PAC RADAR

Digital CX & IoT I Europe I 2019

Platforms for IoT & AR in Europe 2019

SITSI I Vendor Analysis I PAC RADAR

IoT platforms based on open source

– Positioning of Eurotech –

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PAC Germany, July 2019

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RADAR
IT SUPPLIER ASSESSMENT FROM PAC

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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.

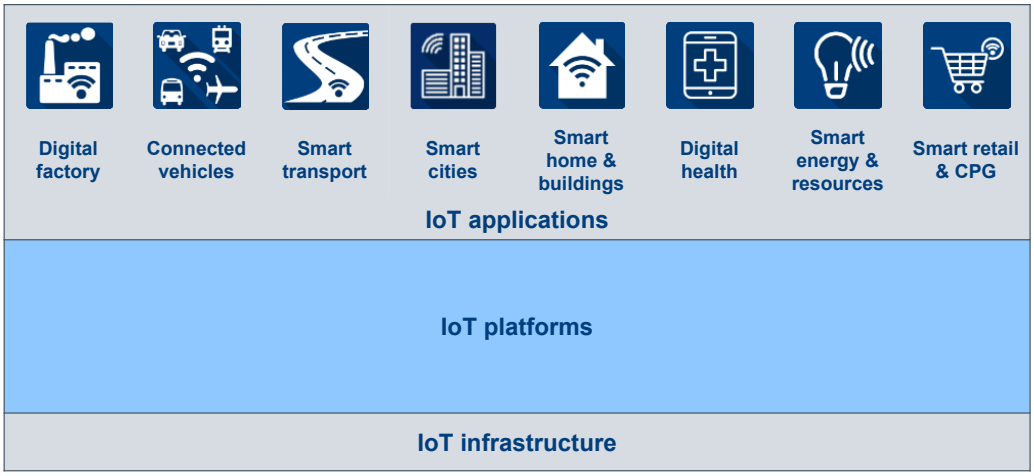


Fig. 1: Basic IoT stack

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.

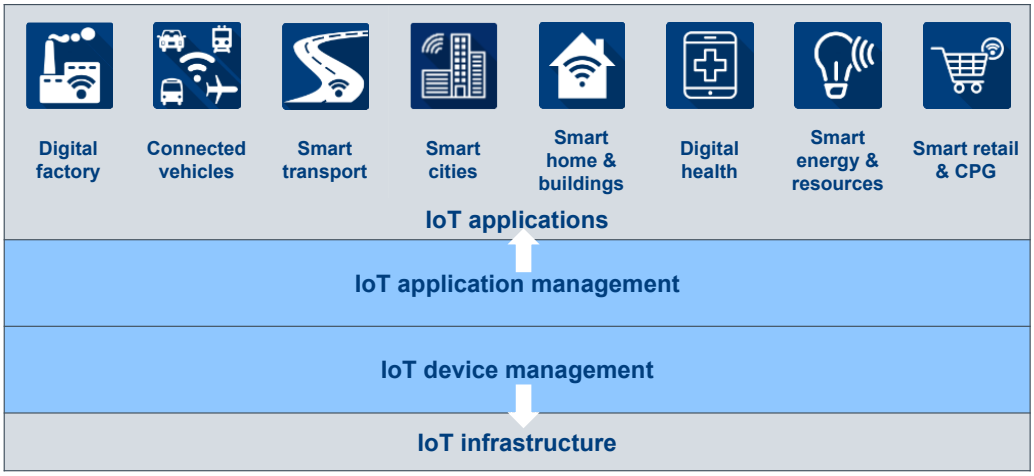


Fig. 2: Basic functional capabilities of IoT platforms

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.

