Dear Reader,

the Internet of Things (IoT) is no longer just a hot topic for European companies. In fact, the development of networked digital products and the optimization of manufacturing, logistics and value chains through the use of sensors and intelligent analysis mechanisms has long since achieved strategic significance.

After all, the development and marketing of company-wide IoT solutions or proprietary IoT platforms and business models are usually associated with enormous investments. At the same time, competition is intense because only a few IoT platforms can be successfully established within each industry. That’s why, when implementing their own IoT platforms and solutions, it’s vital to achieve fast “time to market”, and to select the right technology and Cloud providers.

These requirements often present CIOs, CTOs and CDOs with a real challenge, because the market for IoT technologies and services is characterized by extremely rapid innovation. And it’s not only the global Cloud providers such as Google, Amazon, Microsoft and IBM that are expanding their portfolios with specific IoT services. Even the established Telcos are increasingly becoming IoT providers, because they own the networks. Added to this is the shift of event processing and machine learning towards the “Edge”, resulting in much more complex IoT architectures and new security challenges. As a result, it is becoming clear that the demands on integration and development service providers, which support companies in the implementation of their IoT projects, are also increasing.

Crisp Research has completed this research project in order to assist corporate and digitization decision makers with their evaluation and selection of relevant IoT providers and service partners. The “Crisp Vendor Universe” profiles the relevant IoT vendors and service providers in the German market and evaluates their strengths and weaknesses.

Enjoy the report!

Dr. Carlo Velten
CEO, Crisp Research
AGENDA

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INTRODUCTION
The IoT market has developed rapidly in recent quarters and many companies have already launched prototypes and “test balloons”. But before multiple IoT applications can go into production, a platform discussion has to take place. Software architects and digital strategists know that many prototypes do not necessarily withstand the massive increase in connected devices and associated data traffic. Just how massive the Internet of Things is becoming is illustrated in Figure 1.

Of course, the prediction of IoT revenues is a crucial parameter, in addition to the number of devices. Crisp Research expects that as early as 2020, around 23% of world’s Public Cloud infrastructure and platform services capacity will be consumed by IoT solutions. This would equate to total Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) revenues of $19 billion worldwide in 2020. The IaaS services in the Cloud used by IoT solutions are the same as those being used by all other applications. While PaaS services are mostly based on the IaaS services of the provider or a Hyperscaler, they are mostly tailored to IoT scenarios. These IoT PaaS services correspond precisely to the “IoT Cloud Backend Services” category, which we will examine later. This enormous sum is being invested by providers of IoT solutions to bring their IoT products to the market. However, the $19 billion gives little indication of how much revenue IoT business models ultimately generate. As IaaS and eventually PaaS services become more and more commoditized, and therefore more comparable and cheaper, it is far more difficult to predict how much digital IoT revenue will actually be generated by end customers. Reaching 30 billion IoT devices in 2020 and even 75 billion in 2025 provides much more perspective on the size of the global IoT market.
The spectrum of IoT solutions is huge. Figure 1 illustrates how far we believe the scope will expand. Although many readers in Germany initially think of Industry 4.0 and the optimization of manufacturing processes in particular, IoT has become a generic term for all the business models made possible by Connected Devices, which is a much broader definition. In addition to the process and manufacturing industry and not least the strong automotive sector in Germany, IoT has significant potential within the digital strategies of almost every company in Europe. Moreover, the business models associated with a digital (IoT) products can be quite different. Crisp Research has defined the following four levels within IoT Business Model Evolution:

I. Digital appeal: A traditional product is not changed but is made more attractive by small digital / IoT services.

   Example: A simple fire extinguisher can appear in the asset management system of a smart building via its digital twin. Although it may differ only from a “non-digital” fire extinguisher thanks to a QR code, the scanner and software in the background make it more attractive.

II. Digital Enhancement: A traditional product is enhanced by IoT add-ons. Most of the time this is not a digital business model (OPEX), but merely an addition of value (CAPEX) to the physical product.

   Example: An IoT fire extinguisher with a smoke detector, CO sensor, pressure sensor and full integration into a building’s network. In case of fire, comprehensive software shows people where to locate intact fire extinguishers and warns them about CO- or smoke concentrations if necessary. Customers may pay more for this service over time than the fire extinguisher has cost.

III. Digital Product: The digital value added is already so great that a monthly price (OPEX) can be charged for the IoT product.

   Example: An IoT fire extinguisher with a smoke detector, CO sensor, pressure sensor and full integration into a building’s network. In case of fire, comprehensive software shows people where to locate intact fire extinguishers and warns them about CO- or smoke concentrations if necessary. Customers may pay more for this service over time than the fire extinguisher has cost.

IV. Digital Ecosystem: The digital product or digital platform is completely independent of the related physical products. Within the ecosystem, devices from partners or competitors can be connected in the same way as their own.

   Example: Smart Building Cloud with a monthly subscription. Devices from any manufacturer can be connected.

Depending on the industry and the state of digital strategy progress, companies can act at any of these different evolutionary levels. However, there are also some Industry 4.0 scenarios that are not about pursuing digital business models, but seek only to increase internal efficiency or improve collaboration with suppliers. The product remains completely unchanged for the consumer or business end user. IoT innovations really do cover a broad spectrum.

For example, the sustainability topic also plays a role in driving the IoT boom. In agriculture, crop yields can be increased by sensor data that enables optimal irrigation, or by measuring groundwater levels and flow rates to prevent certain wells from drying out. Smart city and smart building projects also promise significant energy savings, even after switching to LED lighting.

Examples of successful IoT implementations can also change companies’ core business models. A classic IoT world example is provided by predictive maintenance scenarios, i.e. the avoidance of system failures through prior analysis of data measurements and the application of appropriate maintenance. While customers were simply looking forward to longer maintenance cycles and fewer outages, manufacturers of industrial machinery are increasingly on the offensive. For example, if you know the precise operational status of a machine, you could rent out production machines or aircraft turbines rather than sell them. In the long term, this approach might even be more profitable for the manufacturer. These disruptive business ideas are generating tremendous creativity among manufacturers and high expectations among users.
To meet these expectations, Crisp Research would like to use this vendor Universe to recommend the right technologies. First let’s look at a typical IoT topology:

The next level is the so-called Non-Constrained Controller, which has fewer restrictions and more power. In practice, these can be small computers the size of a Raspberry Pi with a complete Linux distribution or small Industrial PCs running Windows 10 IoT. Their task is often to connect local field buses with the Cloud and act as a gateway. Especially in the industrial environment, small controllers are often skipped in favor of connecting sensors and actuators directly to Non-Constrained Controllers. Conversely, in smart home topologies for example, the Non-constrained Controller is often skipped e.g. a wireless light bulb can speak directly to the Cloud via WiFi. We refer to operations at both controller levels, Constrained and Non-Constrained, as Edge Computing.
Due to the significant demand for IoT, a large number of new and established players are active in the market. Indeed, this young market is experiencing a lot of dynamic, and competition is already tough. In addition to the newcomers who entered the market in 2017, the major Hyperscalers AWS, Microsoft and Google have also arrived. Although all they have initially applied their existing Cloud infrastructures to IoT scenarios, all three now offer IoT-specific services in the Cloud and software components for the Edge. The Cloud services from these native Cloud providers are usually far more mature than the Edge services. On the other hand, there are also manufacturers who have been making industrial automation or professional building networks for 20 years. Many members of this group now also offer IoT Cloud services. Some of these also build their offerings on the IaaS services of the Hyperscalers. Nevertheless, the Edge services here are usually more mature than the Cloud services.

Many software architects and buyers are already realizing that this “IoT stack” is commoditizing from top to bottom. IoT Cloud services are therefore much more comparable and cheaper than most Edge offerings that differ greatly in terms of their content. We expect the market to begin a period of consolidation from next year. The rest of 2018 and 2019 will therefore be a critical and highly competitive year for IoT providers. For customers, the competitive situation and the threat of consolidation make it all the more difficult to find a reliable yet agile and innovative IoT provider with an offering that is tailored precisely to their specific needs. For their part, suppliers need a strong strategic focus and a broad network of technology partners to be able to provide their customers with a holistic and well-engineered product portfolio.

Interoperability between different IoT Edge vendors and different IoT Backends will remain a challenge over the next 12 to 18 months. The idea that an Edge device simply gets data from a single sensor manufacturer and passes it on to its own Cloud Backend is an illusion. In reality, an ecosystem of field technologies come through an Edge technology to several applications. That is why we have also evaluated interoperability across different IoT technology stacks. In addition, the manufacturers that also have business middleware in their portfolio have a tactical advantage. In the end, value creation often takes place within business systems such as SAP, Salesforce.com or ServiceNow, which map the workflow behind a maintenance request or similar process. The semantics offer another challenge besides the technical integration. Which data fits together, and how? There are various initiatives here: In the Industry 4.0 environment, for example, the International Data Spaces (formerly Industrial Data Spaces) or the Open Integration Hub emerging in the business integration space. At the end of the day, IoT platforms as well as software development providers are measured by whether they master these technologies or not.

Ultimately, technologies are developing so quickly that hardly any company can build its applications without the help of external Development Service Providers. Of course, many traditional IT Service Providers and System Integrators are trying to do this. However, most do not manage to demonstrate competence across the entire IoT topology, because it’s quite a long way from firmware in a small controller, to high-end modern IoT Cloud on a Hyperscaler. Many users with whom Crisp Research has spoken, or whom we have supported in selecting their technology, end up combining the services of several providers to assemble all the skills required for their projects. In particular, the smaller and medium-sized service providers, some of which possess excellent skills, have difficulty in handling larger projects with 5 Scrum teams made up of 25 developers or so because of their size or capacity. Providers that combine local resources with nearshoring can often offer better availability at attractive prices.

With all the optimism about IoT, the risks and challenges must not be forgotten. In particular, the security and compliance topics are of crucial importance here. Companies need to ensure early on that their customers trust the deployed IoT devices and the associated data flows. Modern device management solutions that are part of the Edge Technology segment in this Vendor Universe can reduce uncertainty here.
The Crisp Research Vendor Universe provides a comparison to help companies find the right technology vendors and service providers for their IoT use cases. We looked at 120 suppliers, of which only 82 qualified for more detailed evaluation.

In this chapter, we define the market segments we evaluated, and explain the selection and exclusion criteria we applied to the providers. Of course, the entire IoT market is still in flux and there is a risk of comparing apples to oranges. In addition, as usual, Crisp Research focuses on the “emerging” market segments to provide decision guidance where users need it most. That’s why we exclude traditional software products from the IoT Vendor Universe from the start. For example, there is an established set of software packages for industrial automation, but if they are not available as a Cloud service, or cannot at least run on Non-Constrained Controllers and talk to Cloud Backends out-of-the-box, they are excluded here. We also do not consider business applications that derive their value purely from IoT data. Although there are many interesting applications in that area, we are only looking at platform services on which applications can be built, and the service providers’ skills in doing that.

On the way from the sensor to the Cloud, or from bottom to top in the IoT topology (Figure 2), we consider the lower and upper halves separately. This leads to a comparison of Edge Technology and the IoT Cloud services in two separate segments. Both are horizontal technologies or platform services with a product character. In addition, there are Development Service Providers who primarily develop customer-specific software based on the previous two segments. Unlike the first two market segments, this is a skill-driven people business. These three perspectives, together with a special look at the Telco market, form the following four market segments within this Crisp Research IoT Vendor Universe.

In order to ensure comparability between and differentiation of the providers in the market segments, we defined the following qualification criteria:

- **Go-to-Market in DACH.** Suppliers must actively approach the German-speaking market in Germany / Austria / Switzerland. This can be done either through a German office, local implementation partners or verifiable references in Germany.

- **Availability in DACH.** In the case of Cloud services, the service should not only be delivered from the EU today or in the near future, but should also be contractually anchored in the EU legal area. Development service providers should have at least some employees onsite in Germany.

- **References in DACH.** The providers should have at least two customer references in the German market. These may also be communicated privately to Crisp Research.
**IoT Cloud Backend**

The Cloud portion of an IoT architecture is quite well established across the market and was studied in detail within the last IoT Vendor Universe two years ago. Since then, a lot has happened. Thus, the established Cloud infrastructure providers especially the three Hyperscalers Amazon, Google and Microsoft - have upgraded their platform services significantly and made them IoT-specific. On the other hand, some providers with higher-quality IoT services use the basic infrastructure of the Hyperscalers, but compete with them higher up the value chain. Ultimately, there are services available in the Cloud today at all levels: IoT-IaaS, IoT-PaaS and IoT-SaaS. We evaluated SaaS applications, for example, in terms of their ability to enable users to perform analytics tasks and create dashboards without any programming knowledge (see Software AG Cumulocity or Microsoft IoT Central). In order to compare them fairly, we evaluated the IoT platform services visible to users, architects or developers - but not the underlying infrastructure. We also did not rate industry-specific SaaS applications because these do not help companies develop their own applications.

