LF Edge Akraino IoT Area Webinar Developer Meetup - Africa

Introduction

Ike Alisson

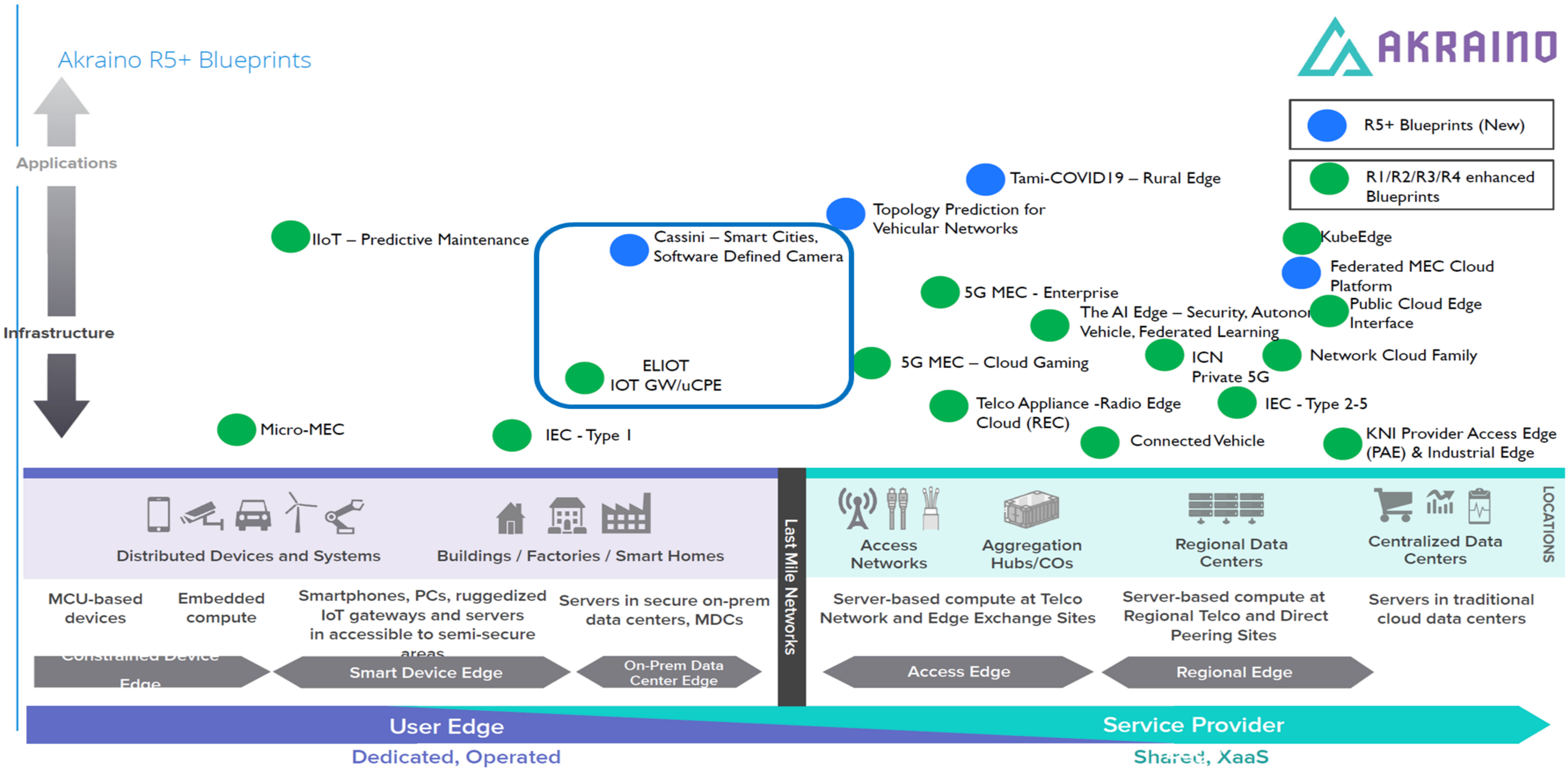
LF Edge Akraino Documentation Sub-committee TSC Chair

September 15h, 2021

Table of Contents

1. LF Edge Akraino Overview
2. IoT Market Overview
3. LF Edge Akraino IoT Area
    - 3.1 Akraino IoT Blueprint (BP) Families
    - 3.2 OPC UA IEC 62 541 IoT Standard for M2M and M2E
    - 3.3 oneM2M IoT Service Layer (SL) Standard

1.1 LF Edge Akraino Project Overview



Akraino R5+ Blueprints

AKRAINO

🔵 R5+ Blueprints (New)