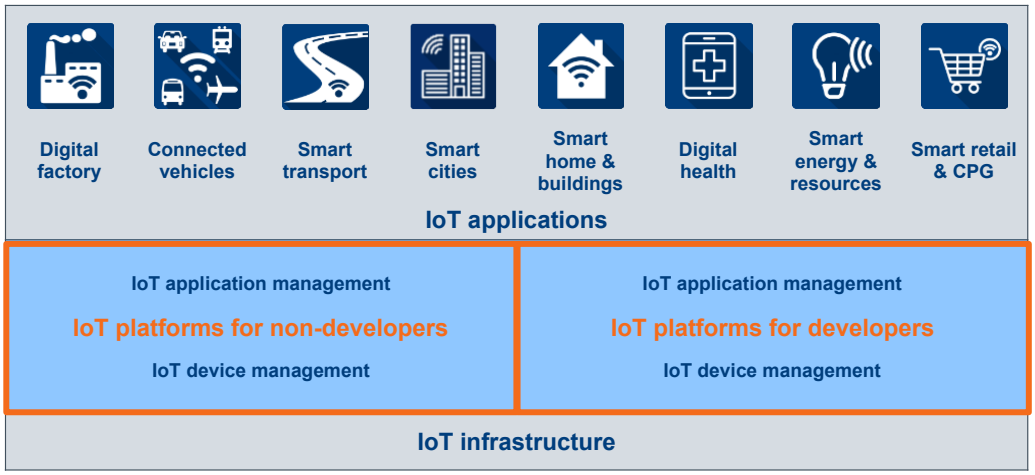


Fig. 3: Basic target audiences of IoT platforms

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.

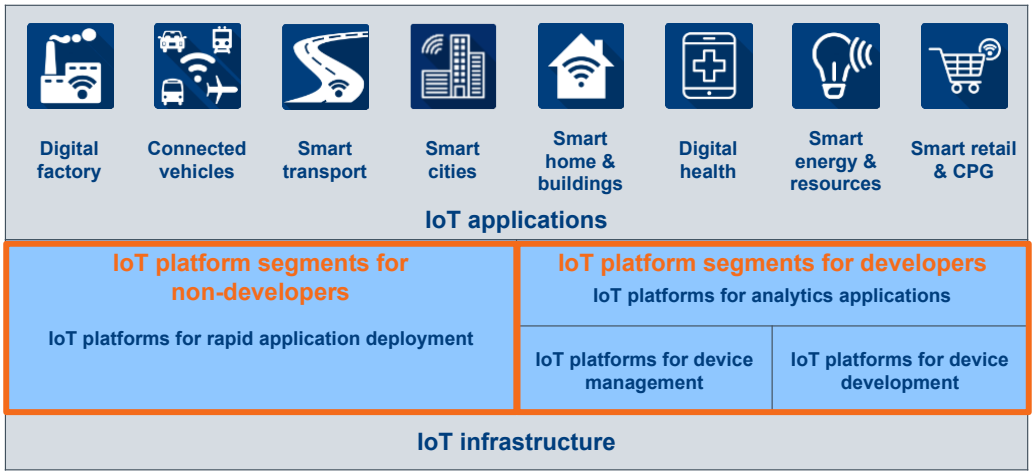


Fig. 4: Segmentation of the current IoT platform market

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.

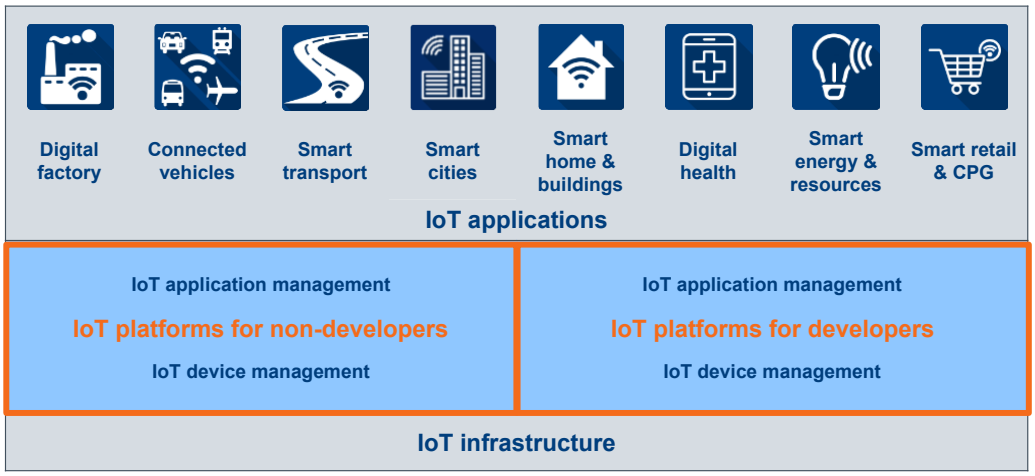


Fig. 5: Future segmentation of the consolidated IoT platform market

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.

