

PAC RADAR

Digital CX & IoT | Europe | 2019

Platforms for IoT & AR in Europe 2019

SITSI | Vendor Analysis | PAC RADAR

IoT platforms based on open source

– Positioning of Bosch Software Innovations –

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PAC Germany, July 2019

teknowlogy | PAC

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IT SUPPLIER ASSESSMENT FROM PAC

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DOCUMENT INFORMATION

Author: Arnold Vogt (avogt@teknowlogy.com)

Publication: July 2019

Last update: n/a

Scope ID: Digital CX & IoT | Europe | 2019

Portfolio ID: SITSI | Vendor Analysis | PAC RADAR

Related reports: This document is part of a series of five RADAR reports.



OBJECTIVE OF THIS REPORT

The purpose of the PAC RADAR from the market research and strategic consultancy PAC (teknowlogy Group) is to provide a holistic evaluation and visual positioning of leading IT providers within a defined IT segment on a local market. Using predefined criteria, the providers' revenue volumes and development and market share are assessed and compared alongside their performance and specific competences in the relevant market segment.



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INTRODUCTION

The broader context of IoT platforms

The basic IoT stack generally has three layers – IoT infrastructure, IoT platforms, and IoT applications.

- **IoT infrastructure** contains all required components to connect devices and machines to the Internet. This includes, for example, sensors and actors within these devices, but also network components such as gateways and embedded software on devices.
- **IoT platforms** form the layer connecting the IoT infrastructure layer and the IoT application layer.
- **IoT applications** are built to provide a solution for specific IoT use cases. This can, for example, be a predictive maintenance solution for a specific machine.

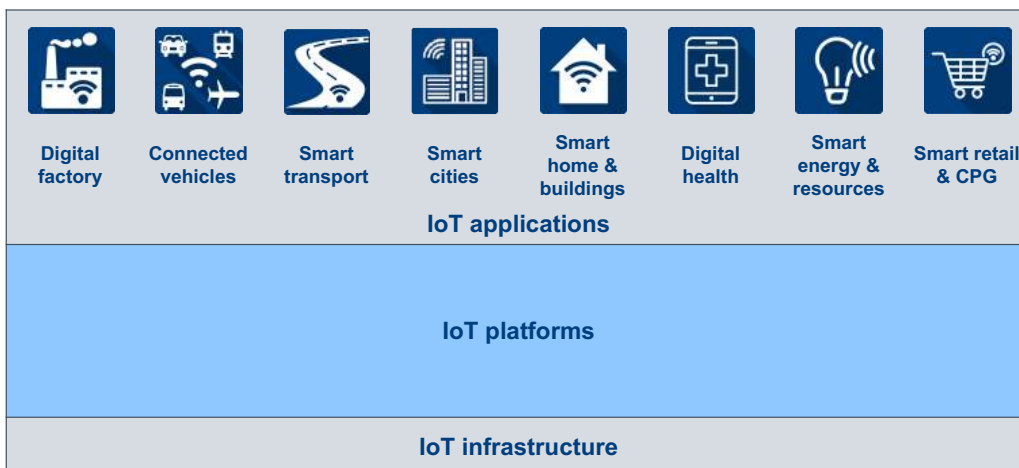


Fig. 1: Basic IoT stack

General definition of IoT platforms

The purpose of an IoT platform is to manage the underlying IoT infrastructure, create and manage IoT applications, and orchestrate the IoT dataflow between IoT infrastructure and IoT applications. To fulfill this purpose, IoT platforms have to provide two kinds of functionality to clients: IoT device management and IoT application management. Both functions can be deployed at the edge, in the cloud, or in a hybrid model.

- **IoT device management** covers device provisioning, device connectivity, remote SW updates, and remote control.
- **IoT application management** includes application development & integration, data management, analytics & artificial intelligence (AI), data visualization, and event processing.