🟢 R1/R2/R3/R4 enhanced Blueprints

Applications

Infrastructure

IIoT – Predictive Maintenance

Cassini – Smart Cities, Software Defined Camera

ELIOT IOT GW/uCPE

Micro-MEC

IEC - Type 1

Tami-COVID19 – Rural Edge

Topology Prediction for Vehicular Networks

5G MEC - Enterprise

The AI Edge – Security, Autonor Vehicle, Federated Learning

5G MEC – Cloud Gaming

ICN Private 5G

Telco Appliance -Radio Edge Cloud (REC)

Connected Vehicle

KubeEdge

Federated MEC Cloud Platform

Public Cloud Edge Interface

Network Cloud Family

IEC - Type 2-5

KNI Provider Access Edge (PAE) & Industrial Edge

Distributed Devices and Systems

Buildings / Factories / Smart Homes

Last Mile Networks

Access Networks

Aggregation Hubs/COs

Regional Data Centers

Centralized Data Centers

LOCATIONS

MCU-based devices

Embedded compute

Smartphones, PCs, ruggedized IoT gateways and servers in accessible to semi-secure areas

Servers in secure on-prem data centers, MDCs

Server-based compute at Telco Network and Edge Exchange Sites

Server-based compute at Regional Telco and Direct Peering Sites

Servers in traditional cloud data centers

Constrained Device Edge

Smart Device Edge

On-Prem Data Center Edge

Access Edge

Regional Edge

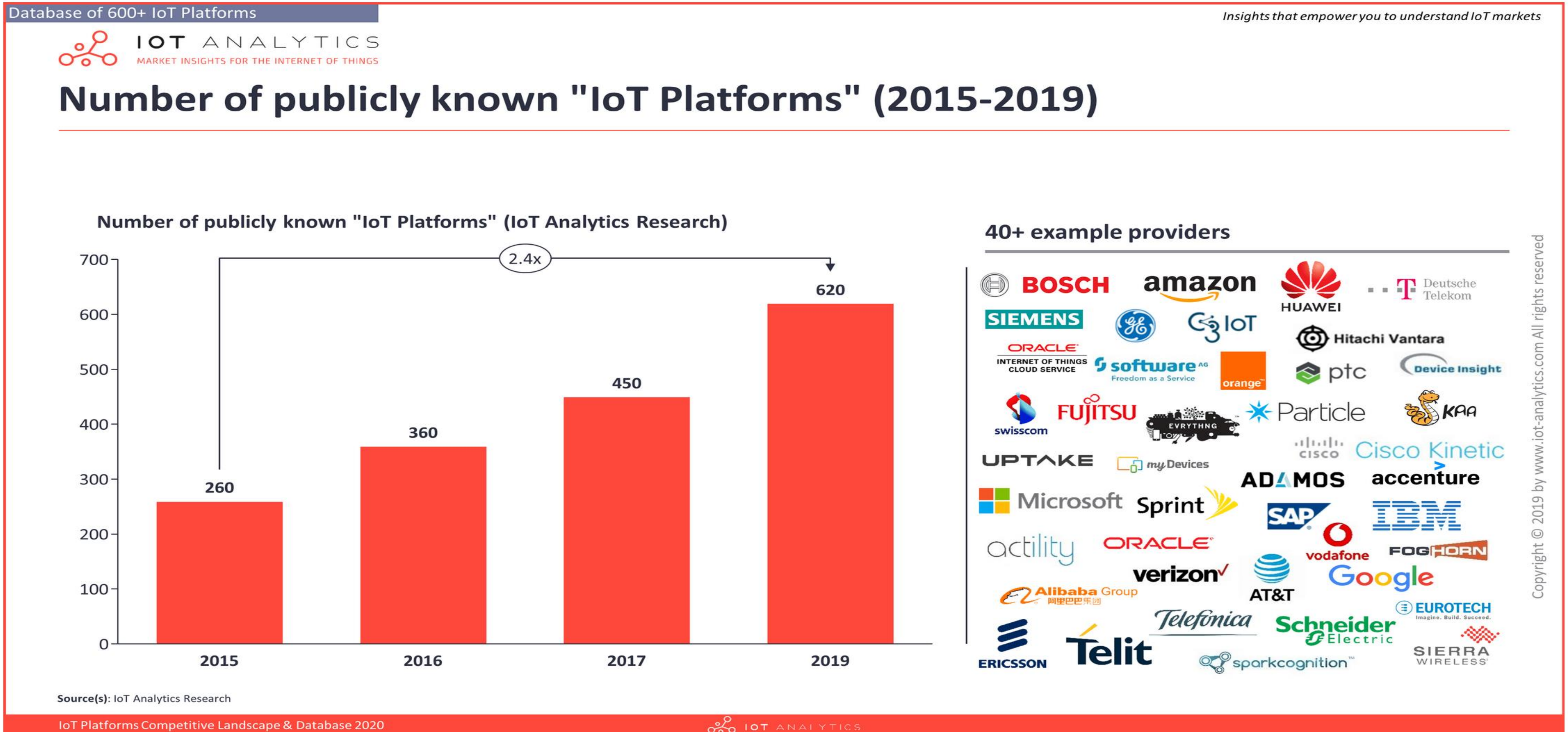
User Edge

Dedicated, Operated

Service Provider

Shared, XaaS

IoT Platforms Competitive Landscape & Database 2020



Database of 600+ IoT Platforms

Insights that empower you to understand IoT markets

IOT ANALYTICS
MARKET INSIGHTS FOR THE INTERNET OF THINGS

Number of publicly known "IoT Platforms" (2015-2019)