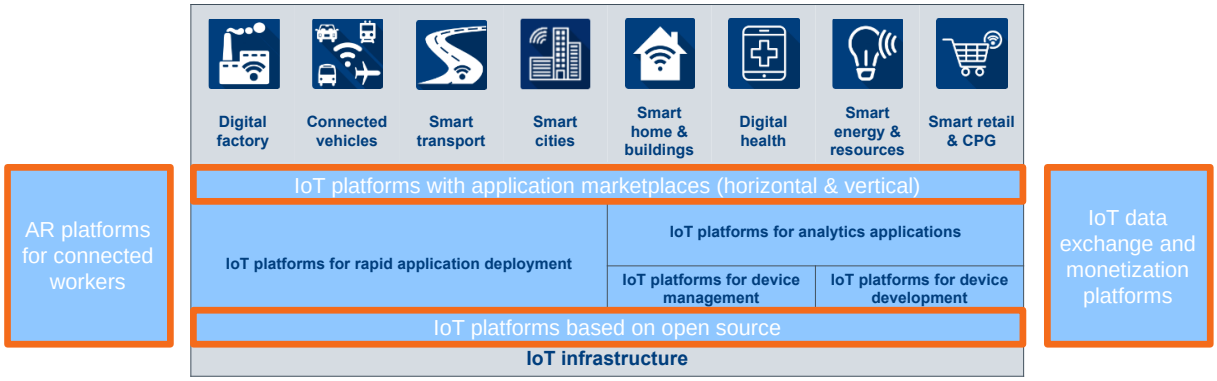


Fig. 6: Newly emerging segments in the context of IoT platforms

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 was one of the founding members of the IoT Working Group within the Eclipse Foundation, back in 2012. Before that, Eurotech was co-developing MQTT (a light-weight messaging protocol) with and for IBM. This technology development also led to one of the initial contributions to Eclipse IoT, the Paho project by Eurotech and IBM (another founding member of the IoT Working Group at Eclipse). The code of the Eclipse Paho project, which has been widely leveraged by now, provides an open-source client implementation of the MQTT messaging protocol for all kinds of IoT application. On top of this, Eurotech has also contributed the Kura project (today available as version 3.2) to the Eclipse Foundation and is one of the driving forces (together with Red Hat) behind the Kapua project, which has been available since early 2019 (as version 1.0). Kura is an IoT edge middleware for IoT gateways, edge servers and other smart devices. It provides full device abstraction, device and software life cycle management, security and support for field protocols. With Kura Wires for example, developers can visually program the edge device and its integrations with sensors and actuators. On the other hand, the Kapua project provides open-source, enterprise-grade IoT platform capabilities in the cloud and on premises, including the management of devices, security and data. Both Eclipse projects, Kura and Kapua, are the basis of commercially supported offerings from Eurotech. 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.

SCOPE & DEFINITION

Definitions

What is the PAC definition of IoT platforms?

- IoT platforms provide two basic types of functionality to clients: IoT device management and IoT application management.
    - **IoT device management** covers device provisioning, device connectivity, remote SW updates and remote control.
    - **IoT application management** includes application development & integration, data analytics, data visualization and event processing.

What is the PAC definition of AR platforms?

- Augmented reality (AR) platforms provide two basic types of functionality to clients: AR application development and AR data visualization.
    - **AR application development** contains a simple-to-use application development platform, which allows developers and/or non-developers to generate workflows and instructions for connected workers to improve their efficiency.
    - **AR data visualization** enables the visualization of data across many different devices, such as smartphones, tablets and smart glasses. This includes the worker's interaction with the device to perform steps and tasks within a process.