While it used to be possible to sell many generic Cloud services, such as a messaging or storage services, as IoT services, just because they were addressable by devices, today’s entry barrier is much higher. In particular, IoT services must provide protocols and features that are critical to the IoT environment. But having just one MQTT service is no longer a differentiator.

An IoT Cloud service should offer MQTT over TLS, as well as the appropriate handling of device identities and certificates. Even positioning a traditional database as an IoT service is no longer enough. Here Time Series Databases for sensor data must be present if they are to be positioned as being IoT Cloud. In order to be able to address developers directly, in addition to traditional enterprise marketing approaches, self-service registration and a free entry-level are absolutely necessary. Here are the inclusion criteria in the Vendor Universe rating for IoT Cloud Backend as a Service:

- **IoT-specific functionality**
- IoT-IaaS, IoT-PaaS or IoT-SaaS Cloud services must be available via an OPEX business model (pure software stacks are not taken into account in the evaluation)
- Availability in the EU regarding the location of the data and the legal jurisdiction of the contract

**IoT Edge Technologies**

In the Edge Technologies market, we see manufacturers making it easier for their customers to use Edge Computing by taking care of Edge hardware and software. Specifically, two groups of providers are in play here:

- **IoT Cloud Providers with software components for Edge devices and a list of certified devices.**
- **Edge Device Vendors with their own or a certified software stack that works with an IoT Cloud.**

According to this definition of the market segment, for example, manufacturers who offer device management in the Cloud but do not guarantee their customers the function for a single actual device are not represented. On the other hand, the large number of (mostly Chinese) hardware manufacturers who build great hardware in every size, but leave their customers completely alone with their software stack have also not been evaluated.

The Edge Technology market is not just about manufacturers competing directly with each other. On the contrary, some manufacturers cooperate with each other or can be combined by users to get all the Edge functionalities they require. For example, device management solutions can be combined with focused connectivity management solutions to fully support wireless IoT devices. The partnership between Software AGs Cumulocity and Cisco's Jasper is one such example.

Until recently, Edge computing was mainly concerned with smart gateway features. However, the translation and transfer of sensor data from local field buses into the Cloud has now become a basic function of an Edge device. Today, Edge computing approaches differentiate in how intelligently data can be directly preprocessed locally and, if necessary, how local tasks can be performed autonomously. Many Cloud providers are trying to bring down their machine learning or event processing frameworks from the Cloud to Edge devices. Amazon's AWS Greengrass is an example of this, as the code of
A combination of (certified) devices and software (on the gateway device, controller, industrial Edge PC).

Connectivity with the IoT backend. The Edge must deliver a preconfigured connection to at least one Cloud Backend.

Local execution of Edge logic. This can be analytics, machine learning or event processing. Local control and regulation tasks are also included here.

IoT Development Services

In the IoT Development Services segments, companies offer IoT-specific coding, modeling and project management that helps a customer actually implement IoT applications.

While the lines of distinction between Cloud providers and Edge Technology providers are now blurring, and there are many who do both, IoT Development Services Providers are mostly separate. The customer-specific services business is still different from product-centric Cloud Services and Edge Technologies. With very few exceptions, these service providers stay away from producing products themselves.

The entry requirements within this market include coding skills on current frameworks and programming languages, such as Node.js or the Go Language. However, to offer machine-level development for Constrained Controllers, C-skills and experience in firmware development are required. Knowledge of different connectivity solutions such as LoRa and Narrow Band IoT (NB-IoT) are also a plus, and it’s also important to be familiar with the leading Cloud Backends. As this provider comparison focuses on the German market, it is very important that providers have developers, scrum masters and architects locally in Germany, which can then be supplemented with nearshore and offshore resources if necessary. These are the main criteria used in the evaluation:

- Development skills or operating capabilities in at least two of the three areas (IoT Clouds, Non-Constrained Controllers, Constrained Controllers)
- Intensive experience with at least one of the leading IoT Clouds (Innovator or Accelerator) and IoT architecture.
- Technology independence in platform selection. Smaller platform providers offering only Development Services for their own platform do not qualify as Development Service Providers.
- Understanding of IoT connectivity
- Knowledge of communication protocols either in the industrial or consumer sector.
- References in German-speaking countries.
- German-speaking employees who can also be onsite.
In addition, of course, there are the general criteria such as an active go-to-market presence in German-speaking countries. Crisp Research examined references very carefully and questioned which elements of larger projects the respective service provider really delivered.

**IoT Telco Stacks**

Telecommunications companies (Telcos) play a special role in the IoT landscape. Traditionally strong in networks and connectivity, they are also now trying to contribute their expertise through narrowband IoT, as well as through local operating services provided for LoRaWan or the licensing of Sigfox. You can refer to this Analyst View that provides an overview of the wireless IoT connectivity. At the beginning of the IoT boom, some Telcos have also tried to go beyond connectivity and develop their own IoT platforms to gain market share in the IoT Cloud Backend services market. Although most Telcos continue to pursue this goal, they have completely abandoned their own development efforts over the past 12 months. Instead, they have entered into partnerships with technology providers, in order to integrate their complementary offerings into their networks. For example, Deutsche Telekom’s IoT Offering is being built on Software AG’s Cumulocity product, while British Telecom is using Luma from Hitachi Vantara.

Ultimately, the offerings of Telcos for business users in this area are quite comparable to many IoT Cloud products, and can even claim differentiation in that NB-IoT bandwidth is often included. However, since the core functionality is mainly differentiated by the technology stacks used, we decided not to compare the Telcos with each other, but rather the technology components that are suitable for building an IoT Telco Stack. This ensures the market comparison is interesting for users who want to know whether their Telco is using the leading technologies, as well as for Telcos that can use the comparison to decide which technology components would fit into their portfolio. For users in Germany, Deutsche Telekom itself is rated in relation to IoT Cloud and Edge technology, and T-Systems in terms of an IoT Development Service.

It should be noted that the Telco Stacks segment is significantly smaller than the IoT Cloud Services or Edge Technologies market segments. Although some technology components are exactly the same as those seen directly in the respective market segments, others do not even meet Telco requirements. Other providers pursue a go-to-market for Telcos, but not for direct customers in DACH, and are assessed individually in the Telco Stacks section, but not in the Cloud or Edge market segments.

Specifically, the following criteria are included in the evaluation of IoT Telco Stacks within this Vendor Universe:

- Scalability must meet Telco requirements, not just enterprise requirements. This means a few million IoT devices as of late 2018.
- White-labeling shows the Telco brand, not that of the technology provider.
- Integration of provisioning and billing within the telco environment
- References with Telcos that operate in DACH.
- Providers with an IoT software value-add. Pure connectivity equipment providers, even for NB-IoT, are not included within the comparison.

While we look at the IoT Clouds to ensure that the providers offer self-serve registration and corresponding OPEX models, this is currently not necessary in the Telco Stacks segment. Telcos are perfectly able to produce an IoT OPEX offering from software licenses (CAPEX) using their own operating services. Here, traditional licensed software is also included, which turns the Telco into a Cloud service provider. The goal for Telcos is to offer an IoT Cloud Backend as a service, with connectivity services provided under their own branding, if applicable.
Dual- and Triple-Play

Crisp Research helps many users select technologies and service providers. An important requirement of individual consulting projects is limiting the number of providers. For midsized businesses in particular, every additional provider is associated with extra effort and, if problems occur, greater risk. Instead of buying a Cloud Backend from one provider, an Edge Technology from another, and development from yet another, the preference is always to work with one or two providers at most.

Our assessment is that only four providers (Deutsche Telekom & T-Systems, IBM, QSC, Relayr) can offer Cloud, Edge and Development performance from a single source (see Figure 3). Only one offers IoT Cloud Services and Development Services. ATOS Cloud Services are mainly aimed at large customers and do not offer self-service registration for new customers. However, this is possible for new users out of corporates, such as Siemens, already working with ATOS. For a German SME customer, ATOS would not appear in the Cloud Provider category at all.

IoT Edge and IoT Cloud services on the other hand, are offered together by a number of vendors. Both have a product character and many IoT Edge Technologies, such as a device or connectivity management, now include a Cloud service in addition to the software on the Edge device. Once a platform has been created to operate these cloud-elements of the Edge Technologies, it makes sense to offer it as a general purpose IoT Cloud Backend as a service.
Qualified and rated Internet of Things (IoT) Vendors & Service Providers

After verification, non-qualified Internet of Things (IoT) Vendors & Service Providers

VENDOR & SERVICE PROVIDER FOR IOT CLOUD BACKEND-AS-A-SERVICE

Akamai
Arm
AT&T
Atos
Autodesk
AWS
Axiros
Ayla Networks
Bosch
BT
C3 IoT

ComputaCenter
Davra Networks
Device Insight
Dimension Data
ei³
Eurotech
GE
Google
Hitachi Vantara
IBM
M2MGO

Microsoft
NTT
Oracle
OSRAM
OVH
Plex Systems
PTC
QSC
Relayr
Rackspace
Salesforce

Samsung
SAP
Schneider Electric
Siemens
Software AG
Telefonica
Telekom
Vodafone
Wago
| Qualified and rated Internet of Things (IoT) Vendors & Service Providers |
| After verification, non-qualified Internet of Things (IoT) Vendors & Service Providers |

- ABB
- Adlink
- Advantech
- Akamai
- Arm
- AWS
- AXOOM Solutions
- Beckhoff Automation
- Bosch
- BT
- Cisco
- Citrix Systems
- Cybus
- Davra Networks
- Dell
- Device Insight
- DG Logik
- Digital Concepts
- ei³
- Emerson
- Eurotech
- FogHorn
- Fujitsu
- Gemalto
- Hitachi
- Huawei
- IBM
- Intel
- IoBroker
- iTAC
- Kontron
- Microsoft
- NEXIONA CONECTOCRATS
- Nordcloud
- OpenHab
- Oracle
- OSRAM
- QSC
- Qualcomm
- Relayr
- Robotron
- Samsung
- SAP
- Schneider Electric
- Sierra Wireless
- Software AG
- Sotec
- Telekom
- Telit
- VMware
- Vodafone
- Wago
- Zebra Technologies
### Vendor & Service Provider for IoT Development Services

**Qualified and rated Internet of Things (IoT) Vendors & Service Providers**

- Accenture
- Atos
- Axians
- BEDM
- Capgemini
- CGI
- Cognizant
- Concept Reply
- ComputaCenter
- Concise Software
- daenet
- DXC
- EPAM Systems
- FIT
- Gemalto
- grandcentrix
- HCL
- IBM
- Infosys
- iXperta
- KPIT
- Navyug
- Netlight
- Nordcloud
- OSRAM
- PLVision
- QSC
- Relayr
- Robotron
- Sotec
- TCS
- Tech Mahindra
- T-Systems

**After verification, non-qualified Internet of Things (IoT) Vendors & Service Providers**

- Twentybn
- Tieto
- Tresmo
- ubk
- Wipro
- Zühlke
<table>
<thead>
<tr>
<th>VENDOR &amp; SERVICE PROVIDER FOR IOT TELCO STACKS</th>
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<td>Akamai</td>
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<td>Sierra Wireless</td>
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<td>Software AG</td>
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EVALUATION CRITERIA

The Crisp Vendor Universe evaluation criteria are divided into two dimensions, “Service / Product Value Creation” and “Vendor Performance”, each with five sub-criteria, which are weighted on a percentage basis. Depending on the market segment, the criteria groups contain further specific and individual characteristics.

The “Service / Product Value Creation” area focuses on market maturity and moves a supplier from the bottom to top. The following criteria groups are included within this category:

- **Service / Product Portfolio**: Service scope including the completeness of the portfolio or the skill set.
- **Service / Product Experience**: Service availability and service experience from a customer perspective. Maturity of the offer.
- **Integration**: Interoperability of Cloud Services and Edge Technologies with one another or the skills to integrate them.
- **Economic factors**: Price transparency and the quality of the business model, not the prices themselves. For service providers, nearshore concepts or skills that deliver low-cost architectures have also been evaluated.
- **Disruption potential**: Recognition of the availability of highly innovative IoT approaches such as a Digital Twin concept or Edge Machine Learning.

### Criteria Groups

<table>
<thead>
<tr>
<th>Features / Service Portfolio, e.g.</th>
<th>Service / Product Experience, e.g.</th>
<th>Integration, e.g.</th>
<th>Economics, e.g.</th>
<th>Disruptive Potential, e.g.</th>
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<tr>
<td>Standard Protocols to Devices (Data &amp; Config) and Business Systems</td>
<td>Product Maturity</td>
<td>Hybrid Cloud Capabilities</td>
<td>Pricing Model</td>
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<td>Edge Hardware Support</td>
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<td>Both Consumer and Industrial Growth Potential</td>
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<td>Knowledge of Typical Standards and IoT Resource Models</td>
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<td>Innovation Strength</td>
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<td>Toolchain</td>
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<td>Integration into Telco Environment</td>
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<th>IoT Development Services</th>
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Weighting for:
“Vendor Performance” looks at the providers in the IoT market environment in terms of their presence and strategy in the market and moves a vendor from left to right:

**Strategy:** Strategy and market understanding. Does IoT fit the company strategy?

**Footprint:** Competitive strength and market presence in terms of customers, reach, visibility and go-to-market.

**Ecosystem:** For Cloud and Edge providers, the number of development service providers who are familiar with their technologies is critical. On the other hand, we evaluate the number of technology suppliers that are listed by Development Service Providers under Partners and Skills. Active involvement in open source communities is also a plus.