Number of publicly known "IoT Platforms" (IoT Analytics Research)

40+ example providers

BOSCH, amazon, HUAWEI, Deutsche Telekom, SIEMENS, GE, C3 IoT, Hitachi Vantara, ORACLE INTERNET OF THINGS CLOUD SERVICE, software AG Freedom as a Service, orange, ptc, Device Insight, swisscom, FUJITSU, EVRYTHNG, Particle, KAA, cisco, Cisco Kinetic, UPTAKE, myDevices, ADAMOS, accenture, Microsoft, Sprint, SAP, IBM, actility, ORACLE, vodafone, FOGHORN, verizon, AT&T, Google, Alibaba Group 阿里巴巴集团, EUROTECH Imagine. Build. Succeed., Telefonica, Schneider Electric, ERICSSON, Telit, sparkcognition, SIERRA WIRELESS

Source(s): IoT Analytics Research

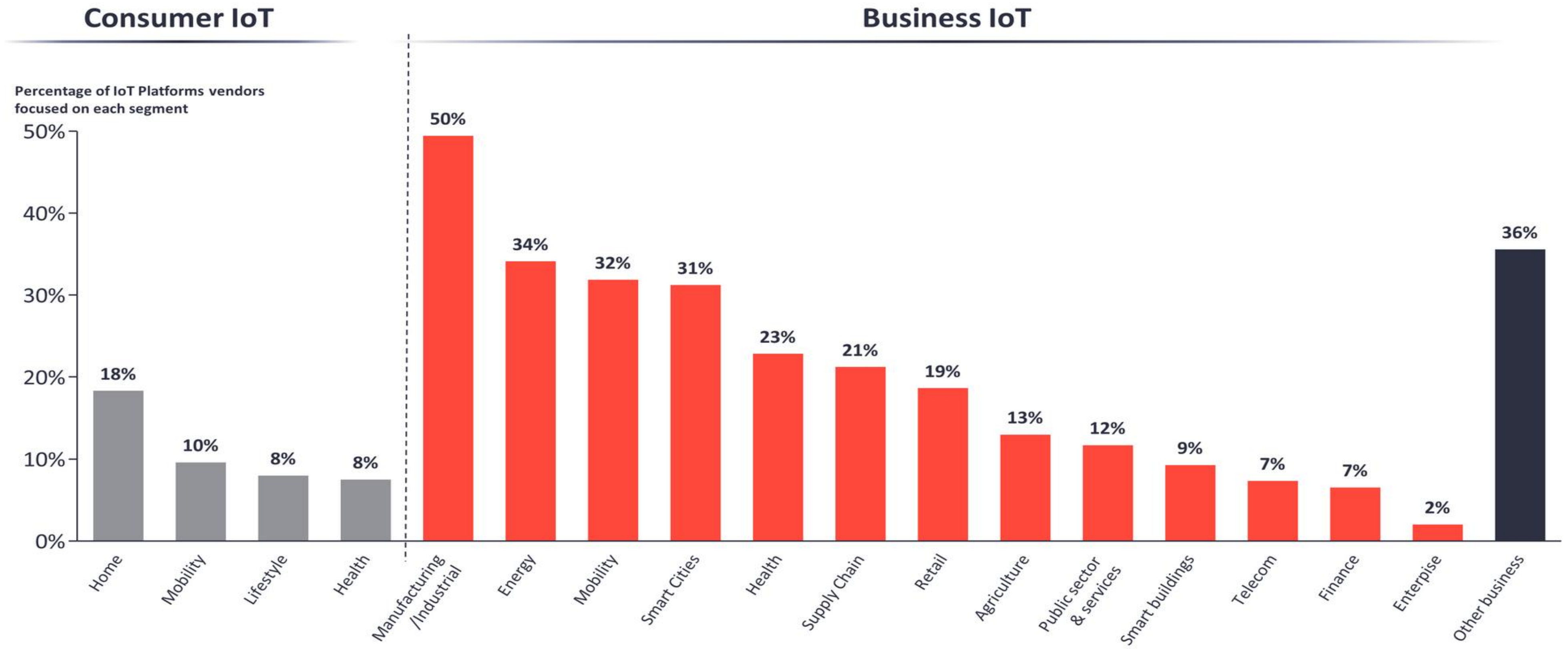
IoT Platforms Competitive Landscape & Database 2020 IOT ANALYTICS