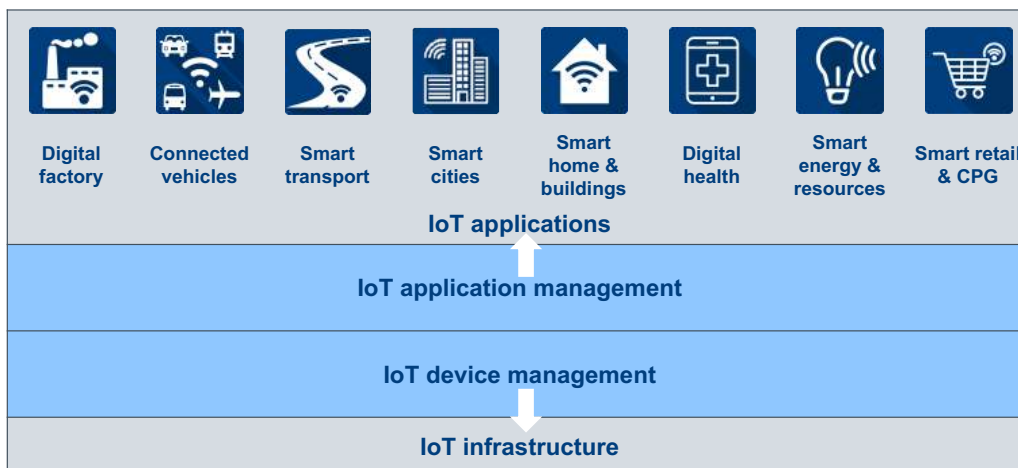


Fig. 2: Basic functional capabilities of IoT platforms

Basic differentiation of IoT platforms

We can basically split IoT platforms into two groups that address two different target audiences – developers and non-developers:

- **IoT platforms for developers** have very broad capabilities and therefore allow the development of more complex IoT solutions. This includes, for example, IoT applications which require advanced analytics or machine-learning capabilities. But besides complex IoT applications, the aspect of device management can also be highly complex, such as in the case of software updates over the air for a large fleet of connected cars.
- **IoT platforms for non-developers** are specifically tailored to the needs of subject-matter experts without developer skills. This kind of platform allows the fast development of less complicated IoT applications. This includes, for example, data visualization and event processing in a simple drag-and-drop mode. Also, device management capabilities are often more basic.

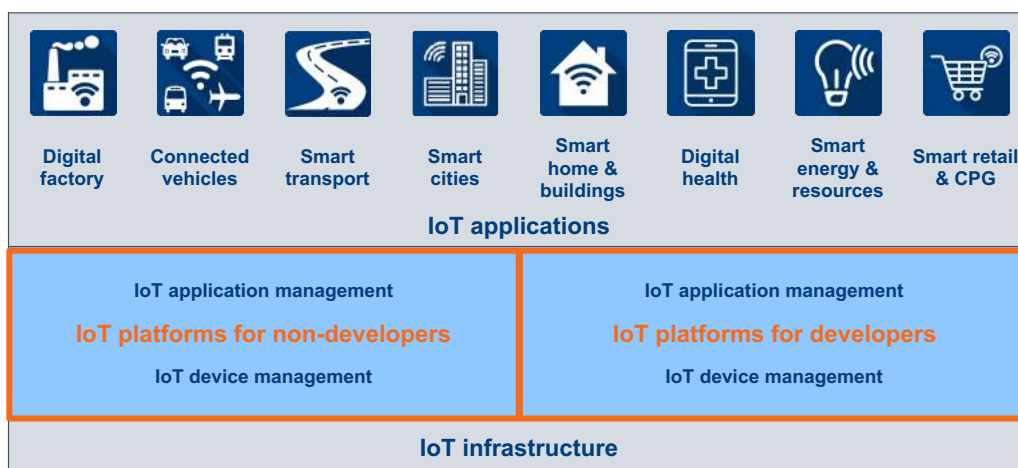


Fig. 3: Basic target audiences of IoT platforms

TRENDS: THE WORLD OF IOT PLATFORMS IS CONSOLIDATING AND EXPANDING SIMULTANEOUSLY

Consolidation of existing market segments

The world of IoT platforms today is more complicated than the above-mentioned basic differentiation indicates (figure 3). In reality, we observe that the market for IoT platforms for developers (around more complex solutions) is still more fragmented than the market for IoT platforms for non-developers. We identified four different market segments where we see providers offering different kinds of IoT platforms with different capabilities:

IoT platforms for developers

- **IoT platforms for analytics applications** focus on the enablement of developers to build more complex IoT applications such as predictive maintenance. For this purpose, an IoT platform has to provide deep capabilities around data analytics, artificial intelligence, application integration, and application development.
- **IoT platforms for device management** supports IT specialists with the critical management of complex device fleets on a large scale. From a functional perspective, besides device provisioning, these platforms mainly focus on centrally managed software updates at the device level (for security or functional reasons), but also remote configuration and control of devices.
- **IoT platforms for device development** are designed to manage IoT operating systems on embedded devices (embedded SW on constrained devices). This market will particularly be driven by the advent of a new range of lightweight IoT devices (based on microcontrollers with embedded SW) that communicate directly with an IoT platform via LPWAN technology (LoRA, Sigfox, NB-IoT), enabling security updates over the air on a large scale for many small devices out in the field.