**Customer Experience:** Availability of information and training for technology providers. Local availability of employees for service providers.

**Agility:** Speed and innovation strength of the providers, assessed in terms of their ability to grasp market trends quickly and, if necessary, develop them with an innovation budget. Fast innovation / release cycles for Cloud providers.

### Vendor Performance

<table>
<thead>
<tr>
<th>Category</th>
<th>Focus</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategy</strong></td>
<td>Market Understanding&lt;br&gt;Focus&lt;br&gt;Thought Leadership</td>
<td>20% 20% 20% 20%</td>
</tr>
<tr>
<td><strong>Footprint</strong></td>
<td>Market Awareness &amp; Visibility References&lt;br&gt;Delivery Infrastructure / Global DC Availability Zones</td>
<td>20% 20% 20% 20%</td>
</tr>
<tr>
<td><strong>Ecosystem</strong></td>
<td>Partner Landscape&lt;br&gt;(Number &amp; Quality, Enablement)&lt;br&gt;Existence of Certifications and Partner Programs&lt;br&gt;Community Engagement, Open Source Contribution</td>
<td>25% 25% 25% 25%</td>
</tr>
<tr>
<td><strong>Customer Experience</strong></td>
<td>Education &amp; Trainings&lt;br&gt;Service &amp; Support Quality&lt;br&gt;Local Support Engineers</td>
<td>15% 15% 15% 15%</td>
</tr>
<tr>
<td><strong>Agility</strong></td>
<td>Market Responsiveness&lt;br&gt;Innovation Budget&lt;br&gt;Agile Release Management</td>
<td>20% 20% 20% 20%</td>
</tr>
</tbody>
</table>

**Weighting for:**
- IoT Cloud Backend-as-a-Service
- IoT Edge Technologies
- IoT Development Services
- IoT Telco Stacks
The detailed sub-criteria within the main criteria groups differ somewhat depending on the market segment. Certain detailed criteria apply only to products, others only to services. In addition, the criteria groups for the "IoT Cloud Backend-as-a-Service", "IoT Edge Technologies", "IoT Development Services" and "IoT Telco Stacks" market segments are weighted differently in order to ensure market relevance.

**DEFINITION OF EVALUATION CATEGORIES AND WEIGHTINGS**

Within Product Value Creation for the IoT Cloud Backend-as-a-Service Providers, features, service/product experience and economics were weighted as the most important criteria groups with 25 percent each. The Integration criteria group contributes 15 percent. Particularly innovative offers with disruption potential were given a 10% weighting.

Within Product Value Creation for IoT Edge Technologies, features, service/product experience and economics were also weighted with 25 percent each as the most important criteria groups. The Integration criteria group contributes 15 percent. Particularly innovative offers with disruption potential were again given a 10% weighting.

Service Portfolio and Service Experience are weighted as important criteria groups within the IoT Development Services market segment, at 25 percent each. Skills integration between IoT platforms and upwards into business systems are also weighted at 25 per cent. The Economics criteria, which also include the sourcing concept, have a 15% weighting. For disruptive potential, service providers that have dealt with very new IoT platforms were given a ten percent weighting. This includes, among other things, the development of IoT skills around the Google Cloud Platform.

The criteria within Telco Stack provider segment are weighted similarly to those in the IoT Cloud BaaS segment. However, additional Telco-specific features such as connectivity management or SIM card provisioning for IoT devices were also included within the evaluation here. Within the Product Experience grouping, Product Scalability is a particularly important factor.

The Economics group only scores highly if pricing models are in place that can also, for example, attractively cater to very large numbers of devices. We have also included white-labeling capability under disruptive potential, which is unusual for normal IoT offerings, but is an urgent requirement for technology components within a Telco Stack.

The distribution of Vendor Performance is equally weighted for all market segments. The IoT market is still so young that it isn’t necessary to weight manufacturer strategy, footprint, ecosystem, customer experience and agility differently in the four market segments. For IoT topics, visibility is currently equally relevant, no matter which market segment you serve. In more mature markets, IoT Development Device Providers find their projects primarily through follow-up deals with existing customers, while product vendors need to achieve greater visibility to ensure revenue growth.

Because in the IoT market, delivering a single solution often requires that offerings from two or more vendors are combined, the ecosystem is more important than it is in most other Vendor Universe assessments. That’s why it has been given a weighting of 25%. A well-developed partner network and certifications are also essential for future success. In addition, making an active contribution to current open source projects is a good way of offering customers more investment security. In contrast to the proprietary frameworks of a Development Service Provider, open source frameworks can also be maintained and developed by other service providers.

Agility, strategy and footprint are weighted equally in the evaluation with 20 percent each and are important success factors. In a very young market, an innovation strategy is crucial. An innovation budget and agile release management enable providers to react to current trends. Likewise, a strategic focus on the IoT topic is perceived as thought leadership by customers.

The customer experience, which is rated at 15 percent, is often challenging for both established and large companies. Start-ups move faster with freemium models that deliver a great customer experience, while established players often fear that such measures will cannibalize their existing business.
ANALYSIS
Crissp Research has examined a total of 117 providers. Of these, 82 qualified for a place in at least one of the four market segments. Some of them have several offers that position themselves in more than one market segment (see Figure 3). That means we have evaluated a total 120 technology and service offerings.

Of these 120 offerings, 50 were ranked as leaders in Product and Service Value Creation, and Vendor Performance. As Accelerators, these 50 offerings currently provide the best solutions and services around IoT Cloud Backend Solutions, Edge Technologies, Development Services and Telco Stacks.

In addition, there are 23 offerings rated as Innovators that demonstrate a good solution approach, but whose vendors do not yet have the market power or the ecosystem to establish a broad market footprint. The remaining 47 offerings have been rated as Challengers or Emerging Players, as they are already involved in the relevant markets, but do not yet have the right offerings within their portfolios to support the IoT performance of their customers optimally.

**IoT Cloud Backend-as-a-Service**

In the Cloud Backend-as-a-Service segment, a total of 33 companies were able to position themselves as relevant providers. Of these, 21 have an attractive product offering above the centerline in Figure 7. Of these, 16 suppliers could also claim above-average vendor positioning and are shown in the upper right area as Accelerators. We see the other 5 positioned top left as Innovators. They have attractive product offerings, but are less well positioned in the IoT market.

The distribution of offers within the IoT Cloud segment shows that this is the most advanced IoT market.
The Hyperscalers AWS, Azure and Google, as well as IBM and SAP, have strong vendor positioning and excellent products. Only these 5 vendors occupy the top of the Accelerator Quadrant, as they are also the strongest players in the generic Cloud market, which is already relatively consolidated. All the other Accelerators have weaker products and are positioned well behind the five leaders.

Amazon Web Services (AWS) is the strongest Accelerator in this category because of its product and strategic focus. Direct competitor Microsoft Azure is a little better positioned strategically than AWS, but has not yet caught up with the variety and maturity of the AWS IoT service portfolio. The IoT Cloud Backend offering from both vendors builds on their General Purpose Cloud IaaS and PaaS services. AWS offers many different IoT-specific services, which can be confusing for AWS newcomers. The AWS IoT Core attempts to combine different services and pre-integrated fine-granular services. However, technically savvy AWS professionals and good IoT architects are happy to assemble the individual services for their IoT scenario together. Of course, Amazon is an American company and while services are technically being delivered out of Germany, they are still within US jurisdiction from a legal perspective. Importantly however, a business entity was recently founded in Luxembourg allowing contracts to be concluded under current EU law.

With its IoT services on Azure, Microsoft is also a leading Accelerator, although lagging somewhat behind AWS from a technical perspective. In terms of vendor performance, however, Microsoft emerged as the best provider. The reasons for this can be found in its comprehensive strategy for the Industry 4.0 market, broad market access in Germany, a well-developed network of partners and a very open corporate culture. The Azure IoT Hub is particularly attractive because of its functionality. However, if you are looking at very large volumes of messages or want to migrate from other MQTT brokers, you need to pay close attention to performance and compatibility. The Azure IoT Hub does not comply 100% with the MQTT standard. Microsoft can be recommended in particular for moderate numbers of devices. Thanks to low latencies, it also offers strategic advantages in terms of identity management, the transition to Microsoft process offerings, and integration into business apps. American legal jurisdiction is still a disadvantage, even though the IoT services are physically offered out of Germany.

IBM has a rich IoT Backend offering a variety of IoT services. IBM is also the only one of the five leading Cloud market segment Accelerators that also offers Edge Technology and Development Services, making it the best triple-play provider with Telekom / T-Systems. A disadvantage of the IBM product portfolio, however, is that a large portion of its products originated in the software world and were not built as Cloud-native applications. In addition, there are some functional overlaps, creating several solutions to the same problem. IBM’s pricing and go-to-market approach pull vendor performance slightly to the left of the Quadrant.

Google has caught up with its major competitors in recent years and is now among the leading Accelerators. Although its portfolio is currently significantly smaller than that of AWS, Microsoft and IBM, existing services are impressive in terms of their stability, scaling and price. Google is an especially good choice as an IoT Backend when addressing large numbers of devices, a lot of data or programming application logic on containers. In particular, Google’s Kubernetes offering is the most stable managed container environment on the market.

SAP’s real strength is actually in the industry applications that we do not evaluate in this Vendor Universe, but it has still managed to position itself among the top five IoT Platform Accelerators. SAP has invested heavily in platform software and also in the Edge. Its offering is deployed within the Leonardo framework on a Cloud Foundry and Kubernetes environment, not the SAP HANA environment. A total of 4 services are offered: Event Processing, Connectivity Management, Device Management and Data Management. Behind them is a modern platform architecture and some open source components, such as Kafka, Cassandra and others. Because of the two technology stacks, SAP HANA and SAP Leonardo, a large number of integrations are required between the applications running on
HANA, and the IoT middleware running on the Edge device and within the IoT Leonardo Foundation. SAP Leonardo also provides the IoT bridge and a kind of dashboard where you can see IoT data and correlate it with SAP application data. In addition to SAP’s data centers, the Leonardo Stack is also available on the Google Cloud platform, which we believe provides a very attractive option due to its scaling, stability, price and network latencies.

In ThingWorx, PTC has a high-level IoT platform for building and operating custom IoT applications. The platform has a very broad range of SaaS offerings, as well as simple messaging services. But ThingWorx does not offer a large number of granular IoT services that can manage millions of devices cost-effectively. On the other hand, ThingWorx is always interesting as an IoT platform, whenever CAD constructions, augmented reality, asset management or other services from the PTC portfolio are being used.

Eurotech is a market leader in the Edge environment with an extensive device and software portfolio. Eurotech’s Everyware Cloud builds on a Hyperscaler’s infrastructure and is particularly attractive to users within the industry 4.0 environment. Thus, Eurotech can be seen as a niche expert, which has a lot of experience to offer industrial customers, regardless of whether Eurotech devices are used within the organization.

Thanks to its acquisition of Cumulocity in March 2017, Software AG has also been able to position itself as an Accelerator within the IoT Cloud Backend sector. The platform has strong device management and ad hoc analytics usable at an easy-to-use SaaS level. Furthermore, Software AG performs very well in the integration criteria group thanks to the integration of Cumulocity and Webmethods integration products. In the meantime, the Apama Streaming Analytics and Event Processing Platform has also been integrated into Cumulocity. This integration within the extensive Software AG portfolio offers a great deal of functionality for integration into business systems in order to, for example, implement predictive maintenance processes. Unfortunately, not all Software AG integration products are available as Cloud services, or even integrated with Cumulocity. In addition, due to its small license turnover, Software AG does not have sufficient resources to develop all of these products intensively. This is why Software AG has founded the industrial alliance ADAMOS, which works with industrial companies to make joint investments to meet requirements together.

The Bosch IoT Suite also has very strong device management and integration with legacy systems, business workflows and service management systems. The IoT Suite is aimed in particular at industrial and automotive customers. In addition, the Bosch Group and its direct ecosystem form an internal market that is not to be underestimated. The IoT Suite is based on Hyperscalers and Bosch’s own IoT Cloud. Unfortunately, the IoT suite is not consistently available on all infrastructure options, making porting between Hyperscalers impossible.

Thanks to its range of flexible orchestratable elements, the GE Predix platform is also positioned as an Accelerator. Although the platform is partially well integrated, has a large feature set and GE can demonstrate strong Digital Twin expertise, it is not a multi-tenant architecture and there is no certification for Edge devices. Moreover, GE Predix has significantly less visibility in German-speaking countries than Siemens Mindsphere. Overall, the GE Digital Division has performed below the expectations of the GE Group and whether further investments will be made is questionable.