Meta analysis of all 600+ platforms

IOT ANALYTICS
MARKET INSIGHTS FOR THE INTERNET OF THINGS

Insights that empower you to understand IoT markets

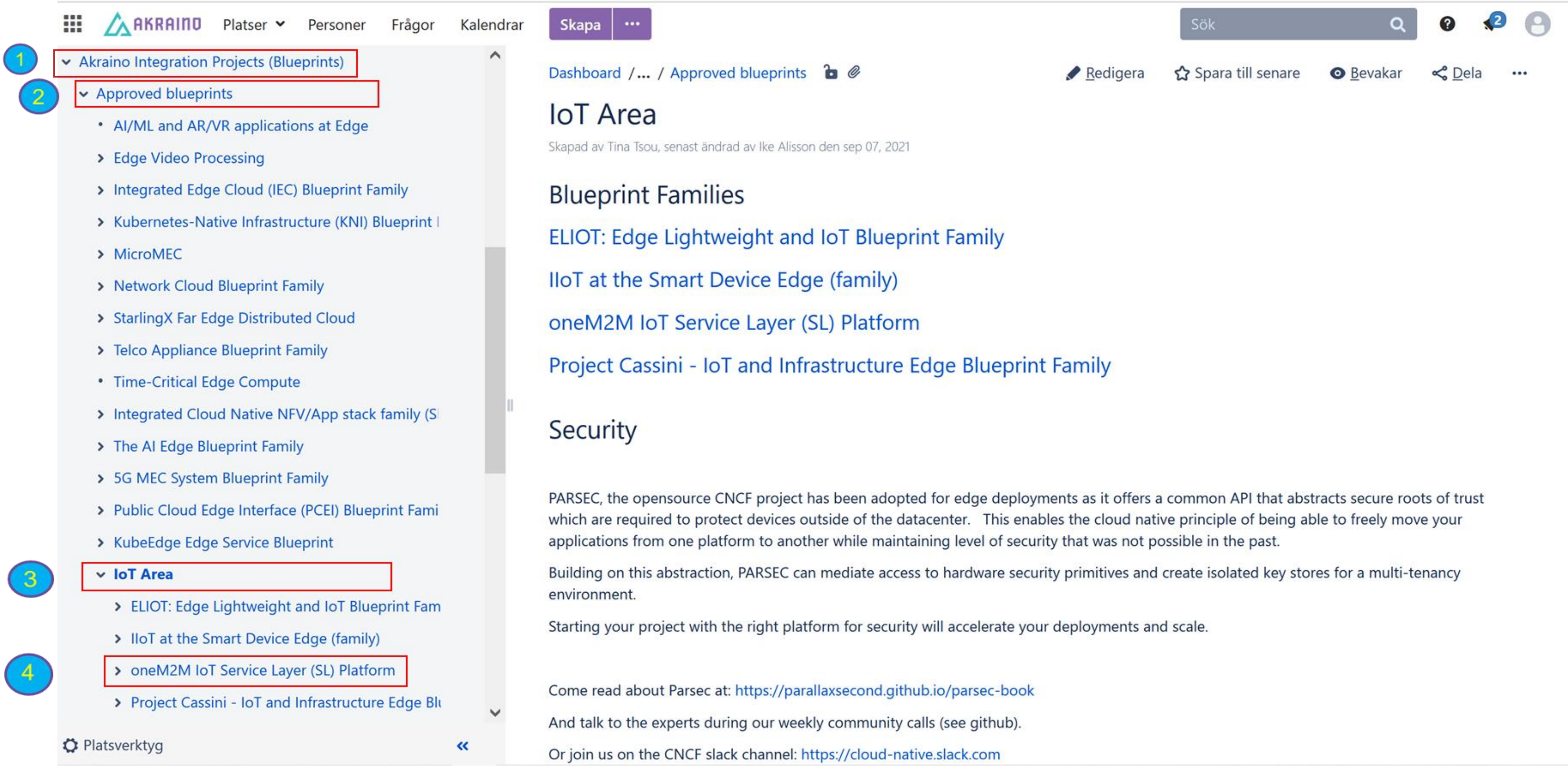
Number of Identified IoT Platforms – By industry (Dec 2019)



Note: Percentages do not add up to 100% as most companies focus on several segments **Source:** IoT Analytics 2020 List of IoT Platform Companies, n=620

1. 4 Akraino IoT Area - 1

https://wiki.akraino.org/display/AK/IoT+Area



- Akraino Integration Projects (Blueprints)
  - Approved blueprints
    - AI/ML and AR/VR applications at Edge
    - Edge Video Processing
    - Integrated Edge Cloud (IEC) Blueprint Family
    - Kubernetes-Native Infrastructure (KNI) Blueprint I
    - MicroMEC
    - Network Cloud Blueprint Family
    - StarlingX Far Edge Distributed Cloud
    - Telco Appliance Blueprint Family
    - Time-Critical Edge Compute
    - Integrated Cloud Native NFV/App stack family (S
    - The AI Edge Blueprint Family
    - 5G MEC System Blueprint Family
    - Public Cloud Edge Interface (PCEI) Blueprint Fami
    - KubeEdge Edge Service Blueprint
    - **IoT Area**
      - ELIOT: Edge Lightweight and IoT Blueprint Fam
      - IIoT at the Smart Device Edge (family)
      - oneM2M IoT Service Layer (SL) Platform
      - Project Cassini - IoT and Infrastructure Edge Blı