IoT platforms for non-developers

- **IoT platforms for rapid application deployment** allow simple and fast device connectivity, data visualization via drag & drop dashboards, and event processing. This use case often serves as an easy starting point for clients in their journey towards IoT and is therefore frequently applied in the context of rapid prototyping.

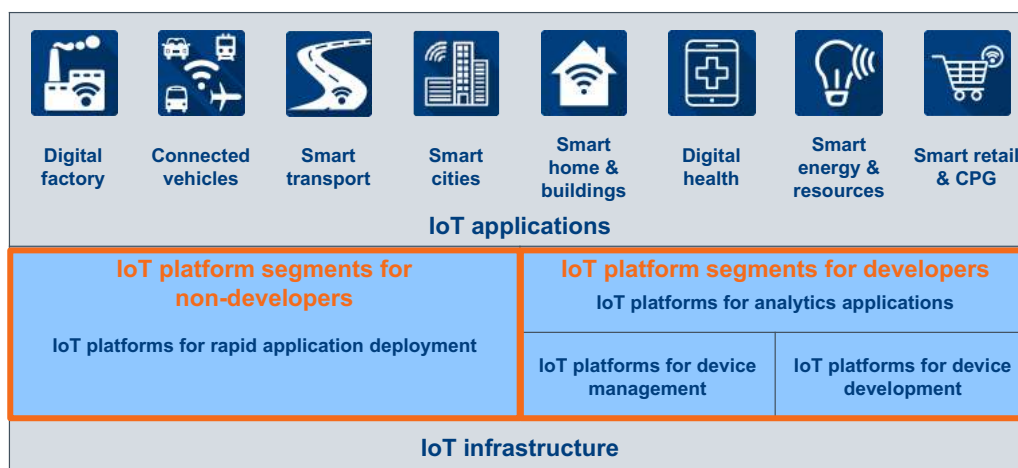


Fig. 4: Segmentation of the current IoT platform market

To evaluate the existing provider landscape in the above-mentioned market segments, teknowlogy published a user survey on IoT platforms in early 2019. The IoT Survey 2019 is the world's first biennial survey of IoT platform users, based on a sample of over 2,000 survey responses. The results offer detailed user feedback on 38 leading IoT platforms. You can download a summary of the key insights here: <https://www.iot-survey.com>

Going forward, we expect to see a consolidation of the current number of market segments. We mainly expect to see the integration of the three IoT platform segments for developers into one converged market segment. This will form a holistic offering, with many building blocks, for the individual needs of IoT developers. This trend will be driven especially by the two cloud hyperscalers Microsoft and AWS. Both players have the clear intention to offer a holistic portfolio for the needs of their developer community. To stay competitive, we expect other vendors to follow this trend – or exit the market. In addition, we expect to see an increasing overlap in the provider landscape between the two market segments for developers and non-developers. Nevertheless, we believe that these market segments will remain separate for the time being, as several players only offer an IoT platform for non-developers, without the intention to offer an additional IoT platform with broader capabilities for developers. Based on this perspective, we expect to see a simplified market segmentation in the future – IoT platforms for developers and IoT platforms for non-developers.

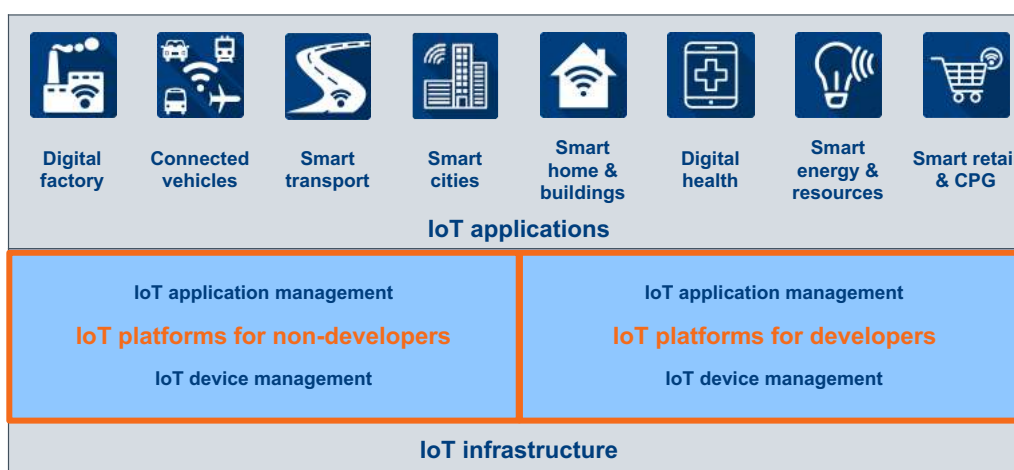


Fig. 5: Future segmentation of the consolidated IoT platform market

Newly emerging segments in the context of IoT platforms

Besides the ongoing convergence of established market segments, we also see new market segments emerging that have the potential to further enlarge the overall market scope of IoT platforms to new levels. Two of them are emerging around IoT applications, two are related to technology, and one market segment provides additional services around IoT data:

- Emerging market segments where we see providers moving beyond IoT platforms with the intention to offer an open IoT application marketplace on top of their platform:
 - IoT platforms with application marketplaces
 - IoT platforms with industrial application marketplaces
- Emerging market segments around technology that are currently significantly increasing in relevance and user attention in the context of IoT:

- IoT platforms based on open source
- Augmented reality (AR) platforms for connected workers
- A newly emerging market segment that provides add-on services around IoT data:
 - IoT data exchange & monetization platforms

Not all of these solutions are tightly integrated or linked with IoT platforms today; however, we expect that the further evolution of the market will lead to these emerging market segments increasing in relevance. Plus, if they represent a separate market today (like AR), they will increasingly converge with the IoT platform market (see figure 4). Let's take a closer look at why we believe that this will happen.

In the context of IoT platforms in combination with IoT applications, we already discussed last year the emergence of more vertically-oriented IoT platforms that provide industry-specific applications to their clients for dedicated use cases. However, the evolution of vendors towards this new model has been slow over the past 12 months. We currently observe two developments: first, as an interim solution, some vendors provide a horizontal IoT application marketplace that addresses more generic use cases such as device tracking and monitoring across different industries. Second, from a vertical perspective, we see the most traction to adapt to this new concept in the industrial space.

In the context of open source, the answer is straightforward. Across the IT market, open source software is highly relevant and attractive to many users. Linux, one of the dominant operating systems for servers, is just one example in this context. Therefore, we see no reason why this should not also be the case for IoT platforms. We notice an increasing interest from user companies in taking open source into account in their vendor selection process for IoT platforms.

In the context of AR, we observe several things happening simultaneously. On the provider side, AR application development platforms are becoming simpler and also increasingly usable for non-developers. Also, the necessary hardware, smart glasses, is constantly improving in quality, and prices are falling. On the user side, there is increasing adoption of AR in the manufacturing space to provide support in many areas, such as field services, assembly, quality control, logistics, and training. The increasing integration of IoT data into AR applications is a logical next step. Therefore, we see the potential of IoT platforms, as the source of IoT data, and AR platforms, as a new means to visualize this IoT data, converging in the future.

The increasing capturing and storage of IoT data in IoT platforms enables a new kind of service – the exchange of IoT data plus its potential monetization. New platforms are emerging that are designed to orchestrate the data exchange and monetization between different providers and consumers. Today, this kind of service is mainly separate from IoT platforms, and we observe different vendor landscapes. However, as both kinds of platform focus on the best possible utilization of captured data, the increasing convergence of them is a potential scenario. We expect to see some vendors offer both in the future.

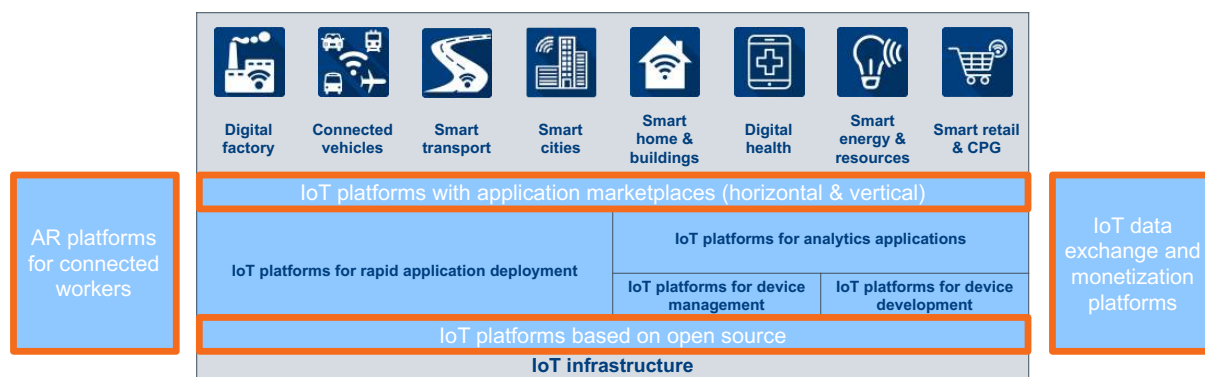


Fig. 6: Newly emerging segments in the context of IoT platforms

As a user survey on a broader basis is generally not possible for newly emerging markets such as the segments mentioned above (figure 5), we evaluate the provider landscape in our INNOVATION RADAR 2019 on IoT platforms. The INNOVATION RADARs provide our analyst perspective on the current provider landscape around newly emerging market segments.