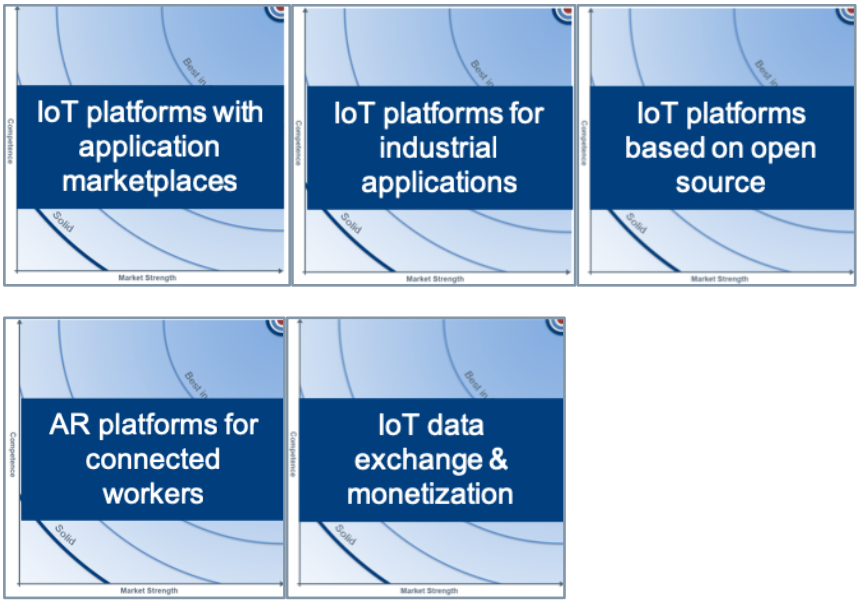
What is the PAC definition of IoT data exchange & monetization platforms?

Companies need access to data – today and even more so in the future. But not all data are easily accessible. On the other hand, companies have access to large parts of data which are also potentially relevant for other companies. Sharing data is the right solution for both parties and data marketplaces can bring buyers and users together on a large scale. A new kind of platform is emerging, which orchestrates data exchange and monetization. This becomes especially relevant in the context of IoT data. These new platforms allow for the secure management of data access, confidential sharing as well as monetization.

Segmentation of IoT & AR platforms

How does PAC segment the provider landscape for IoT platforms?

PAC is going to evaluate the providers of **IoT & AR platforms in Europe** by five new PAC INNOVATION RADAR segments, which are dedicated to specific user requirements:



How will the providers be matched to the different types of IoT platform?

Depending on their specific focus area, the providers will be positioned in one or more of five PAC INNOVATION RADAR analyses.

Why is PAC introducing and evaluating new types of platforms?

First, the boundaries between the segments of horizontal IoT platforms (for device management, rapid application deployment, analytics application, device development) introduced earlier are blurring, and existing vendors of IoT platforms are extending their capabilities more and more into other segments.

Second, as the established market segments of IoT platforms are growing more mature, we ask the users for their opinion. The IoT Survey 2019 is the world's first annual survey of IoT platform users, based on a sample of over 2,000 survey responses. For details on the survey, please visit https://www.iot-survey.com.

Third, the feedback from users is that they are increasingly looking for platforms which provide additional or very specific capabilities, besides the above-mentioned existing IoT platform categories. Therefore we will frequently enhance the perspective of the PAC INNOVATION RADAR with insights from newly emerging areas in the IoT context to address fast-evolving user needs. This year, we will focus on augmented reality (AR), open source and application marketplaces, but also IoT data exchange and monetization.

Focus areas of different types of IoT & AR platform

What are the focus areas of the different types of platform?

In principle, we can group the platforms analyzed into three different categories of platform:

- **IoT platforms**
    - IoT platforms with application marketplaces
    - IoT platforms for industrial applications
    - IoT platforms based on open source
- **AR platforms**
    - AR platforms for connected workers
- **Data exchange & monetization platforms**
    - IoT data exchange & monetization platforms

The focus areas of these IoT platforms are the following:

IoT platforms with application marketplaces use a microservice structure and provide open APIs to their external ecosystem of developers. Based on this strength, we will see that powerful IoT platforms will establish and enhance an open marketplace of horizontal apps and add-ons, but also solutions for various verticals. This creates a continuous and entirely open system of innovation for the existing user base and their connected devices.

IoT platforms for industrial applications use a microservice structure and provide open APIs to their external ecosystem of developers. Based on this strength, we will see that powerful IoT platforms will establish and enhance an open marketplace of apps and add-ons dedicated to the complex industrial space. This creates a continuous and entirely open system of innovation for the existing user base and their connected devices.

IoT platforms based on open source are receiving more attention in the market, as they are becoming increasingly available. Also business users tend to consider them as a potential option in the IoT space. Since open source is relevant in general and very attractive to many users, we will take a first look at several of the most prominent open-source-based IoT platforms to understand their strengths and weaknesses by comparison.

