud, but it was in Archiver.
performance	<ul> <li>Archiver is considering using power usage effectiveness (PUE) in specifications, but this is still challenging.</li> </ul>
	<ul> <li>Wigner (HU) data centre RFT (8 years ago): attempted to specify renewable sources, but arguments about definitions thereof could not be included in the specifications.</li> </ul>
Focus on SME	The design of the PCP was intended to allow for the participation of SMEs. The follow-on Archiver and OCRE projects were intended to improve accessibility for SMEs as potential suppliers/consortium members.





Obstacles/Barriers	
Technical barriers	n/a
Legal barriers	None. We used an off-the-shelf agreement from CERN. Defined the framework agreement – describes the 4-3-2 PCP selection process (described above) and included the EC conditions <sup>15</sup> ; also incorporated learnings from the project SLA-Ready <sup>16</sup> .
	HNSC did not sign standard provider agreements with individual suppliers. Providers' standard contracts varied enormously. There is an international standard, but it was not used.
	GEANT doing OCRE using an international standard agreement.
	Signed a special acceptable-use-policy document (standard).
Economic barriers	The promoters of the initiative had to describe market potential to potential bidders (more time spent on this in the Archiver project). Needed to spend more time describing PCP procurement processes.
	HNSciCloud Deliverable D7.3 describes the challenge because there were many intermediaries between users and deciders.
	Also, budgetary aspects: Buyers had limited understanding of their existing unit costs to compare with supplier's offers. Typically considered capex, rather than converting to standard unit cost of usage.



<sup>&</sup>lt;sup>15</sup> Details on tendering process available at https://www.hnscicloud.eu/sites/default/files/Deliverable%202%202%20HNSciCloud\_Public%20Deli verable%2012\_12\_2016%20final%20V1.1.pdf

<sup>&</sup>lt;sup>16</sup> https://www.sla-ready.eu/



## IDS\*

Identification	
Organisation	Fraunhofer Institute
Sector	Public administration and research

Initiative	
Description of the initiative	In 2015, the Federal Ministry of Education and Research in Germany launched an initiative for International Data Spaces (IDS), which aims to drive European data sovereignty. IDS created a secure data space that enables organisations from different industries to monetise their data resources through the secure exchange and easy combination of data in value chains, creating the foundation of smart services, innovative solutions, and automated business processes. IDS is a critical part of GAIA-X and provides expertise and partners to the initiative. More than 100 organisations, which are mostly from Germany but include some from other countries, such as Spain and the Netherlands, are already collaborating in the International Data Space (for example, in industrial, materials research, pharmaceuticals, and healthcare). IDS use cases are developed collaboratively between end-users and technology companies, like Bayer, Thyssenkrupp, and T-Systems. The Fraunhofer Institute plays a key role in developing software components and ensuring that the connectors – data flow policies and application policies – that technology companies make available are interoperable with the standard messaging architecture. IDS provides data policy/governance and interoperability services for European users of cloud services. There are 100 members, mostly from Germany. There are currently eight hubs (Germany, Netherlands, Finland, Spain,).
Timing of the initiative	Started in 2015
Key stakeholders	Members belong to major industries and include software companies and research institutions. <sup>17</sup>
Funding	Funding comes from the German Federal Government's Ministry of Education and Research and IDS members.
Technical solution	IDS provides a reference architecture, a formal standard, and reference implementations, including sample code. IDS is a concept analogous to the internet based on peer-to-peer

<sup>&</sup>lt;sup>17</sup> More info here https://www.internationaldataspaces.org/the-association/



Initiative	
	communication, but not a platform. Internal/External: IDS addresses ecosystems and corporate networks. Certification: The certification concept confirms the conformity of components (connectors) and organisations with the IDS architecture by independent organisations (PwC, TÜV, and Fraunhofer). This ensures that the organisations have taken all necessary measures for an IDS-compliant operating environment and use components that have been implemented according to the reference architecture.
	IDS connectors standardise message hubs, policy applied to the data flow, and policy applied to the application. For higher security levels, it also goes into hardware trust anchors.
	IDS connector: The IDS connector acts as a gateway. It can be implemented in different ways, depending on the scenario: on micro-controllers, sensors, mobile devices, and servers in the cloud. Due to the container architecture, the IDS connector also allows trusted execution of apps – those that can sovereignly process data from different sources. These software services will not run in an ERP system behind the firewall, but on cloud platforms, i.e. 'in the centre' of ecosystems. The connector is therefore a suitable execution component for Amazon Web Services (AWS), Data Intelligence Hub (DIH), SAP HANA, etc., because it enables the platforms to offer a secure environment in which data sovereignty can be guaranteed. Domain-specific application profiles enable embedding in specialist domains with different requirements (see DIN SPEC 27070).
Relation to H-CLOUD key areas	Federated cloud and edge computing

Examples of use cases <sup>18</sup> :
arrival and departure slots – Policies: GPS coordinates are not sent to Thyssen.
<ul> <li>Predictive maintenance for facilities – Policies: Production information about those facilities is not exchanged with the maintenance company.</li> </ul>
There are two tiers of participants to IDS:
• You can be a user without being a member of the association
• Members of the association (most of the time) contribute to the standards and the software development

<sup>&</sup>lt;sup>18</sup> https://www.internationaldataspaces.org/success-stories/#\_usescases



Obstacles/Barriers	
Technical barriers	GAIA-X takes IDS and leverages the existing work to take a step further in terms of data sovereignty:
	<ul> <li>It aims to define a layer above the cloud system. The user looks at a catalogue of cloud providers; the layer provides the ability to apply policies, manage contracts with vendors, etc.</li> </ul>
	<ul> <li>GAIA-X nodes aim to include IaaS, PaaS, and potentially edge device, but, at the IoT layer, it gets very complicated</li> </ul>
	Differences between IDS and GAIA-X:
	<ul> <li>IDS – data sovereignty and data exchange</li> </ul>
	GAIA-X – services and more infrastructure related
Economic barriers	Currently, the use cases are bilateral data exchanges, not multilateral data exchanges. Scaling to a true multilateral ecosystem is difficult because of concerns over intellectual property and personal data protection and the lack of a clear business case.
	The Fraunhofer Institute only develops prototypes. In the IDS association, members like SAP, Siemens, and T-Systems will provide connectors with their software. But they will prioritise the use cases that are most relevant to cross-sell and upsell their proprietary solutions.