Siemens is also rated as an Accelerator with its Mindsphere platform, and has a particular strength in the form of its industrial ecosystem. Partners also have the opportunity to offer additional apps. Mindsphere is available in both the Public Cloud (AWS) and on Private Clouds via a managed service from Atos. However, Crisp Research is skeptical about announcements from Microsoft that it also intends to run Mindsphere. Mindsphere is focused on industrial applications and is in high demand within Siemens’ domestic market. But gradually, market share outside of Siemens is also growing.

Above all, Salesforce owes its position as an Accelerator to its advanced corporate strategy and its strongly positioned
Service Cloud. A large part of the available functionality really is industry-independent and so freely configurable that we can class it as an industry-independent platform (actual business applications are not part of the evaluation). In addition, the closely integrated Heroku platform offers the ability to pre-process IoT data. However, Crisp Research recommends combining Salesforce with other IoT Cloud Backends when it comes to handling large volumes of device and sensor data. From a functional perspective therefore, Salesforce is in the lower third of the Accelerator Quadrant.

Deutsche Telekom is the only telco provider to be positioned as an Accelerator in the IoT Cloud Backend market segment. All the other Telcos operating in German-speaking countries have a much weaker portfolio. The combination of technology components and network services plays a key role here. The technology components include some that we have also evaluated within the Telco Stack market segment. These include hardware and OpenStack Cloud Management from Huawei, which provides the IaaS infrastructure for all Telekom’s offerings. Cumulocity and other software components also run on it under the Telekom brand. Through its integration, Telekom has been able to hide a lot of the complexity, which is especially attractive for IoT beginners within the SME sector. For example, the complex integration products within Software AG’s portfolio are not even available on the Telekom Cloud. On the other hand, this limits the functionality for advanced users, which is why Telekom is positioned well below Software AG in the Quadrant.

As a strong hardware manufacturer and with its ARTIK Cloud platform, Samsung has also claimed a spot as an Accelerator. Coming from the lighting and building environment, Cloud connectivity is coming increasingly to the fore, and many features for building individual applications are also available. However, Samsung’s portfolio still has some gaps when compared with those of the big Hyperscalers.

Akamai is known as a CDN manufacturer, but was able to position itself as an Accelerator due to the development of its new IoT offering. Akamai has initially focused its activities on a specific part of IoT Cloud functionality, namely the MQTT message broker. But Akamai has done so by deploying a distributed system on all its 250,000 servers at Internet providers around the world. As such, Akamai has developed a very exciting and innovative concept. IoT solutions can connect to IoT Cloud Backends from anywhere in the world with extremely low device latency.

Oracle has managed to offer enough portfolio elements to be named as an Accelerator – but only just. This is mainly due to the sheer size of the company. In the German-speaking world, Oracle’s presence is primarily that of a provider of middleware and database platforms, less as an application manufacturer and still less as an IoT thought leader. Oracle will no doubt continue to struggle with trying to make multi-tenant Cloud Services out of those traditional software products that could potentially take over a role in an IoT Cloud stack.

Osram, the leading manufacturer of lighting technology and LED components for the B2B and professional markets, has established itself as the strongest Innovator in the IoT Cloud Services segment. The recently launched Lightelligence platform is an IoT Cloud Backend Service that initially focuses on professional building automation. Lightelligence is essentially based on Kubernetes and operated by OSRAM as an end-to-end service on a Hyperscaler infrastructure. The platform has a modern multi-tenancy infrastructure and a very open business model and ecosystem. For example, other building automation manufacturers can re-brand and incorporate Lightelligence into OEM models. The ecosystem approach is different when it comes to building automation because each building comprises different components from multiple manufacturers. The Lightelligence platform has a high degree of openness, allowing the integration of all the technology components within a building. However, since the platform has only just come onto the market, OSRAM is still positioned to the far left of the Quadrant.

M2MGO takes a high-level approach to helping users with IoT solutions. Similarly to ThingWorx – actually even better in terms of specific details, but not nearly as complete - M2MGO offers a Low Code IoT platform. Applications can be created
here without a lot of coding effort. The platform is particularly well-suited for prototyping, and has good scalability and modern architecture for low-code-productive applications. M2M-GO currently uses Microsoft’s Azure IaaS.

In addition to its hardware offering, QSC also has an innovative IoT backend solution in the form of Q-cloud. Together with its Development Services, QSC is one of the four Triple Play providers in this Vendor Universe. The Q-cloud Cloud Offering also respects standards very well and uses common open source projects.

Relayr also offers Cloud, Edge and Development Services, positioning it as another one of the four triple players. Relayr’s middleware scores particularly highly as a Cloud Service, which promises to transport data and events from various protocols into dashboards. Relayr has just been acquired by MunichRe and it uncertain if this focuses the company into directions. Relayr Cloud Services are deployed on a Hyperscaler platform.

C3 IoT positions itself as a full-stack platform provider with all the key platform components required for IoT solutions. However, the company’s strategy and communications within the German market are rather mediocre. In the absence of self-service registration, Crisp Research was only partially able to validate which services were already available on the platform. C3 IoT cooperates with AWS and Azure, but also offers an appliance in partnership with a leading hardware manufacturer. Its partner network is very sparse in the German-speaking area, which keeps C3 IoT far to the left within the Innovator Quadrant.

Schneider Electric is the first member of the IoT Cloud Services Challenger Quadrant. Schneider’s EcoStruxture is on the way from being an architectural blueprint to becoming a true Cloud Backend. The concept offers storage services for sensor data as well as device management and analytics, mainly for industrial automation. Schneider competes directly with Wago, Beckhoff or ABB in this area, for example.

Vodafone is one of the major Telcos in Germany alongside Deutsche Telekom, but is significantly weaker than its competitor when it comes to IoT Cloud Services. It lacks important elements in the IoT stack, as well as development providers who can build on the Vodafone platform. Just offering IoT connectivity is not enough to be a true IoT Cloud provider.

AT&T is even weaker as a Cloud platform in the DACH region. Although large and well positioned in its US home country, AT&T has not been able to launch an attractive platform.

In terms of its core business, Wago competes directly with Schneider Electric, Beckhoff, ABB and other smaller manufacturers of control cabinet components. With Codesys 2, Wago also has sophisticated software for industrial automation. Relevant services and parts of this software are offered by Wago as the Wago Cloud. Wago relies entirely on Microsoft Azure infrastructure.

British Telecom (BT) is still ahead of Vodafone but behind Deutsche Telekom. BT is trying to build an IoT stack in the UK using partner technology, such as the Hitachi Vantara IoT Stack Lumada. It also contains the powerful Pentaho analytics framework. Nevertheless, the offering is far from complete and largely unknown in Germany.

Arm is better known as a chip manufacturer and supplies many controllers for use in IoT devices. Nevertheless, the hardware manufacturer has ventured into the software and Cloud services market with its Mbed Cloud platform. Mbed is actually an operating system for Constrained Controllers made by Arm. With the Mbed Cloud, the right Cloud services for secure communications such as device management and TLS management are also now available. The Mbed Cloud is currently still in private beta and is far less complete than the leading Cloud offerings. Nevertheless, Mbed is an interesting option in combination with other IoT Cloud Backends that do not perform these tasks well.

NTT, Japan’s global Telco, is also trying to position an IoT Cloud platform that can run apps created by NTT, partners and customers. Unfortunately, its connectivity-focused offering is barely more than marketing, despite the provider’s huge size. Neither its references in Germany nor its self-service Cloud capability would usually have passed the admission criteria. However, Crisp Research has confidential information that justifies its inclusion.
With **Davra Networks**, we move into the Emerging Players Quadrant for Cloud Services. Unfortunately, Davra Networks has hardly gained any market awareness in German-speaking countries so far. The Davra platform is particularly suitable for Remote Asset Monitoring, Smart Connected Fleets, First Responders, Connected Mass Transit, Oil, Gas & Mining, and Safety & Security use cases.

**Ayla Networks** has built its IoT platform according to the Phone-as-a-Gateway concept. Here, IoT devices with local fieldbuses use Bluetooth to connect to a smartphone, which then serves as a gateway. The gateway function is much smarter than a WiFi hotspot. Messaging, local preprocessing etc., make the concept interesting for devices that only need to be online during maintenance.

**Hitachi Vantara**, the software and IT service division of the Hitachi group, is consolidating its IoT software stack under the Lumada brand. The analytics component in particular is very powerful, as it builds on Pentaho, which Hitachi acquired. Lumada is successful as a Telco Stack, but is having a hard time in terms of appealing directly to other types of business, as some components are missing.

**Atos** is a heavyweight in the managed service market with over €12 billion in revenue. Due to its close relationship with Siemens, Atos offers various operating concepts for Siemens Mindsphere within Atos data centers and on-premise. Atos has also made repeated attempts to position itself as a Public Cloud provider. However, its go-to-market strategy is essentially focused on major existing customers. In addition to Mindsphere, Atos also offers custom platform development or Mind Apps for the Mindsphere platform. Crisp Research does not recommend ATOS as being suitable for SMEs.

**ei3** comes from the Gateway hardware market and is an Emerging Player that is trying to build a Cloud service on a Hyperscaler infrastructure. The offering is mainly interesting for customers who also use ei3’s hardware or industry solutions.

**IoT Edge Technologies**

Within the IoT Edge Technologies market segment, a total of 40 companies were classified as being relevant enough in terms of their offerings to be included in the evaluation. The intersection of Cloud Backend and Edge Technology vendors is surprisingly large, with 17 vendors that are relevant in both market segments. Four other providers also offer additional IoT Development Services. Just two years ago, hardly any Edge vendors had their own IoT Cloud. Likewise, most Cloud providers were more or less offering generic Cloud infrastructures and barely had an understanding of IoT Edge Technologies. Of the relevant Edge vendors, 18 were able to position themselves as Accelerators in the top right Quadrant and another 8 as Innovators in the top left.

Across the evaluation criteria, **Eurotech** leads the Accelerator Quadrant. This Edge hardware vendor recognized the need for specialized software for IoT devices early. In fact, it was Eurotech that co-founded the MQTT standard alongside IBM eighteen years ago and provided a reference implementation. Today Eurotech is very active within the two Eclipse open source projects, Kura and Kapua. Learn more in the Crisp Research Analyst View. As an Oasis Member, Eurotech also drives the MQTT standard and has become one of the most competent Edge companies. Its go-to-market strategy is based on a well-developed partner network and cooperation with the Hyperscalers.

Advantech is one of the largest manufacturers of Edge devices and gateways, and offers its own Wise-PaaS platform, which provides a fairly comprehensive set of Edge management functionality. This includes device management with software / firmware updates, security and other platform services. Wise uses the Azure infrastructure and can of course also manage non-Advantech devices. Advantech has also built a good ecosystem with IoT Cloud Backends and additional partners (see product link).

**Gemalto**, best known for security software, has also made a name for itself in the Machine2Machine (M2M) market with a variety of connectivity modules and IoT Edge devices. Gemalto offers a broad portfolio of applications and platform services, middleware and device management. In particular, the
connectivity modules it offers for various wireless technologies are a strong differentiator. Paired with its software stack and remaining portfolio components, Gemalto is a leading Edge Technology Accelerator. This is despite the fact that Gemalto’s industry-specific business applications in the IoT area have not been evaluated here. Gemalto does also offer its own Development Services, but they are not well known and mainly relate only to Gemalto products.

IBM is one of the few providers that acts as a triple player. IBM has always been in high demand in the Edge area, especially in the industrial computing environment, but part of this has gone to Lenovo, so IBM does not produce many low-power devices any more. However, IBM invests heavily in open software standards, so its IoT solutions are certified or compatible with others. One drawback is that the innovation model is mainly built on acquisitions and that these acquisitions are not as seamlessly integrated as they could be. This is particularly the case as regards the acquisitions in device management or Edge device operating systems, which do not work seamlessly with the rest of the portfolio. In addition, IBM is also in the upper price segment due to the inherent complexity of its solutions and its traditional pricing structure. In particular, IBM prices must be calculated very carefully for applications with very large numbers of devices.

Although AWS comes from the Cloud environment, it is particularly interesting that both Edge classes, i.e. gateways (Non-Constrained) and smaller Constrained Controllers systems (WiFi controllers such as ESP 8266 with an MQTT client but without a file system) are supported. Greengrass is available at the Gateway / Non-Constrained Controller level. It allows Lambda functions (i.e. AWS Event Processing and Function Computing) to be executed locally. For the small Constrained Controllers, AWS supports the Free Real-time Operating System (FreeRTOS), whose core developer is on the AWS payroll. Developers can easily configure a secure end-to-end MQTT connection from the smallest controller to the AWS Cloud without writing a single line of code. Local Edge computing with Greengrass enables pre-processing on the Edge.