IMPACT ON THE EXISTING VENDOR LANDSCAPE

To summarize the previous chapter, we basically observe two main trends – the consolidation of existing market segments and, simultaneously, the emergence of new market segments in the context of IoT platforms. Both trends are already having an impact on the existing vendor landscape for IoT platforms, and this impact will continue in the future:

- Intensifying competition leads to a new level of shakeout.
- Increasing relevance of partnerships with hyperscalers.
- Vendor repositioning to enhance differentiation.

Intensifying competition leads to a new level of shakeout

The consolidation of different market segments intensifies the competition between vendors. This is of course not new, but is now reaching a new level – from acquisitions to actual market exits. During 2014-2018, the vendor landscape constantly changed through acquisitions. This led to the market entry of big players such as AWS, Microsoft, SAP, Software AG, and Google. As a consequence, smaller players disappeared from the market and were replaced by large vendors. Over the past 12 months, besides further acquisitions by bigger vendors (ARM acquired Stream Technologies, Siemens acquired Mendix, and Munich RE acquired relayr), we also saw the first actual market exits of vendors. Windriver left the IoT platform market and transferred all assets to Telit. Samsung shut down its ARTIK cloud service. C3 IoT shifted its focus away from IoT use cases and even renamed the whole company to C3 AI to reflect this change in strategy.

Increasing relevance of partnerships with hyperscalers

In the IoT space, collaboration with external partners has been highly relevant for years. However, the nature of partnerships has been changing over time. At the beginning, we saw strong competition between the IoT platform providers to collaborate intensively with the big C&SI providers such as Accenture, IBM, or Capgemini. In the next phase, many IoT platforms started to also collaborate with each other, which is still the case. The latest trend is for many IoT platforms to especially intensify collaboration with Microsoft and AWS. These partnerships are not only limited to their cloud infrastructure; they also include the integration of IoT platform capabilities. At the beginning of 2019, SAP announced the integration of SAP Leonardo IoT with Microsoft Azure IoT, and later on also with AWS IoT Core. SAP's intention is to utilize the connectivity and device management capabilities of AWS and Azure to give clients more flexibility in this space. PTC has been doing the same with AWS and Microsoft. PTC's relationship with Microsoft is even more strategic and holistic, and also includes AR/mixed reality, besides cloud infrastructure and IoT. In 2018, GE Digital also announced the integration of its Predix platform with Azure IoT. Microsoft and AWS are also further increasing their relevance in the industrial space through the announced strategic partnerships with big automotive vendors around connected cars and the digital factory (BMW and Microsoft in the factory space; VW and Microsoft around connected car services; VW and AWS in the factory space, BMW and AWS around connected car services).

Vendors are repositioning and enhancing their differentiation with new capabilities

Vendors are turning towards repositioning and more differentiation to stay relevant in the tightening competitive landscape and to tap into new market opportunities.

SAP is shifting its focus to IoT applications and away from device management (they increasingly collaborate with Microsoft and AWS in this space, as mentioned above). In the application space they are focusing on application development and application management for developers and non-developers, plus application marketplaces.

Bosch Software Innovations is shifting its IoT positioning more and more towards open source, which is a good differentiator in the current market. The core of the Bosch IoT Suite is not only built on open source components, Bosch Software Innovations is also growing its consulting and system integration capabilities around open source-based IoT solutions in order to offer the whole stack of consulting, system integration, and managed services.

Siemens acquired Mendix, a low-code application development platform, with the intention to accelerate application development around MindSphere and build a growing industrial application marketplace. In addition, with the newly formed Business Unit for IoT Integration Services, Siemens is expanding its IoT platform offering to provide more support to customers in their digital transformation. Siemens plans to offer consulting, design, prototyping, and implementation services. The company plans to hire about 10,000 people in this area by 2025.