IoT Area

Skapad av Tina Tsou, senast ändrad av Ike Alisson den sep 07, 2021

Blueprint Families

ELIOT: Edge Lightweight and IoT Blueprint Family

IIoT at the Smart Device Edge (family)

oneM2M IoT Service Layer (SL) Platform

Project Cassini - IoT and Infrastructure Edge Blueprint Family

Security

PARSEC, the opensource CNCF project has been adopted for edge deployments as it offers a common API that abstracts secure roots of trust which are required to protect devices outside of the datacenter. This enables the cloud native principle of being able to freely move your applications from one platform to another while maintaining level of security that was not possible in the past.

Building on this abstraction, PARSEC can mediate access to hardware security primitives and create isolated key stores for a multi-tenancy environment.

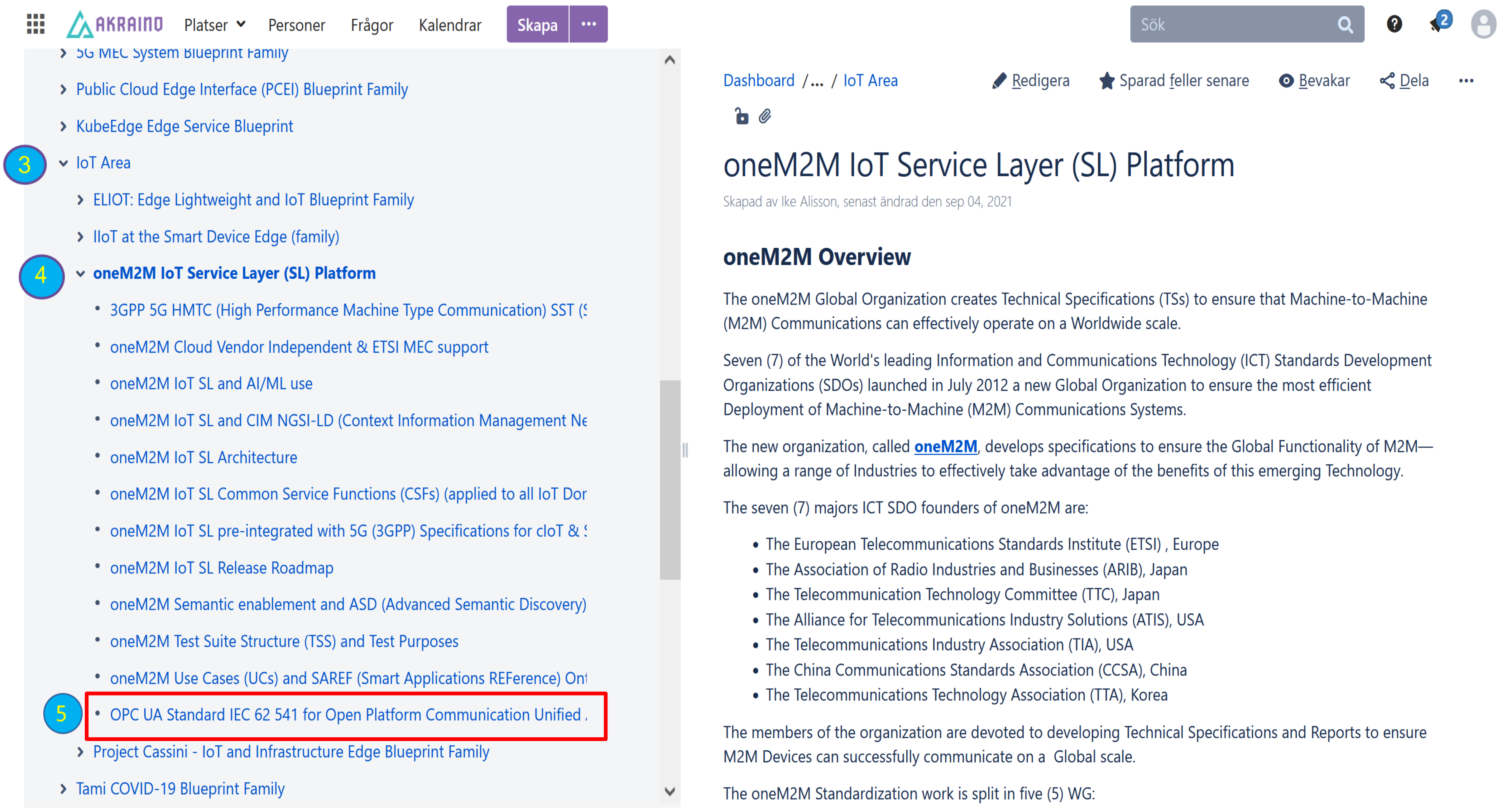
Starting your project with the right platform for security will accelerate your deployments and scale.