Sierra Wireless comes from the connectivity sector and has also secured a spot as an Accelerator. The manufacturer mainly supplies devices and radio modules (connectivity modules for narrowband, Bluetooth, LoRa), which can be installed, for example, in gateways or small sensor boxes. However, Sierra Wireless also offers device management, alerting and reporting, which helps cement their Accelerator status.
Software AG has bought a strong Edge product, Cumulocity, with which they have also been able to position themselves as Accelerators. A large number of certified devices ensure interoperability, in some cases right up to the firmware update. Added to that is a free trial offering that allows you to try Cumulocity in minutes.

Microsoft is also rated as an Accelerator and is in direct competition with Cumulocity and other Edge management solutions with its IoT Central offering. IoT Central is a SaaS solution with device management, easy-to-configure sensor data analysis, and software management. IoT Central also builds on Azure’s IoT platform components. Large customers can achieve the same goal by orchestrating the platform components and with relatively little development effort adjust it accordingly. Microsoft supports a variety of industry protocols at the Edge and is deeply involved in partnerships with various automation vendors.

SAP’s acquisitions of PLAT.ONE and Fedem added Device Management and Digital Twin technology to the Leonardo’s IoT element. These and other technologies (including an OEM element from Telit) make up SAP’s Edge technology. SAP IoT Edge runs on non-constrained controllers and gateways, and communicates with its counterparts in the SAP Cloud. One drawback is that although SAP goes down to the Non-Constrained Controller, it does not go down to the sensor level of the Constrained Controller. Here, Amazon’s FreeRTOS, Microsoft’s SphereOS, Eurotech and even Arm have much more to offer. You can learn more by reading this Analyst View that sheds light on the SAP IoT portfolio. The biggest disadvantage at launch was the pricing, but this has since been improved by SAP with their “document-based” pricing initiative.

Telit was able to secure its place as an Accelerator due to its exceptional connectivity management. In addition, the software features strong device management, enabling it to manage large volumes of wirelessly connected IoT devices. Telit is a good choice in combination with other Edge services, because one of the many Telit Connectivity hardware modules can be combined with other Edge Technologies and integrated into corresponding gateways.

Due to its own Bosch Group internal market, Bosch has a lot of experience with Edge devices within the automotive and industrialization fields, which has also helped the provider establish itself as an Accelerator. The Bosch Business Unit responsible for this, Bosch Software Innovations, has also made acquisitions in gateway software and process software, which have now been combined within the Bosch IoT Suite. The interaction of the backend, a process solution and gateway software results in a good end-to-end portfolio.

Deutsche Telekom, in combination with T-Systems as the system integrator, has an end-to-end Edge offering. Rather than only using partner technologies, it also designs and builds its own devices. T-Systems has reference projects in which it leverages the Telekom portfolio and customer-specific solutions to deliver complete Edge functionality. In this way, gateway devices and wireless sensors with customer-specific functions can be offered from a single source.

Samsung is a sought-after Edge technology provider not just in Asia, but also worldwide, thanks to the way it enhances its own hardware with software elements. Basic Device Management for Samsung and Non-Samsung Devices functionality is very easy to access within the Artik Cloud.

Cisco, a major networking equipment manufacturer, has also secured a position as an Accelerator. The acquisition of Jasper has enabled it to offer very feature-rich connectivity management. However, this does not include complete device management because there is no firmware management capability, and ad hoc analytics are also not sufficiently well developed. However, connectivity issues can be solved for millions of devices, and the basic device management functionality is also capable of managing wireless devices in particular. On the hardware side, Cisco also offers Edge devices. This combination is what has helped Cisco & Cisco Jasper achieve Accelerator status.

Schneider Electric can position itself much more effectively in terms of Edge Technology that it can in relation to Cloud platforms. This major manufacturer of industrial controls for
building technology has therefore also secured a position as an Accelerator. This is mainly due to the effective positioning of its Edge Technologies and is characterized by extensive connectivity functionality, ranging from embedded Linux in switchgear to a separate Cloud service.

Adlink is known among the Accelerators as a manufacturer of industrial and rugged Edge devices. The latter can still function under extreme environmental conditions, for example in vehicles or for military purposes. For these scenarios, the demands are particularly high in terms of vibration, extreme climatic situations or water resistance. Adlink has also qualified for Accelerator status thanks to the pre-packaging of its software and the connectivity of its devices.

Device Insight has also entered the Accelerator Quadrant with its product Centersight. This product is a software package that is functionally similar to Microsoft’s IoT Central or Software AG’s Cumulocity.

Wago is well known in Germany for industrial automation. As a competitor to Beckhoff, ABB or Schneider Electric, Wago technology is to be found in many control cabinets. In addition, WAGO’s CODESYS software brings a sophisticated automation product related to these devices. Within this Vendor Universe, Wago can be most directly compared with Schneider Electric, which has better Cloud connectivity, or Beckhoff, which offers significantly less software.

FogHorn is a newcomer has secured the leading Innovator position among Edge Technologies, due to its effective approach to event processing and machine learning within Edge devices. This is especially important if you have a large number of events from industrial plants and sensors, for example, that you would like to filter on the spot. Detecting local anomalies in audio or image data saves a lot of bandwidth in the Cloud. FogHorn works with hardware vendors such as Arm and Intel, and publishes specifications but not a list of specific certified devices. Foghorn should therefore be combined with other Edge Technologies that incorporate Device and Connectivity Management.

Robotron has now established itself as a quality manufacturer of Edge devices. The portfolio includes both gateway devices for Industry 4.0 and gateways for general sensor applications. Robotron offers pre-configured products with the relevant software stack connected with Azure. This makes them Edge Innovators, even though they do not offer Cloud Backend or Development Services themselves. Therefore, Robotron is well suited for the sensor segment of the Industry 4.0 environment.

OSRAM’s Lightelligence platform gives it a position as an Innovator, although Lightelligence is only just coming onto the market. Today, developers already have services available that enable user and device identities, secure TLS communication to Edge devices, and store sensor data. Although other Edge functionality is not yet available, published concepts demonstrate parallel container execution on the Lightelligence Cloud and the Lightelligence Edge Device or Gateway. Other than SAP and Amazon (AWS Greengrass), no other Edge manufacturer has credibly planned the portability of Cloud logic to the Edge. In addition to producing its own devices, OSRAM has partnerships with the likes of Beckhoff.

QSC has also positioned itself as an Innovator with its Edge offering. Q-Loud, QSC’s subsidiary, has its own hardware portfolio with a variety of hardware components in the gateway, data capture and wireless IoT connectivity spaces. The devices are made available in combination with the Q-Loud Device Manager and Data Broker. Overall, the portfolio is well integrated and offers a full-stack from device management to middleware and Cloud services. One advantage QSC has is that IoT services are only one part of its broad IT portfolio, which also provides general Cloud services, consulting and Development Services. This makes QSC attractive in a more holistic sense.

ioBroker is actually an open source project for which this young company is currently building up commercial support. The software was written specifically for the Edge and therefore has very fast native Node.js eventing and an open adapter concept. Designed mainly for the smart home sector, but now increasingly for the professional sector, there are about 200 adapters to all sorts of field buses and hardware adapters. With a few exceptions, the adapters are also open source. ioBroker also comes with a great visualization function that can...
create interactive web and mobile apps in an attractive design. ioBroker is also launching its own Cloud service that enables eventing, messaging and Cloud notifications. However, this is mainly aimed at the consumer market and has not been evaluated here. Depending on the event volume, ioBroker runs on a Raspberry Pi or an industrial PC. Pre-configured Edge devices are part of the offering.

Davra Networks also secured a place as an Innovator. Its RuBAN offering is interesting for both users and Telcos, thanks to its large number of supported and certified gateways. Nevertheless, Davra Networks is a niche player in this marketplace.

Relayar was also rated as an Innovator, thanks to its ability to ensure data flow and end-to-end device management from Edge devices to one of the mainstream IoT backends. The company’s strategy and marketing are also well presented, although Relayar offers only a software stack and has no hardware of its own. However, it does also offer IoT development.

Another of our Innovators is Akamai, which is increasing its penetration in the IoT market through software offerings. These software solutions are designed to provide connectivity, network tunnels and a high degree of security for IoT scenarios.

ABB is one of the major automation electronics suppliers alongside Schneider Electric, Wago and Beckhoff. ABB offers on its Edge technology on the open market and sells its Cloud solutions only within large customers and on a project basis. That’s why ABB is rated within the Edge technology category, and leads the Challenger Quadrant here. Its IoTSP (Internet of Things, Services and People) portfolio also includes Edge technology, aimed especially at utilities, logistics and manufacturing companies via the ABB Ability Technology Platform and Cloud Infrastructure.

Beckhoff Automation is also one of the major automation electronics suppliers alongside Schneider Electric, Wago and ABB, although Beckhoff has Twincat, a software solution for many automation tasks on its own Edge hardware. This software also works well with Hyperscalers like Azure or AWS. Beckhoff’s devices are also designed with openness in mind and can execute customer-specific code. However, some of the functionality of a complete device and connectivity management solution is missing, especially for wireless devices.

Arm is a global semiconductor manufacturer with a large market share in mobile and Edge devices. With Mbed, Arm provides an ARM Constrained Controller operating system (ARM Cortex-M Controller) and a productive IDE for embedded software development. Nevertheless, as an Edge technology, ARM is only a Challenger and is lagging far behind its own potential. Interoperability between Mbed and other Cloud Backends is still unclear, and Device and Connectivity Management have also not published yet.

As a traditional PC and server manufacturer, Dell offers Edge devices in the industrial environment. Unfortunately, Dell has failed to put together a software stack and essentially relies on other Edge Technology vendors to certify Dell Devices. In addition, the Dell portfolio caters too little to smaller, low-power IoT devices below 30 watts.

Huawei is a global provider of Telco Equipment and is investing more and more in data center software such as Cloud Management Openstack. Huawei has its own gateway devices for the IoT Edge, but it’s having a hard time with industry Edge software. That’s why Huawei is just a Challenger here. But we should also make clear it has a significantly better positioning in the IoT Telco Stack.

British Telecom, or BT is only a Challenger in the Edge Technology segment because it does not offer end-to-end device design and development, as Deutsche Telekom / T-Systems does. In addition, the BT IoT Cloud lacks sufficient Edge management capabilities to be rated more highly.

Similar to BT, Vodafone has not really got going in terms of the IoT Edge. Offering bandwidth, connectivity management, and a bit of device management is not enough to get data safely from the Edge to the Cloud.
With Loita, VMware offers an open source SDK for Edge devices and with VMware Pulse, it also has a simple device management offering. However, bearing in mind the size of the company, it has to be said that functionality lags a long way behind customer expectations, which is why it is only rated as a Challenger. Many things are simply re-used from human end points. But an IoT device that doesn’t get touched by a human for years has quite different requirements.

iTAC is the first player within the Edge Technology Emerging Player Quadrant. This leading manufacturer of Manufacturing Execution Systems (MES) positions itself primarily as an application provider and not as a platform for custom IoT applications. Nevertheless, iTAC offers a lot of functionality for visualizing data from Edge devices.

Digital Concepts offers a solution for industrial applications with its Enocean Gateway technology. A gateway comes with a pre-built software stack that enables connectivity to Azure, Google and AWS. In addition, it is also possible to execute flows in Node-Red on the gateway. However, the software stack on and around the Enocean Devices still has many gaps, from device management to certificates for TLS communication. That’s why it is "only" an Emerging Player with future potential at the moment.

Sotec, the Stuttgart-based IoT player, is already one of Google’s few IoT Cloud partners but also develops its own devices. Unfortunately, there are far too few details about the software stack on these devices. As a small company, Sotec has not invested much in market visibility, which is why it is positioned in the upper segment of the Emerging Players segment.

Cybus is an Edge Technology provider focused on the industrial environment. The Cybus Connectware product provides organizations with clarity about what data is sent from any particular enterprise Edge device. Complementing the software, Cybus also offers the Cybus Sandbox, a pre-configured gateway device that can connect to all the leading IoT backends. Despite a strong concept, both the product and the company are still in the early stages of their development, and are therefore rated among the Emerging Players.

ei³ is an interesting hardware manufacturer offering industrial gateways and Edge devices. Nevertheless, it lacks the expertise associated with a sophisticated software stack that creates additional added value. Although ei³ also offers applications, it does not offer an open programming model. If it did, it would be classified as an Innovator rather than an Emerging Player.

Hitachi Vantara, as an Edge technology vendor that could serve Telco customers with millions of devices, is currently not operating anywhere near its potential. Its Lumada solutions has big gaps in terms of device management, and the software stack cannot port Business Logic to Edge Devices.