PTC, besides its IoT platform, ThingWorx, is increasingly investing into its AR platform, Vuforia. Their vision is to increasingly integrate IoT and AR, which will allow to use AR for the visualization of IoT data to connected workers. PTC also intends to build more and more standardized applications on top of ThingWorx and Vuforia to address dedicated use cases in a very easy-to-use way.



MARKET SITUATION – IOT PLATFORMS BASED ON OPEN SOURCE

Providers of open source software basically have a freemium business model. They give the entire software code, or at least a large proportion of it (otherwise attractiveness for users would be very limited and nobody would use it), away for free. Under this business model, vendors can earn money with consulting and system integration, hosting and support, or around proprietary software components for specific add-on functions. As open source software is generally becoming increasingly popular among user companies, we expect to see the same trend in the IoT space, too. This is why we will not discuss the general pros and cons of open source vs. proprietary software in this chapter. Instead, we will dig a bit deeper and focus on two specific questions:

- What makes a specific open source-based IoT platform more attractive to users than other open source-based IoT platforms?
- Who are the leading vendors in this field today?

What makes an open source-based IoT platform attractive to users?

One aspect we consider as highly relevant is a constant stream of improvements. The faster this stream is the better for users. This includes bug fixing on existing code, but also the development of totally new components to enhance the current functionality. This basically means for users that large and highly dedicated developer communities can provide the best value in the long run. This underlines the relevance of open source communities, which provide a framework for many different developers to collaborate under a joint governance model. They also ensure that no single entity can control the strategy, policies, or operations of projects. We do not see many open source communities dedicated to IoT in the market today, but some do exist. The most prominent examples are Eclipse IoT, FIWARE, and EdgeX Foundry. From our perspective, the Eclipse IoT Working Group is the leading open source community around IoT platforms today. We therefore included Bosch Software Innovations and Eurotech in our analysis as they are very active players in the Eclipse IoT community. We also considered including FIWARE-based vendors, but none of them have so far established a strongly open source-based IoT platform offering and/or a broader go-to-market approach in Europe. We also did not include EdgeX Foundry, as they currently only focus on an IoT edge framework. Besides the two Eclipse-based vendors, Bosch Software Innovations and Eurotech, seven interesting open source-based initiatives around IoT platforms exist on GitHub: DeviceHive, DGLogik, Kaa, Mainflux, SiteWhere, Thinger.io, and ThingsBoard. Another very important aspect for user companies is the level of service and support a vendor is able to provide. This includes the breadth of the service portfolio (consulting, system integration, hosting, and support) and also the service quality (based on client references, size of the service team, skills level).

Who are the leading vendors in this field today?

In our view, Bosch Software Innovations is the clear market leader in this area, with Bosch being the main contributor today to the Eclipse IoT Working Group. Since 2015, Bosch has been one of three strategic members of this community, together with Eurotech and Red Hat. Overall, developers from Bosch Software Innovations have contributed around 50% of the code to Eclipse IoT (around 1.5 million lines of code, out of a total of around 3 million). Today, Bosch has more than 60 developers working on Eclipse IoT projects. Since joining the Eclipse IoT community, Bosch has launched six different IoT open source projects, and contributed to many more. However, it is not just a power contributor, but also a power user of these components within its Bosch IoT Suite. Bosch IoT Hub is the commercial product based on Eclipse Hono. Bosch IoT Rollouts is the commercial product based on Eclipse hawkBit. Bosch IoT Things is the commercial product based on Eclipse Ditto. These are fully managed services – and as thus part of the Bosch IoT Suite. Bosch Software Innovations has been leading even more open source projects, e.g. Eclipse Vorto for easy integration of devices into IoT solutions. Besides its strong contribution to open source software, Bosch Software Innovations offers its expertise as a dedicated open source consulting offering for companies wanting to use open source software or starting their own projects. This is part of a larger service offering that supports companies in their digital transformation (including open source consulting, business consulting, UX consulting and development, hosting, testing, training, support, technical communications). No other vendor today can provide more consulting and system integration capabilities dedicated to open source-based IoT platforms. The quality of their services is confirmed by many strong client references.

Eurotech is a founding member of the IoT Working Group in the Eclipse Foundation. Eurotech has contributed the Kura project (IoT edge; version 3.2) to the Eclipse Foundation and is one of the driving forces (together with Red Hat) behind the Kapua project (IoT platform; version 1.0), which has been available since early 2019. The combination of Eurotech's strong commitment to open source-based IoT solutions and its strong capabilities in IoT hardware and embedded solutions makes the company a strong full IoT solution provider. This is reflected by the many reference clients they have across Europe.