AR platforms for connected workers provide worker-related application development and data visualization. AR application development contains a simple-to-use application development platform, which allows developers and/or non-developers to generate workflows and instructions for connected workers to improve their efficiency. AR data visualization enables the visualization of data across many different devices, such as smartphones, tablets and smart glasses. This includes the worker's interaction with the device to perform steps and tasks within the processes.

IoT data exchange & monetization platforms represent a new kind of platform, which orchestrates data exchange and monetization. This is becoming increasingly relevant in the context of IoT data, as more and more IoT data are being collected and made available via various IoT platforms. These new platforms for data exchange and monetization allow for the secure management of data access, confidential data sharing between data owners and buyers as well as data monetization.

PAC RADAR EVALUATION METHOD

Provider selection & participation

Which providers are positioned in the PAC INNOVATION RADAR?

Providers are selected and invited according to the following criteria:

- Size of revenues in the segment to be analyzed in the specified region;
  "Relevance": Even providers that do not belong to the top-selling providers in the segment to be analyzed are considered, if PAC classifies them as relevant for potential customers, for instance due to an innovative offering, strong growth, or a compelling vision.

There is no differentiation as to whether the providers are customers of PAC – neither in the selection of the providers to be positioned, nor in the actual evaluation.

What do providers have to do in order to be considered in a PAC INNOVATION RADAR analysis?

The decision as to which providers are considered in the PAC INNOVATION RADAR analysis is entirely up to PAC. Providers do not have any direct influence on this decision.

However, in the run-up to a PAC INNOVATION RADAR analysis, providers can make sure in an indirect way that PAC can adequately evaluate their offerings and positioning – and thus their relevance – e.g. by means of regular analyst briefings etc.

Why should providers accept the invitation to participate actively?

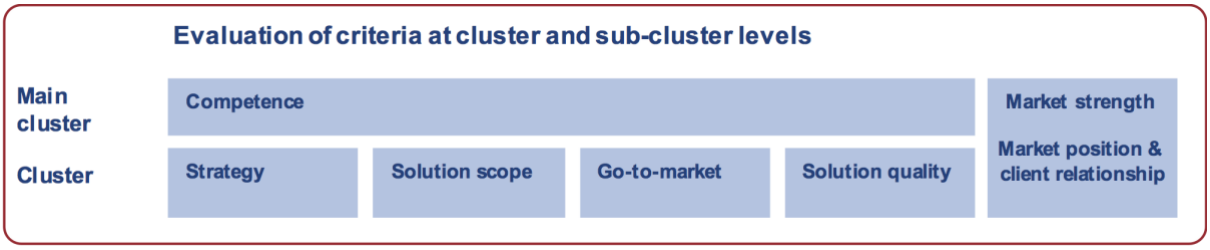
Whether or not a provider participates in the RADAR process does not actually affect their inclusion and positioning in the PAC INNOVATION RADAR, nor their assessment. However, there are a whole host of benefits associated with active participation:

- Participation ensures that PAC has access to the largest possible range of specific and up-to-date data as a basis for the assessment;
- Participating providers can set out their specific competences, strengths and weaknesses as well as their strategies and visions;
- The review process guarantees the accuracy of the assessed factors;
- The provider gets a neutral, comprehensive, and detailed view of its strengths and weaknesses as compared to the direct competition – related to a specific service in a local market;
- A positioning in the PAC INNOVATION RADAR gives the provider prominence amongst a broad readership as one of the leading operators in the segment under consideration.

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
• Advantech • Amazon Web Services (AWS) • FIWARE • Google • Libelium • Microsoft • PTC • SAP	• ADAMOS • Advantech • Amazon Web Services (AWS) • AXOOM • FORCAM • GE Digital • Microsoft • OSIsoft • PTC • SAP • Siemens	• Bosch Software Innovations • DeviceHive • DGLogik • Eurotech • Kaa • Mainflux • SiteWhere • Thinger.io • ThingsBoard	• Amazon Web Services (AWS) • Atheer • DAQRI • Diota • EON Reality • PTC (Vuforia) • RE'FLEKT • Scope AR • Ubimax • Upskill	• Caruso • DataBroker DAO • Deutsche Telekom/ T-Systems • IOTA • Otonomo • Streamr • Terbine

The concept



Evaluation method

PAC uses predefined criteria to assess and compare the providers within given service segments.

The assessment is based on the report-card score within the peer group of the positioned providers.