**IoT Development Services**

The IoT Development Services’ market segment consists of software and hardware development service providers that build custom solutions leveraging IoT Clouds and Edge Technologies. While the intersection of the first two market segments profiled in this Vendor Universe is quite large, most development shops simply do not provide products. There is only a very minimal intersection between them and the 3S offerings that are relevant here. Apart from the two big triple players, IBM or Deutsche Telekom, and the two smaller ones Relayr and QSC, only Atos offers Development Services as well as Cloud services. The latter are only offered in an elastic fashion for large existing customers and are therefore not really Public Clouds in the strictest sense. Three other vendors, Gemalto, Robotron and Sotec offer their own devices as well as general IoT Development Services that are also competitive independent of their own Edge Technology. In total, 9 of the providers evaluated were classified as Accelerators and therefore market leaders. Another 8 offers have succeeded in positioning themselves as Innovators with a good service value proposition. This can be used to classify the three user-relevant market segments strategically as follows:

- **IoT Cloud providers are already mature and partially consolidated.** This is proven by the fact that the market leaders in the Accelerator Quadrant have expanded their product and manufacturing strength equally.
**IoT Edge Technologies are still fragmented.** Traditional providers with a lot of experience are fighting against the Cloud providers from the right and the automation technology providers from below. The Accelerator Quadrant therefore has a relatively large number of vendors occupying very different positions.

**The IoT Development Services segment is still establishing itself.** This is made clear by the fact that the Accelerator Quadrant consists of two groupings: The large and well positioned general development service providers on the right in the Accelerator midfield; and the smaller specialists much further to the left with excellent skills at the top of the Accelerator and Innovator Quadrant. Crisp Research expects that some of the big system integrators will either buy up smaller firms or organically expand their IoT skills to respond to the maturing market.

Among the companies that have convinced Crisp Research with particularly good service quality or simply pronounced IoT skills are Netlight, Tresmo, Reply, Zühlke, Epam and Axians. The smaller ones, however, cannot handle larger projects of 5 or more Scrum teams alone. Either they are too small or so busy that customers have to wait months for the availability of good developers. Here are the providers in detail:

**Netlight** scored highest in Product / Service Value Creation and is positioned as an Accelerator in the IoT environment. Netlight is well known as innovative e-commerce system integration for nearly two decades employs more than 1000 consultants and developers in Stockholm, Oslo, and Helsinki. In the meantime, it has expanded to Copenhagen, Munich, Hamburg, Berlin and Zurich, giving it a strong presence in the German-speaking markets. With very good Node.js skills, Netlight is well positioned and is not afraid of the modern programming languages that are increasingly being used in the IoT environment, such as the Go-Language. Its weakness is its limited size and a lack of experience with low level devices. That’s why Netlight is not necessarily the first choice when it comes to developing firmware, but is a good choice when it comes to IoT applications, integrations and connectivity.

**Tresmo** has also secured its position as an Accelerator thanks to its superior performance in terms of Product / Service Value Creation. This system integrator and development service provider focuses on key trending topics such as Cloud and mobile applications, rather than legacy development. Tresmo positions itself as technology independent and has a wide range skills on platforms as diverse as GE Predix, Cumulocity, IBM, Microsoft and AWS. Unfortunately, it is still lacking in terms of Google Skills. Tresmo is unable to handle large IoT projects on its own because it only has 35 employees, which is why it is often used within the scope of larger projects to complement general service providers with its deep IoT expertise.
The Reply Group consists of numerous subsidiary organizations which, based on multiple partner technologies, provide services primarily in the areas of Cloud Computing, big data, e-commerce and IoT. The Reply Group’s specific IoT offer includes several business entities within the Reply Group that manage very different areas, ranging from private to industrial workloads. One of the key subsidiaries is Concept Reply, which has very good IoT development and integration skills, especially in the device and firmware area. Broadly speaking, the Reply Group can provide holistic IoT solution expertise to medium-sized and large companies, from initial consulting through to development and organization, and the operation of complex IoT solutions and platforms. Due to the close connections between the various subsidiaries, it can tackle large projects with correspondingly high resource requirements - even if the mix of Reply brands makes things less transparent for customers.

Zühlke is a special provider that not only positions itself as an Accelerator in the area of IoT Development Services, but also offers traditional engineering services. This means that Zühlke not only produces software, but also provides hardware engineering in, for example, the mechanical engineering field. The IoT and software area benefits from the fact that Zühlke has the DNA of an engineering company, especially in terms of the methodology and skills it uses to perform strongly in the IoT field. However, its sourcing model is clearly a disadvantage. As a Swiss company with many employees in Germany, Zühlke does not offer a mix nearshore and offshore resources. As a result, project costs can quickly escalate. Most of its previous project experience also focuses on the Microsoft stack, although it is gradually expanding its AWS and Google Skills.

IBM was able to position itself as an Accelerator, primarily because of its extensive development experience in customer projects and in the field of automation. In addition, IBM drives many innovations in the field of IoT. Furthermore, IBM has tried to establish proximity to the German automotive and industrialization market by locating its Watson IoT headquarters in Munich. The disadvantage is that IBM does not operate in a vendor-independent way, preferring to try and sell its own products during customer projects, which may not necessarily be in the customer’s best interests. Although IBM has excellent IoT experts, the staffing of every project at an equally high skill level is a challenge.

Accenture’s position as an Accelerator is due in particular to its broad industry knowledge and business process experience. This consulting provider has accumulated a lot of background knowledge, which is a great advantage for the positioning of IoT scenarios in different industries. Although Accenture has nearshore and offshore capabilities, customers report that they are missing IoT experience. As a result, Accenture IoT projects tend to either be very expensive, or suffer from skill challenges in the IoT area.

Infosys has been rated as an Accelerator due mainly to its extensive experience with IoT projects and its large number of developers. A good sourcing mix consisting of a traditional offshore model in India with an increasing number of nearshore employees also makes for attractive pricing for customers. Due to the growing number of employees in Germany, projects can also be staffed completely with local employees. Its IoT portfolio and process models are also well structured. The resource situation and the IoT portfolio structure make Infosys the sole Indian development service provider within the Accelerator Quadrant.

T-Systems is also a strong Accelerator, but it isn’t just a recommended option for projects that work with technologies from the Telekom portfolio. It has also developed skills on other platforms, including those that can only be combined with connectivity and devices from its own portfolio. However, T-Systems is also increasingly focusing on technologies that its customers have, but which Telekom does not currently operate. Of course, connectivity skills are a strength and customers are particularly well served by T-Systems when it comes to Narrowband IoT projects. However, T-Systems is not the best choice when it comes to Software Development on a Hyperscaler’s IoT platform.

Capgemini was able to position itself as an Accelerator as a direct competitor to T-Systems and Infosys. Unfortunately though, although it has already completed many IoT projects,
Capgemini does not do a good job of communicating its skills and procedural models, or present a structured service portfolio. Nevertheless, a good mix of resources from onsite, nearshore or offshore still puts Capgemini in the Accelerator Quadrant.

**EPAM Systems** is a young nearshorer which has also secured a good position in the Innovator field. It is growing rapidly and has a focus on new Cloud, IoT and AI technologies. With 26,000 employees, EPAM is well-suited for larger projects, has excellent experience in Node.js and other modern programming languages, and scores highly in projects through a good mix of German onsite and nearshore employees. One of the great strengths of EPAM is its end-to-end project engineering capability, including device engineering from the idea, via software and the device, to the operation of the Cloud. The core of the development team is based in Ukraine, but EPAM also has a presence in North America and Europe. Unfortunately, many potential customers are not aware of EPAM, which has prevented them from becoming an Accelerator rather than a strong Innovator.

**QSC**’s Q­loud offering positions the company as an Innovator in this third market segment. But it has only achieved this because, in addition to its own products, Development Services for the other leading IoT platforms are also presented in a credible way. QSC has good industry know-how across energy management, trading and logistics. Combined with the remaining portfolio elements in Edge Technologies and Cloud Platforms, QSC is a strong Development Service Provider.

With less than 50 employees, Stuttgart-based **Sotec** is currently a well-kept secret in the industry, offering end-to-end hardware, software development and integration. Sotec is one of the few providers with skills in Google’s IoT offering, and is referred to by Google as one of its IoT implementation partners. Of course, Sotec can only play a limited role in larger projects because of its small size.

**MaibornWolff** has 360 employees based mainly in Munich, with a lot of IoT experience and a rather conservative corporate culture. Its IoT references come from the automotive and transportation industries. MaibornWolff convinces with its methodological competence and development skills in modern programming languages, as well as the fact that it has developers for firmware development. However, the company is focusing mainly on building its base of local employees and does not offer its own nearshore / offshore option. Those employees don’t focus on IoT exclusively, but also offer data management, mobile development and consulting. This means larger IoT projects with short lead times are a challenge.

With a team of about 140 developers from locations in Poland and the Ukraine, **PLVision** has been providing Development Services in Europe and the USA for 10 years. Compared to some other vendors in this Vendor Universe, PLVision has a lot of expertise at the firmware level. Numerous case studies demonstrate its embedded software development competence, even with wireless fieldbuses. PLVision is also suitable as a project participant that can bring these skills to a larger IoT project. Therefore, PLVision is more likely to be seen as a competent niche provider in the Innovator Quadrant, since despite the case studies, it still has no branch office in Germany. Neither does PLVision have any experience with the three Hyperscalers, although its experts are familiar with the industry platforms offered by Predix, Thingworx and Bosch.

**Axians** is the IT Services subsidiary of Vinci Energies. Vinci is a corporation that operates large-scale commercial buildings ranging from power plants to hotels. As a result, Axians has gathered a lot of IoT experience from its internal Group market, which it has been leveraging in the open market for several years. With a high level of service value, Axians is positioned almost at the level of IBM and significantly above Accenture or T-Systems, because its IoT portfolio structure and process models are well defined, and it has relevant skills for utilizing the leading IoT platforms. In addition, Axians’ presence is distributed across small offices in Germany, enabling it to offer good customer proximity, and proximity to physical facilities. However, Axians still needs a better nearshore / offshore mix to enable it to be more aggressive on price.

**daenet** offers some expertise in industrial IoT solutions. In contrast to most other development service providers, daenet can
also bring in ready-made software frameworks - in particular for an IoT middleware - to shorten project runtime. Although this has initial benefits, customers need to be aware of their long-term commitment to daenet because their frameworks are not open-source. In addition, it is very focused on Microsoft, which puts is towards the bottom of the Innovator Quadrant.

As a triple player, Relayr is present in all three customer-relevant market segments as an Innovator and is focused entirely on IoT. Here in the Development Services market, it was only just able to qualify for the Innovator Quadrant because, outside of its own technologies, performance is poorly defined. It does have partnerships and competencies with GE Predix, SAP Leonardo and Wago in the industrial environment. Its nearshore and offshore options also allow it to deliver medium to large projects.

CGI is one of the heavyweights in the IT services sector with $10 billion in revenue and 70,000 employees. Despite its size, the IoT portfolio is rather weak and it does not communicate about any procedural models for IoT projects. For these reasons, CGI leads the Challenger Quadrant.

HCL is one of the mid-sized IT service providers with its origin and headquarters in India, offering everything from development to desktop management services. Although HCL has a better structured IoT service portfolio than other Challengers, it has no references in DACH.

Freudenberg IT is the IT subsidiary of the Freudenberg Group, and is also positioned at the top of the Challengers Quadrant, close to the border with the Accelerator Quadrant. Good Industry 4.0 references, especially relating to SAP technology, make Freudenberg IT an attractive IoT integrator. Nevertheless, its portfolio description, process models and sample project structures do not position its IoT skills strongly to new customers.

With sales of 12 billion euros, Atos is one of the heavyweights in the IT services market and still focuses on managed services. This also allows Atos to outsource operating services, for example from Mindsphere Deployments outside of the Hyperscalers. Although Atos has realized many IoT projects, especially for Siemens, the French giant does not promote an IoT service portfolio or process models. In addition, compared to the size of the company, references outside of the familiar major customers are noticeable by their absence. This clearly puts their performance credibility within the Challenger Quadrant.

Tech Mahindra is another Indian company with IoT Development Service Provider ambitions. Similar to Zühlke, Tech Mahindra also has an industrial engineering background, but in this case it comes from its own parent company. The Mahindra Group is one of the largest Indian automotive manufacturers. Tech Mahindra is beginning to promote the structure of its service portfolio. Although Crisp Research knows that Tech Mahindra also works for German car manufacturers, far too few references have been published. One strength the provider has is in the development of embedded software (firmware) that runs within vehicles or industrial IoT controllers. Tech Mahindra’s Challenger status owes much to its lack of expertise with the big IoT Cloud platforms.

Gemalto, which has positioned itself as a strong Accelerator in Edge Technologies, only achieves Challenger status as an independent IoT Development Service Provider. To achieve a higher position, it would need to promote many more skills outside of its own technologies and with the leading IoT Cloud Platforms. Wherever Gemalto Technologies are already being used, a Gemalto solution can make sense for medium and larger IoT projects.

Like Tech Mahindra, Tata Consulting Services (TCS) is the IT arm of an Indian corporation, only the Tata Group is much larger. However, within this Vendor Universe, TCS is behind Tech Mahindra and in the midfield of all the Indian IT service providers. TCS does not promote its IoT portfolio sufficiently, even though it offers ready-made IoT project frameworks.