The strength of ThingsBoard is the fast development cycle we have seen over the past 18 months, combined with several service and support options. ThingsBoard released versions 2.0 and 2.2 in 2018, followed by version 2.3 in 2019. It also has several reference clients in Europe, such as Deutsche Telekom and Engie.

Mainflux is another interesting vendor in the current landscape. Its strength is its holistic open source approach (at the platform level and at the edge), combined with its capabilities in developing full IoT solutions for its clients, including embedded software development and IoT hardware.



CONSIDERED PROVIDERS BY SEGMENT

IoT platforms with application marketplaces	IoT platforms for industrial applications	IoT platforms based on open source	AR platforms for connected workers	IoT data exchange & monetization platforms
<ul style="list-style-type: none"> • Advantech • Amazon Web Services (AWS) • FIWARE • Google • Libelium • Microsoft • PTC • SAP 	<ul style="list-style-type: none"> • ADAMOS • Advantech • Amazon Web Services (AWS) • AXOOM • FORCAM • GE Digital • Microsoft • OSIssoft • PTC • SAP • Siemens 	<ul style="list-style-type: none"> • Bosch Software Innovations • DeviceHive • DGLogik • Eurotech • Kaa • Mainflux • SiteWhere • Thinger.io • ThingsBoard 	<ul style="list-style-type: none"> • Amazon Web Services (AWS) • Atheer • DAQRI • Diota • EON Reality • PTC (Vuforia) • RE'FLEKT • Scope AR • Ubimax • Upskill 	<ul style="list-style-type: none"> • Caruso • DataBroker DAO • Deutsche Telekom/T-Systems • IOTA • Otonomo • Streamr • Terbine

Evaluation criteria

Main cluster “Competence”

Sub-cluster “Strategy”

- Strategic focus on the topic
- Strategic activities over the last 12 months
- Unique selling proposition (USP)

Sub-cluster “Portfolio”

- Specific criteria for IoT platforms with application marketplaces:
 - Number of IoT applications
 - Number of IoT applications from third parties
 - Marketplace capabilities
 - Quality of IoT applications
- Specific criteria for industrial IoT platforms with application marketplaces:
 - Number of industrial IoT applications
 - Number of industrial IoT applications from third parties
 - Marketplace capabilities
 - Quality of industrial IoT applications
- Specific criteria for IoT platforms based on open source:
 - Open-source components of the IoT platform
 - Open-source components at the edge
 - Complementary service capabilities
 - Portfolio quality based on client references
- Specific criteria for IoT data exchange and monetization platforms:
 - Total number of data sources
 - Value of data sources
 - Addressed use cases
 - Complementary add-on services
- Specific criteria for AR platforms for connected workers:
 - Addressed use cases
 - Portfolio quality based on client references
 - Device flexibility and HW-related interoperability
 - Application and data integration

Sub-cluster “Go-to-market”

- Business model and pricing
- Sales approach and capabilities
- Marketing approach, partner strategy and training

Main cluster “Market strength”

Sub-cluster “Market growth”

- Market perception in Europe
 - Awareness
 - Image
- Ability to grow
 - Capabilities
 - Momentum

Sub-cluster “Market position”

- Ecosystem of partners
 - Number of partners
 - Quality of partners
- Client base and relationship in Europe
 - Client base in Europe
 - Client relationship in Europe

General PAC research method

The following overview describes PAC's research method for market analysis and key differentiation features.