Come read about Parsec at: https://parallaxsecond.github.io/parsec-book

And talk to the experts during our weekly community calls (see github).

Or join us on the CNCF slack channel: https://cloud-native.slack.com

1. 4 Akraino IoT Area - 2



- 5G MEC System Blueprint Family
- Public Cloud Edge Interface (PCEI) Blueprint Family
- KubeEdge Edge Service Blueprint
- IoT Area
  - ELIOT: Edge Lightweight and IoT Blueprint Family
  - IIoT at the Smart Device Edge (family)
  - **oneM2M IoT Service Layer (SL) Platform**
    - 3GPP 5G HMTC (High Performance Machine Type Communication) SST (
    - oneM2M Cloud Vendor Independent & ETSI MEC support
    - oneM2M IoT SL and AI/ML use
    - oneM2M IoT SL and CIM NGSI-LD (Context Information Management Ne
    - oneM2M IoT SL Architecture
    - oneM2M IoT SL Common Service Functions (CSFs) (applied to all IoT Dor
    - oneM2M IoT SL pre-integrated with 5G (3GPP) Specifications for cIoT &
    - oneM2M IoT SL Release Roadmap
    - oneM2M Semantic enablement and ASD (Advanced Semantic Discovery)
    - oneM2M Test Suite Structure (TSS) and Test Purposes
    - oneM2M Use Cases (UCs) and SAREF (Smart Applications REFerence) Ont
    - OPC UA Standard IEC 62 541 for Open Platform Communication Unified
  - Project Cassini - IoT and Infrastructure Edge Blueprint Family
- Tami COVID-19 Blueprint Family

Dashboard /... / IoT Area

oneM2M IoT Service Layer (SL) Platform

Skapad av Ike Alisson, senast ändrad den sep 04, 2021

oneM2M Overview

The oneM2M Global Organization creates Technical Specifications (TSs) to ensure that Machine-to-Machine (M2M) Communications can effectively operate on a Worldwide scale.

Seven (7) of the World's leading Information and Communications Technology (ICT) Standards Development Organizations (SDOs) launched in July 2012 a new Global Organization to ensure the most efficient Deployment of Machine-to-Machine (M2M) Communications Systems.

The new organization, called **oneM2M**, develops specifications to ensure the Global Functionality of M2M—allowing a range of Industries to effectively take advantage of the benefits of this emerging Technology.

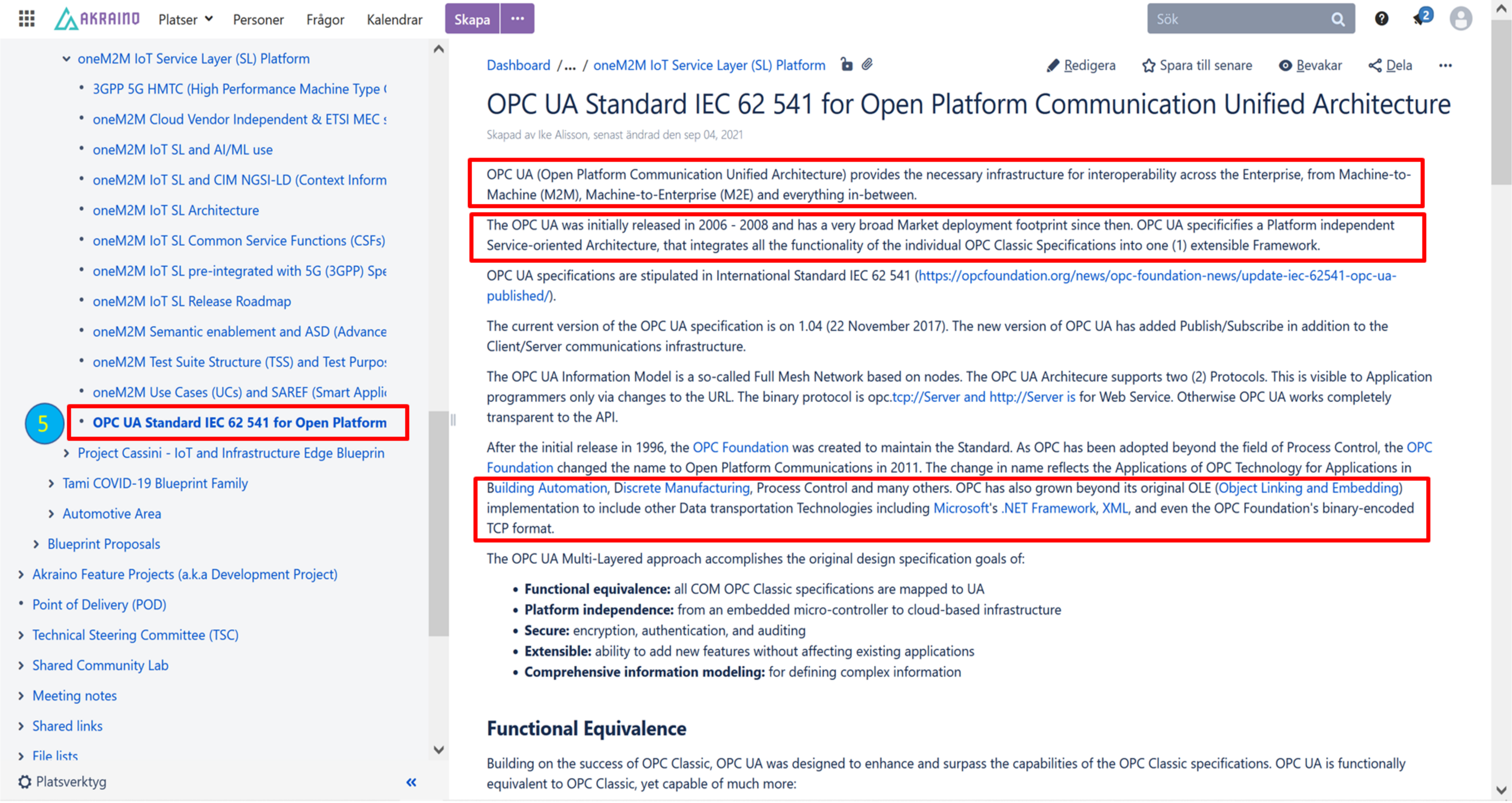
The seven (7) majors ICT SDO founders of oneM2M are:

- The European Telecommunications Standards Institute (ETSI) , Europe
- The Association of Radio Industries and Businesses (ARIB), Japan
- The Telecommunication Technology Committee (TTC), Japan
- The Alliance for Telecommunications Industry Solutions (ATIS), USA
- The Telecommunications Industry Association (TIA), USA
- The China Communications Standards Association (CCSA), China
- The Telecommunications Technology Association (TTA), Korea

The members of the organization are devoted to developing Technical Specifications and Reports to ensure M2M Devices can successfully communicate on a Global scale.

The oneM2M Standardization work is split in five (5) WG:

1. 4 Akraino IoT Area - 3



- oneM2M IoT Service Layer (SL) Platform
  - 3GPP 5G HMTC (High Performance Machine Type (
  - oneM2M Cloud Vendor Independent & ETSI MEC s
  - oneM2M IoT SL and AI/ML use
  - oneM2M IoT SL and CIM NGSI-LD (Context Inform
  - oneM2M IoT SL Architecture
  - oneM2M IoT SL Common Service Functions (CSFs)
  - oneM2M IoT SL pre-integrated with 5G (3GPP) Spe
  - oneM2M IoT SL Release Roadmap
  - oneM2M Semantic enablement and ASD (Advance
  - oneM2M Test Suite Structure (TSS) and Test Purpo:
  - oneM2M Use Cases (UCs) and SAREF (Smart Applic
  - 5 **OPC UA Standard IEC 62 541 for Open Platform**
- Project Cassini - IoT and Infrastructure Edge Blueprin
- Tami COVID-19 Blueprint Family
- Automotive Area
- Blueprint Proposals
- Akraino Feature Projects (a.k.a Development Project)
- Point of Delivery (POD)
- Technical Steering Committee (TSC)
- Shared Community Lab
- Meeting notes
- Shared links
- File lists

Dashboard / ... / oneM2M IoT Service Layer (SL) Platform

Redigera · Spara till senare · Bevakar · Dela

OPC UA Standard IEC 62 541 for Open Platform Communication Unified Architecture

Skapad av Ike Alisson, senast ändrad den sep 04, 2021

OPC UA (Open Platform Communication Unified Architecture) provides the necessary infrastructure for interoperability across the Enterprise, from Machine-to-Machine (M2M), Machine-to-Enterprise (M2E) and everything in-between.

The OPC UA was initially released in 2006 - 2008 and has a very broad Market deployment footprint since then. OPC UA specificifies a Platform independent Service-oriented Architecture, that integrates all the functionality of the individual OPC Classic Specifications into one (1) extensible Framework.

OPC UA specifications are stipulated in International Standard IEC 62 541 (https://opcfoundation.org/news/opc-foundation-news/update-iec-62541-opc-ua-published/).

The current version of the OPC UA specification is on 1.04 (22 November 2017). The new version of OPC UA has added Publish/Subscribe in addition to the Client/Server communications infrastructure.

The OPC UA Information Model is a so-called Full Mesh Network based on nodes. The OPC UA Architecure supports two (2) Protocols. This is visible to Application programmers only via changes to the URL. The binary protocol is opc.tcp://Server and http://Server is for Web Service. Otherwise OPC UA works completely transparent to the API.