Wipro also operates globally from India but is still in the orientation process regarding how the company wants to position itself in the future IoT market. As a result, it finds itself in the midfield of the Challengers.
DXC Technology, the result of the HP Enterprise and CSC merger, does not provide information on its IoT service portfolio. Although there are some reference customers, DXC is lagging far behind its potential.

Cognizant, with $13 billion in revenue and 260,000 employees, is a heavyweight among Indian Service Companies. It is all the more surprising therefore, that it provides no information about its IoT service portfolio. Cognizant is at the bottom of the Challengers Quadrant.

Robotron leads the Emerging Players in this field, with a strong service value offering. Although it is much better positioned as an Innovator with its Edge Technologies (Edge devices & other IoT hardware), this know-how is insufficient compared to leading service providers that deliver complete IoT solutions, especially when they are delivered on the Hyperscaler’s IoT Cloud platforms.

BEDM is a local IT service provider with two locations in Germany. Although it delivers custom solutions, BEDM has also recognized the value of Intellectual Property and has created an Industry 4.0 framework. This will give BEDM a strong position as an emerging vendor. However, the framework is not available as a Cloud service, nor as software for projects outside of BEDM services. It is still a long way from a software product that allows customers to change their implementation partner without any risk. Either BEDM has to turn this framework into a real product and sell it outside of its own projects, or open it up to reduce the long-term risk for the user.

Nordcloud from Finland emerged as one of the leading Accelerators in the Managed Cloud Provider market in the general Cloud Vendor Universe, but can only position itself as an Emerging Player in terms of IoT development performance. The most important reason for this is the lack of a clearly defined IoT portfolio or any reference projects in Germany. Nevertheless, NordCloud can also make a high-quality development and operations contribution to IoT projects running on Hyperscaler platforms. In particular, Crisp Research is aware that NordCloud has experience with Google, as well as with AWS and Azure. We recommend combining NordCloud’s offering with those of other service providers which have more IoT device-related skills but perhaps less in the way of Cloud native platform skills.

Concise Software, with its locations in Berlin and Poland, has a good mix of nearshoring and local presence. Unfortunately, neither service portfolios nor process models are communicated publicly, which calls into question whether the company really has a systematic and repeatable procedure.

iXperta is a Czech software specialist and management buyout from the Siemens Group. This agile company, which is now independent of Siemens and for the most part belongs to the management team, has been operating software product development using a nearshore model for decades. Much of this has been communications software running on hardware appliances or SIP phones. Unfortunately, iXperta is only now beginning to transfer this experience from the "old embedded software world* into the new IoT devices arena, and is therefore only positioned as an Emerging Player. iXperta is a good choice if you don’t just need a short IoT project solution, but are rather seeking continuous development and maintenance of IoT products for your own customers in a nearshore country.

ubk, also from the Czech Republic, addresses the German IoT market and is a small, agile service provider with some IoT references. Unlike iXperta, ubk focuses on individual projects. With 10,000 employees, KPIT is one of the small Indian IT service providers that now also addresses the German market. Due to its size, it can also handle medium and larger projects. However, KPIT lacks a clearly defined portfolio and customers must engage in a direction discussion to find out whether the available skills fit their requirements.

Navyug Infosolutions completes the Emerging Player Quadrant. This small Indian development shop only has around 50 employees, but can deliver embedded software for certain IoT devices very competitively. However, the narrow focus and small size of the company limit its positioning.
IoT Telco Stacks

The Telco Stacks market segment is for telecoms companies that want to integrate and sell a complete IoT portfolio of their own connectivity services and other components from technology suppliers. This makes the Telcos themselves IoT Cloud Backend Providers. Many technology providers who contribute to Telco Stacks also offer an IoT Cloud Backend or Edge Technology directly to the end customer. However, some technology components are pure software products that only become a Cloud service via the Telco. As a result, they are not evaluated within the IoT Cloud market segment. Other providers have also decided to offer their products only to Telcos in Germany and not to end customers. In order to be relevant within the Telco Stacks, software products must meet some criteria that are not relevant in other markets. These include massive scalability or extensive white-labeling of the solution. Integration into Telco provisioning and billing systems is also essential. However, three of the vendors evaluated here also specialize in meeting the needs of Telcos and are nowhere to be found in other market segments.

While 30-40 vendors were evaluated in the other market segments, the Telco Stack market segment comprises just 12 offerings that are currently relevant for Telcos in Germany. Let’s focus on the providers which help Telcos offer IoT Cloud Backend or IoT Edge Technology. As described earlier, we have intentionally excluded the connectivity equipment providers. In the Telco Stacks market segment, 7 providers are positioned as market leaders in the Accelerator Quadrant. This is mainly due to the fact that as an Emerging Player, it is relatively difficult to work with Telco companies that are typically quite large. In other words, the market entry barriers are quite high here.

Sierra Wireless offers Device Management similar to Software AG’s Cumulocity, but with a few more features that are specifically relevant for the Telco Stack. In addition, its positioning is improved by the manufacturing of its own hardware. This makes for an ideal combination for Telcos that need to provide connectivity for large numbers of devices. Sierra Wireless communicates about its product and the entire company poorly, which is why it is positioned at the left Edge of the Accelerator Quadrant. Moreover, Sierra Wireless does not have a complete programming environment or sensor data storage.

Cisco Jasper is one of the leading connectivity management systems for IoT landscapes. It is even better positioned here in the Telco Stack than it is in terms of direct sales to companies within the Edge Technologies market segment. This is mainly due to two factors. First of all, Cisco Jasper has some skills that are more suited to Telcos and used less frequently or not at all by other companies. Secondly, Cisco Jasper is not a complete Edge Management solution. For example, many Telcos use Jasper to manage connectivity and combine it with Cumulocity for the rest.
of the required Device Management and simple Sensor Analytics functions. While adding another tool always adds cost and complexity for other businesses, Telcos are accustomed to scaling services by integrating a large number of tools into dashboards.

Software AG is well positioned for the direct and Telco markets with its Cumulocity solution, which is also used within Deutsche Telekom’s IoT portfolio. In fact, the split between licences sold to Telcos and businesses is roughly 50/50. Extensive re-branding and integration capabilities also make the software particularly attractive to Telcos, which can then operate it themselves.

Huawei now has a broad portfolio of network equipment, servers and Edge hardware, and software products. Since the number of Telcos is manageable, Huawei can afford to make individual products available only after consultation with potential customers in the German market. This includes, for example, a current OpenStack hardware and software environment that supplies the Open Telekom Cloud at Deutsche Telekom. This makes the Telco comparable to a Hyperscaler and offers the environment the ability to offer high-value tools such as Cumulocity available in a stable way. However, Huawei also continues to offer products for supplying Narrowband IoT or LoraWan in the Telco equipment sector. In addition to hardware, Huawei is increasingly offering software that positions it as a strong Edge Technology provider in the Telco Stacks segment, as well as in data center infrastructure.

Ericsson is a traditional telco equipment manufacturer that does not serve businesses directly. Although we do not evaluate pure Telco equipment, it is remarkable how much software from the transmission towers communicates directly with IoT devices. Examples include wireless 5G IoT scenarios such as vehicle-to-vehicle communication in autonomous vehicles. Unfortunately, Ericsson has not managed to achieve user visibility via the telcos. This Analyst View provides an overview of wireless IoT connectivity.

Akamai is known as a CDN provider and its products are an integral part of the infrastructure of almost all Telcos. With its newly distributed MQTT broker offering, it has positioned itself as an attractive provider of technology components for an IoT Telco Stack.

Microsoft is well on the way to translating its strong IoT Clouds and enterprise Edge Technologies strategy for the Telco market. Unfortunately, the products do not always match Telco requirements, which pushes them to the bottom of the Accelerator quadrant. This can be seen, for example, within Azure Germany, which is an Azure instance managed by Deutsche Telekom. Although Microsoft could make all Azure IoT services available here, Telekom has decided to use its own mix of technology partners operating on the Open Telekom Cloud (based on Huawei’s Openstack). Nonetheless, the Microsoft offering remains within the Accelerator quadrant due to its strong technology components and the ability to place an Azure Stack at strategically-significant locations within the Telco infrastructure, and may well play a key IoT role within other Telcos.

As an Emerging Player, Hitachi Vantara finds itself a long way behind as far as the end user business is concerned. Here in the Telco Stacks segment, Vantara’s Lumada sits confidently within the Innovator Quadrant. Although some of the functionality within the British Telecom IoT stack comes from Lumada, it is relatively unknown in the DACH Telco market.

Although Samsung was twice able to position itself as an Accelerator with its Artik Cloud and Edge Technologies, it is only an Innovator when it comes to meeting Telco requirements. Although the functionality it provides is also attractive for Telcos, most of them do not see Samsung’s Artik as a way of bringing smart building offerings to the market. Another example is Deutsche Telekom, which has developed a large part of this IoT functionality itself within the Qivicon alliance. Samsung’s main competitor OSRAM does not yet offer Telco-specific solutions.

Atos is the Challenger Quadrant leader in the Telco space. Although it has very high visibility within Telcos in some countries, which has been boosted further through its acquisition of Unify, the company continues to build many relevant technologies only at the request of specific Telcos. With IoT Stacks, this concept no longer works because of the enormous speed of innovation in the market.
BlackBerry, known best as the messenger technology of the last decade, has developed tremendous efficiency for managing large numbers of mobile devices and successfully sold it to telcos for many years. What used to work for Mobile Messenger could also now work for mobile IoT devices with just a few changes. With their device management, for example, they address mobile trackers in the logistics sector. But BlackBerry needs to offer even more modern IoT functionality to "climb" into the Accelerator Quadrant again.

Digimondo is an innovative German company that is currently focused primarily on offering its LoRaWan technology to businesses or municipalities. With at least two of its four portfolio elements, it could also generate good opportunities with Telcos in the future. For example, Digimondo Connectivity Management is actually technology-independent and works equally well with LoRaWan NB-IoT. We also view the Digimondo IoT Data Hub as being a possible component in a Telco Stack.
## VENDOR ANALYSIS | IoT CLOUD BACKEND-AS-A-SERVICE

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## VENDOR ANALYSIS | IoT CLOUD BACKEND-AS-A-SERVICE

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## Vendor Analysis | IoT Edge Technologies

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### Vendor Performance

<p>| Strategy 20 % | ABB 70 % | Adlink 50 % | Advantech 75 % | Almacal 40 % | Arm 80 % | AWS 90 % | Beckhoff Automation 80 % | Bosch 70 % | BT 50 % | Cisco Jasper 80 % | Cybus 50 % | Darrs Networks 50 % | Dell 30 % | Device Insights 60 % | Digital Concepts 35 % | eQ 30 % | Eurotech 20 % | FogHorn 90 % | Gemalt 20 % | Hitachi Vantara 90 % | IBM 60 % | IoBroker 80 % | iTC 50 % | Microsoft 90 % | Average 60 % |
| Footprint 20 % | ABB 60 % | Adlink 60 % | Advantech 35 % | Almacal 100 % | Arm 85 % | AWS 80 % | Beckhoff Automation 100 % | Bosch 80 % | BT 90 % | Cisco Jasper 25 % | Cybus 25 % | Darrs Networks 80 % | Dell 30 % | Device Insights 25 % | Digital Concepts 80 % | eQ 20 % | Eurotech 70 % | FogHorn 20 % | Gemalt 90 % | Hitachi Vantara 20 % | IBM 90 % | IoBroker 30 % | iTC 20 % | Microsoft 70 % | Average 60 % |
| Ecosystem 25 % | ABB 70 % | Adlink 50 % | Advantech 45 % | Almacal 100 % | Arm 80 % | AWS 60 % | Beckhoff Automation 80 % | Bosch 75 % | BT 30 % | Cisco Jasper 40 % | Cybus 85 % | Darrs Networks 55 % | Dell 50 % | Device Insights 25 % | Digital Concepts 20 % | eQ 90 % | Eurotech 70 % | FogHorn 20 % | Gemalt 50 % | Hitachi Vantara 20 % | IBM 60 % | IoBroker 60 % | iTC 30 % | Microsoft 75 % | Average 59 % |
| Customer Experience 15 % | ABB 80 % | Adlink 70 % | Advantech 40 % | Almacal 50 % | Arm 90 % | AWS 60 % | Beckhoff Automation 60 % | Bosch 60 % | BT 40 % | Cisco Jasper 45 % | Cybus 50 % | Darrs Networks 30 % | Dell 80 % | Device Insights 30 % | Digital Concepts 30 % | eQ 40 % | Eurotech 55 % | FogHorn 30 % | Gemalt 30 % | Hitachi Vantara 40 % | IBM 60 % | IoBroker 60 % | iTC 40 % | Microsoft 90 % | Average 55 % |
| Agility 20 % | ABB 70 % | Adlink 70 % | Advantech 40 % | Almacal 60 % | Arm 100 % | AWS 50 % | Beckhoff Automation 60 % | Bosch 60 % | BT 45 % | Cisco Jasper 60 % | Cybus 45 % | Darrs Networks 35 % | Dell 70 % | Device Insights 30 % | Digital Concepts 30 % | eQ 70 % | Eurotech 60 % | FogHorn 20 % | Gemalt 20 % | Hitachi Vantara 100 % | IBM 20 % | IoBroker 60 % | iTC 20 % | Microsoft 100 % | Average 54 % |</p>
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## Vendor Analysis | IoT Development Services