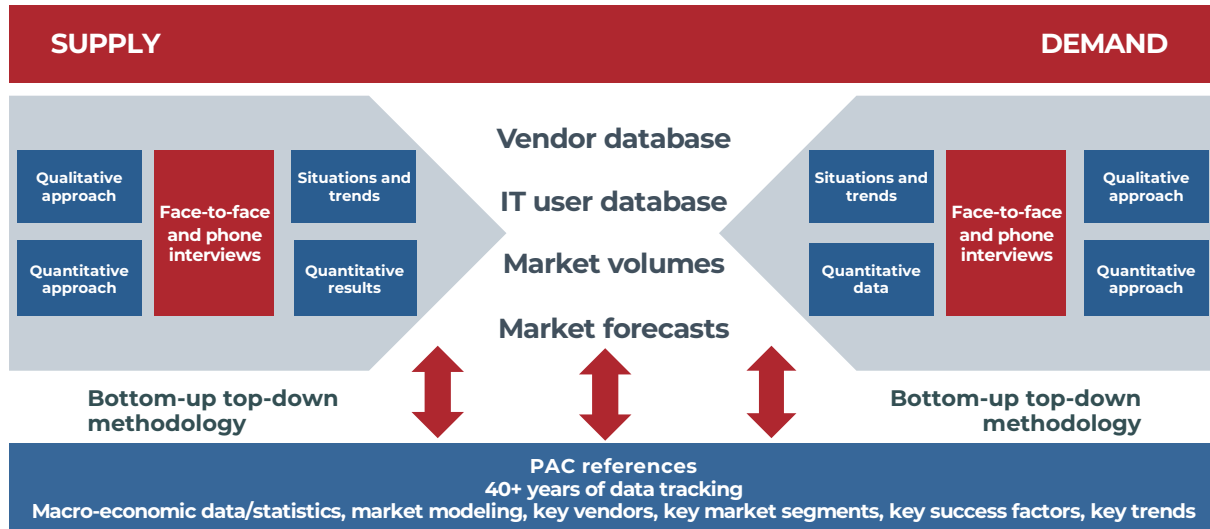


Fig. 7: Description of the PAC methodology

Local research and face-to-face communication are two core elements of PAC's methodology. In our market studies, we can draw on more than 40 years of experience in Europe.

Positioning within the PAC RADAR

Based on the scores in competence and market strength, the overall score is calculated (calculation: competence score plus market strength score, divided by two). From the resulting overall score, each provider receives their characteristic positioning within a ring of the PAC RADAR. Here, the following applies: The closer a provider is to the center, the closer they are to meeting customers' requirements.

The "customer requirements" at the center represent a cross-section of the market; the position of the provider represents the completeness with which the provider's offerings and competence correspond with the requirements of all potential customers; i.e. purely local clients, international key accounts and SMEs alike.

The providers are positioned within ring 1 (innermost ring) to ring 4 (outermost ring), based on the total grade they achieved. The total grade is the average score of the two main clusters ("competence" & "market strength").

The rings of the PAC RADAR can be classified by the following attributes:

Ring 1: "Best in Class" (total grade between 1 and 1.99)

Ring 2: "Excellent" (total grade between 2 and 2.99)

Ring 3: "Strong" (total grade between 3 and 3.99)

Ring 4: "Solid" (total grade between 4 and 4.99)



PAC RADAR “PLATFORMS FOR IOT & AR IN EUROPE 2019” – IOT PLATFORMS BASED ON OPEN SOURCE

PAC RADAR IoT platforms based on open source in Europe 2019



Fig. 8: PAC RADAR IoT platforms based on open source in Europe 2019



REVIEW OF TOP-SEEDED PROVIDER BOSCH SOFTWARE INNOVATIONS

Bosch Software Innovations

PAC RADAR IoT Platforms Based on Open Source in Europe 2019 **Best in Class**

Cluster	Average	Bosch Software Innovations
Competence	2.56	1.50
Market strength	2.86	1.55
Total score	2.71	1.53

Criteria rated as significantly ABOVE AVERAGE (more than 0.5)

- Strategic focus on this topic
- Strategic activities in the last 12 months
- Unique selling proposition (USP)
- Open source components of the IoT platform
- Complementary service capabilities
- Portfolio quality based on client references
- Business model and pricing
- Sales approach and capabilities
- Marketing approach, partner strategy and training
- Market perception in Europe
- Ability to grow
- Ecosystem of partners
- Client base and relationship in Europe

Criteria rated as significantly UNDER AVERAGE (more than 0.5)

- None



ABOUT TEKNOLOGY GROUP

teknowlogy Group is the leading independent European research and consulting firm in the fields of digital transformation, software, and IT services. It brings together the expertise of four research and advisory firms, each with a strong history and local presence in the fragmented markets of Europe: [Ardour Consulting Group](#), [CXP](#) and [PAC \(Pierre Audoin Consultants\)](#).

We are a content-based company with strong consulting DNA. We are the preferred partner for European user companies to define IT strategy, govern teams and projects, and de-risk technology choices that drive successful business transformation.

We have a second-to-none understanding of market trends and IT users' expectations. We help software vendors and IT services companies better shape, execute and promote their own strategy in coherence with market needs and in anticipation of tomorrow's expectations.

Capitalizing on more than 40 years of experience, we operate out of seven countries with a network of 150 experts.

For more information, please visit www.teknowlogy.com and follow us on [Twitter](#) or [LinkedIn](#).



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The PAC RADAR is a graphical representation and written analysis of the positioning of various IT providers within a defined market segment at a specific point in time. The positioning and characterization of selected companies within the PAC RADAR is conducted on the basis of an analytical assessment of criteria which PAC previously defined for this analysis.

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