This is based on:

- The provider's detailed self-disclosure about resources, distribution, delivery, portfolio, contract drafting, pricing, customer structure, references, investments, partnerships, certifications, etc.;
- If applicable, a poll among customers by PAC;
- The analysis of existing PAC databases;
- Secondary research;
- Dedicated face-to-face interviews as relevant.

The provider data is verified by PAC and any omissions rectified based on estimates.

If the provider does not participate, the assessment is performed using the proven PAC methodology, in particular based on

- Information obtained from face-to-face interviews with the provider's representatives, analyst briefings, etc.;
- An assessment of company presentations, company reports, etc.;
- An assessment of PAC databases;
- An assessment of earlier PAC (INNOVATION) RADARs in which the provider participated;
- A poll among the provider's customers (as required) on their experiences and satisfaction.

Reissue of published RADARs

The assessments in the PAC INNOVATION RADAR represent an assessment of the providers within the given peer group in the year in which the respective PAC INNOVATION RADAR was published.

The evaluations may not be directly comparable with those of any previous version due to subsequent content modifications. They particularly do not depict a development of individual providers over time.

Methodological and/or organizational modifications may be made due to changing market conditions and trends and can include:

- Different peer group in the focus of the analysis;
- Modification of individual criteria within clusters and sub-clusters;
- Increased or altered expectations by user companies;
- Adjustment of the weighting of individual criteria.

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.

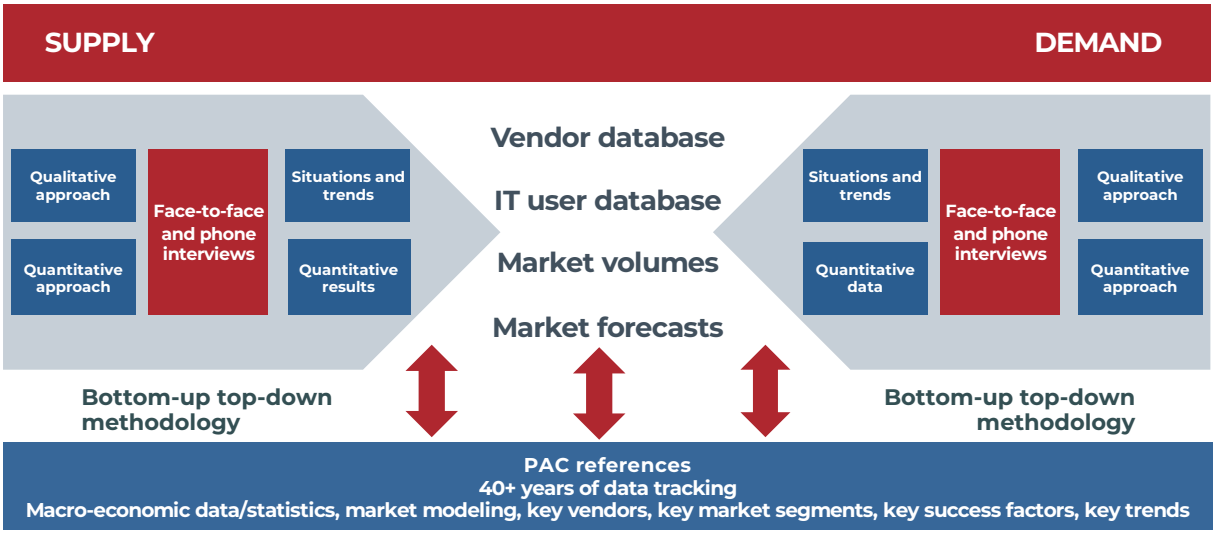


Fig. 7: Description of the PAC methodology

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

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

REVIEW OF TOP-SEEDED PROVIDER EUROTECH

Eurotech

PAC RADAR IoT Platforms Based on Open Source in Europe 2019

Best in Class

Cluster	Average	Eurotech
Competence	**2.56**	**1.74**
Market strength	**2.86**	**1.85**
Total score	**2.71**	**1.80**

Criteria rated as significantly ABOVE AVERAGE (more than 0.5)

- Strategic activities in the last 12 months
- Unique selling proposition (USP)
- Open source components at the edge
- 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
- Ecosystem of partners
- Client base and relationship in Europe

Criteria rated as significantly UNDER AVERAGE (more than 0.5)

- None

ABOUT TEKNOWLOGY 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.

ABOUT THE PAC RADAR

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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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