### Service Portfolio
- **Accenture**: 60% | 40% | 85% | 60% | 60% | 50% | 30% | 20% | 60% | 40% | 75% | 50% | 55% | 40% | 80% | 75% | 30% | 30% | 54% | 57%
- **Atos**: 70% | 50% | 70% | 40% | 70% | 45% | 30% | 40% | 50% | 35% | 80% | 50% | 45% | 50% | 60% | 60% | 40% | 40% | 57%
- **Axians**: 80% | 60% | 80% | 45% | 65% | 60% | 40% | 40% | 50% | 45% | 70% | 50% | 45% | 40% | 90% | 70% | 40% | 45% | 59%
- **Capgemini**: 70% | 50% | 70% | 35% | 65% | 50% | 25% | 60% | 40% | 30% | 90% | 45% | 40% | 80% | 70% | 65% | 60% | 35% | 56%
- **CGI**: 80% | 70% | 70% | 40% | 70% | 45% | 30% | 65% | 40% | 50% | 80% | 50% | 45% | 90% | 70% | 65% | 60% | 35% | 52%
- **Cognizant**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **daemonet**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **DXC Technology**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **EPAM Systems**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **Freudenberg IT**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **Gemalto**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **IBM**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **Infosys**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **iXperta**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **KPIT**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%
- **Average**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55% | 52%

### Vendor Performance
- **Strategy**: 90% | 70% | 40% | 10% | 80% | 70% | 40% | 20% | 65% | 55% | 55% | 60% | 45% | 90% | 70% | 30% | 10% | 52%
- **Footprint**: 90% | 100% | 40% | 20% | 90% | 90% | 90% | 20% | 10% | 80% | 60% | 80% | 100% | 90% | 90% | 80% | 100% | 50%
- **Ecosystem**: 80% | 60% | 45% | 20% | 70% | 60% | 90% | 20% | 40% | 70% | 20% | 70% | 55% | 50% | 90% | 60% | 40% | 30% | 48%
- **Customer Experience**: 80% | 60% | 55% | 30% | 60% | 90% | 40% | 40% | 65% | 70% | 60% | 55% | 50% | 90% | 60% | 50% | 30% | 55%
- **Agility**: 80% | 60% | 40% | 40% | 50% | 60% | 75% | 45% | 40% | 60% | 80% | 50% | 60% | 50% | 75% | 60% | 50% | 20% | 53%
# Vendor Analysis | IoT Development Services

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# CRISP VENDOR UNIVERSE | INTERNET OF THINGS (IoT) VENDOR & SERVICE PROVIDER

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**IoT Cloud Backend-as-a-Service**
## INTERNET OF THINGS (IoT) VENDORS AND SERVICE PROVIDERS

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## INTERNET OF THINGS (IoT) VENDORS AND SERVICE PROVIDERS

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IoT Development Services

IoT Telco Stacks
IOT VENDOR & SERVICE PROVIDER

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IOT PORTFOLIO

Within the Reply group of more than 100 companies and more than 7000 employees, several companies provide services for the development or operation of IoT projects. Concept Reply offers experience in the device and firmware area agnostic to the cloud platforms and can be combined with Reply companies, which focus for example on AWS or Azure. In addition, there are Reply companies that focus on specific topics such as smart cities. In order to help other small companies and start-ups in the IoT environment with their first steps, the Reply Group has founded Breed Reply, an IoT incubator and investment company.

ANALYST VIEW

The Reply Group can position itself as a leading provider of services and development services in the IoT environment. In particular Concept Reply has specialized as a software factory especially on IoT Development Services. The team of 30 specialists develops independently of the frameworks and technologies and uses for each customer the individually optimized technology stack for firmware, backend and frontend. The high level of competence in accompanying holistic IoT projects throughout the entire lifecycle, independent of manufacturer and technology, has already been proven by several well-known customers.

STRENGTHS

- High agility of the individual Reply companies due to small team sizes
- Well-known references on an enterprise level including the consumer IoT and Industry 4.0 range
- High level of expertise both in sector-specific IoT projects and in pure technology projects

WEAKNESSES

- Low number of employees of the individual Reply companies limits delivery capability in major projects. Sourcing from other Reply companies can slow down agility.
- The overall IoT portfolio within the Reply Group is confusing for customers.
- Despite the great agility of the small and medium-sized Reply companies, the perception as a cooperating network is not visible to customers.
APPENDICES
CRISP VENDOR UNIVERSE | INTERNET OF THINGS (IoT) VENDOR & SERVICE PROVIDER

PROCESS AND METHODOLOGY

In the third edition of the Crisp Internet of Things (IoT) Vendor Universe, analysts and consultants from Crisp Research have once again undertaken an analysis of the development of the most important market categories around IoT, and the key vendors/service providers active within them. In particular, the evaluation is focused on the requirements of medium-sized and large companies that are searching for suitable IoT partners and service providers within the context of their digitalization strategies and the further development of their IT infrastructures. The results of the completed analyses include, among other things:

- Manufacturer ratings and positioning within the "Crisp Vendor Universe" Quadrant
- Detailed analysis of the scoring model for market comparisons
- Strengths and weaknesses of the providers, their portfolios and their impact on Cloud Computing
- Analyst statements on strategies and portfolios

The analysis inputs that form the basis of our conclusions include user surveys, manufacturer information, expert interviews and results of Crisp Research’s own studies. This process involves the following four phases:

**RESEARCH**

Extensive secondary research is carried out which, in addition to reviewing the offerings of the individual providers, also includes an evaluation of Internet and marketing materials, as well as product/service specifications.

**PROVIDER SURVEY**

Another component is the supplier survey, conducted via a standardized questionnaire. The questionnaire consists of 20-30 questions which help profile the strategy, market positioning, portfolio and the innovation capabilities of each provider.

**USER INTERVIEWS**

Discussions with market and technology experts, as well as Vendor customers are also important components. In addition, Crisp Research can leverage its broad experience of consulting projects with users to assess the actual performance of providers in real world implementations.

**RATING**

The three previous phases form the basis for the final evaluation and positioning of the providers. The information and insights gained from each step are consolidated and rated according to pre-defined criteria.
At the third definition level, the respective criteria are defined even more closely based on the specific market in question. This ensures that the precise criteria used to rate each Provider are aligned with the requirements of each respective market. This enables Crisp Research to provide a complete Provider rating for both technology Vendors and Service Providers in each market environment.

They always include the following criteria:

**EVALUATION CRITERIA**

The evaluation criteria comprise a total of three definition levels. They are divided into two main categories, “Product Value Creation” and “Vendor Performance”, each containing five subcategories. The subcategories (2nd level of definition) include the defining product or service features, and the percentage weighting applied to each. “Product Value Creation” focuses mainly on the market maturity of the service offer and is therefore evaluated predominantly on the basis of each Provider’s product or service offering. This includes the user experience and implementation options of the solutions, as well as the price point and the added value potential for users. “Vendor Performance” focuses on the strategic and tactical approaches that each company takes in relation to each respective market environment. These include, for example, thought leadership in the respective market, a good partner network, as well as responsiveness and innovation speed. The first two definition levels are standardized independently of the specific market environment and serve as the evaluation foundation for every Vendor Universe.

<table>
<thead>
<tr>
<th>SERVICE / PRODUCT VALUE CREATION</th>
<th>VENDOR PERFORMANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>Strategy</td>
</tr>
<tr>
<td>Service / Product Experience</td>
<td>Footprint</td>
</tr>
<tr>
<td>Integration</td>
<td>Ecosystem</td>
</tr>
<tr>
<td>Economics</td>
<td>Customer Experience</td>
</tr>
<tr>
<td>Disruptive Potential</td>
<td>Agility</td>
</tr>
</tbody>
</table>

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STRATEGIC CLASSIFICATION WITHIN THE “CRISP VENDOR UNIVERSE”

The Crisp Vendor Universe provides a scoring for each provider made up of a total of 10 sub-criteria. Dependent on the respective main category, each of these criteria is weighted according to the market environment, which in turn gives us an assessment of the maturity of the technology or service (“Product/Service Value Creation”) and the strengths of the Provider in the market (“Vendor Performance”). The Crisp Research Vendor Universe Quadrant categorizes each provider into one of the following four fields:

- **ACCELERATOR**
  Providers classified as "Accelerators" are the most important players within their respective market environments. Thanks to an attractive portfolio that gives companies optimal support in implementing their respective business project, as well as a clear strategy, organization and visibility, the Accelerators belong on every supplier shortlist.

- **INNOVATOR**
  "Innovators" are characterized by an attractive portfolio and a high level of technological competence. Product and service innovation and development potential are particularly high among Innovators. However, these providers often lack general visibility and awareness among users, indicating that they need to evolve their approach, especially at a strategic level.

- **CHALLENGER**
  " Challengers" have a strong market and competitive position but have a lot of catching up to do at the technology or service level and are behind the Accelerators in terms of the degree of implementation and innovation they have achieved.

- **EMERGING PLAYER**
  Companies positioned as "Emerging Players" are still lacking a mature technology or range of services. At the same time, various other deficits and improvement potential in terms of market and competitive positioning are also easily identifiable. As relevant providers however, Emerging Players still have the potential to develop into attractive Providers if they evolve their portfolio and strategy sufficiently.
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RELATED RESEARCH

- **Analyst View** “Software AG wird mit Cumulocity zu einer IoT Plattform Option”, April 2017
  

- **Analyst View** “Industrie 4.0-Hype blockiert IoT-Innovationen und digitale Produkte”, Mai 2017
  
  https://www.crisp-research.com/industrie-4-0-hype-blockiert-iot-innovationen-und-digitale-produkte/

- **Analyst View** “IoT-Plattform Auswahl – Wie CIOs die richtige Entscheidung für ihre IoT-Projekte treffen”, Juni 2017
  

- **Analyst View** “Leonardo IoT: SAP spielt mit dem Vertrauen seiner Kunden”, Juni 2017
  

- **Analyst View** “Industry Of Things World’ Oder ‘IoT Expo’ – Welche Messe trifft den IoT Puls?”, September 2017
  

- **Analyst View** “IoT Vendor Universe – Research-Phase gestartet”, Oktober 2017
  
  https://www.crisp-research.com/iot-vendor-universe-research-phase-gestartet/

- **Analyst View** “IoT-Anbieter-Landschaft”, November 2017
  
  https://www.crisp-research.com/IoT-Anbieter-Landschaft/

- **Analyst View** “Microsoft IoT Central: SaaS wird auch für IoT Mainstream”, Dezember 2017
  
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RELATED RESEARCH

- **Analyst View** “Vom IoT-Projekt zur IoT-Plattform – Die IoT Trends im Jahr 2018”, Februar 2018
  

- **Analyst View** “Industriespezifische IoT PaaS-Plattformen”, März 2018
  

- **Analyst View** “IoT Connectivity - Der drahtlose Weg in die Cloud”, Mai 2018
  

- **Analyst View** “IoT und Open Source - Teil 1: Eclipse”, Juli 2018
  

- **Analyst View** “Digitale IoT-Produkte und traditionelle Produkte - zusammen stark”, August 2018
  
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ABOUT CRISP RESEARCH

Crisp Research AG is an independent IT Research and Consultancy company. Through its team of experienced analysts, consultants and software developers, Crisp Research evaluates current and future market and technology trends. Crisp Research also supports companies in the digital transformation of their IT and business processes.

Analysis and commentary from Crisp Research is published and discussed across a wide range of specialist business and IT magazines and social media platforms. As “Contributing Editors” to leading IT publications (Computerwoche, CIO, Silicon et al.), as well as highly engaged BITKOM members and in-demand keynote speakers, our analysts actively contribute to debates around new technologies, standards and market trends, and are highly influential within our industry.

Crisp Research was founded in 2013 by Steve Janata and Dr. Carlo Velten, and focused its research and consultancy activities on “Emerging Technologies” such as Cloud, Analytics or Digital Marketing, and their strategic and operational implications for corporate CIOs and business decision makers.
Internet of Things (IoT) - Research Team

Dr. Stefan Ried

Dr. Stefan Ried – IoT Practice Lead, Principal Analyst – is responsible for the research and consulting activities covering IoT and modern platform architectures. Stefan Ried worked previously at Unify, a global communications and collaboration vendor as CTO. Graduated in Physics with a PhD at the Max Planck Institute, Germany, Stefan brings 20 years of experience in senior positions in software development, product management and marketing from international vendors to Crisp Research. His experience includes two software startups and major players including SAP and Software AG. Over 7 years at Forrester Research, Stefan lead the cloud platform research globally as a Vice President.

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