After the initial release in 1996, the OPC Foundation was created to maintain the Standard. As OPC has been adopted beyond the field of Process Control, the OPC Foundation changed the name to Open Platform Communications in 2011. The change in name reflects the Applications of OPC Technology for Applications in Building Automation, Discrete Manufacturing, Process Control and many others. OPC has also grown beyond its original OLE (Object Linking and Embedding) implementation to include other Data transportation Technologies including Microsoft's .NET Framework, XML, and even the OPC Foundation's binary-encoded TCP format.

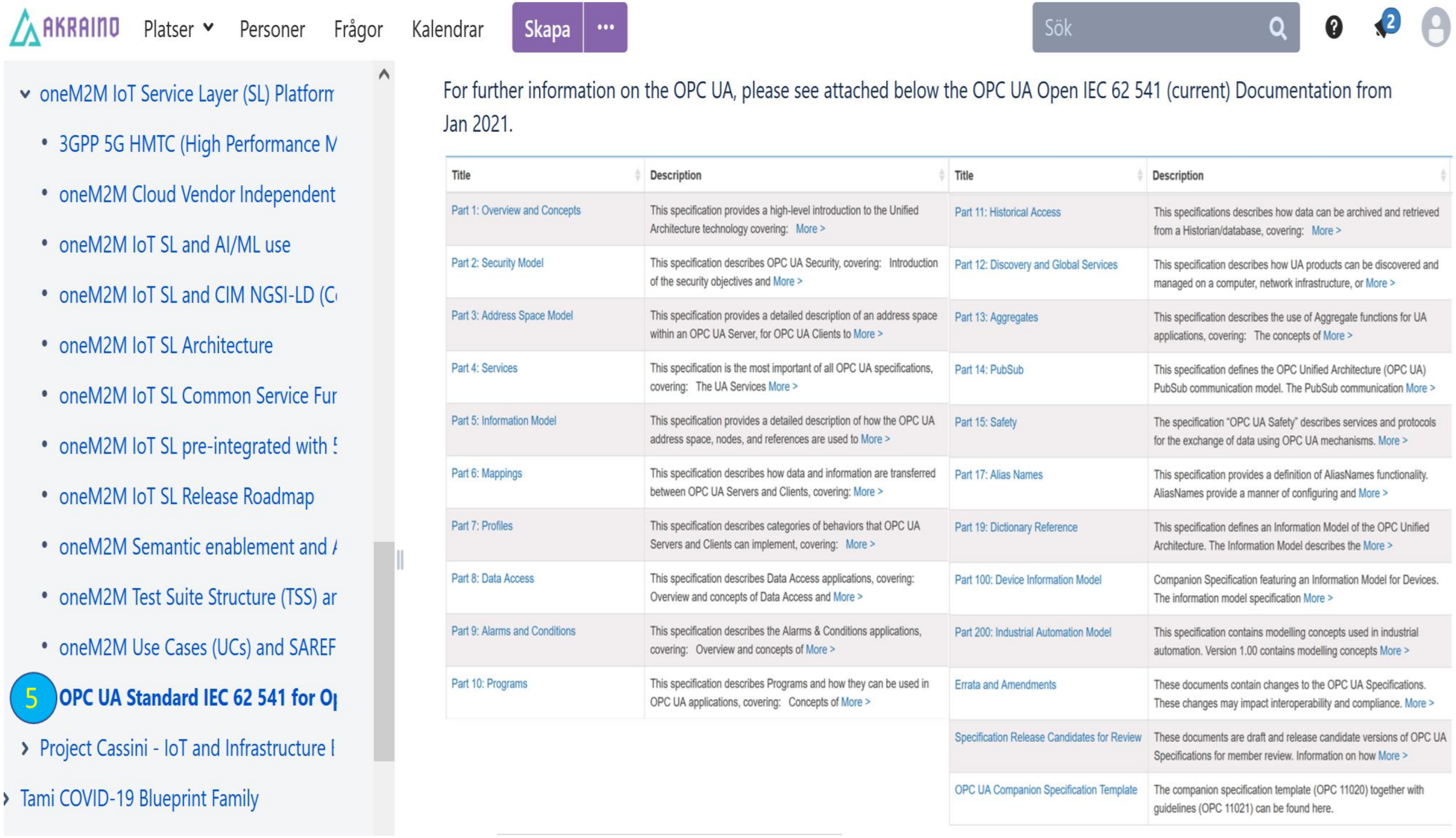
The OPC UA Multi-Layered approach accomplishes the original design specification goals of:

- **Functional equivalence:** all COM OPC Classic specifications are mapped to UA
- **Platform independence:** from an embedded micro-controller to cloud-based infrastructure
- **Secure:** encryption, authentication, and auditing
- **Extensible:** ability to add new features without affecting existing applications
- **Comprehensive information modeling:** for defining complex information

Functional Equivalence

Building on the success of OPC Classic, OPC UA was designed to enhance and surpass the capabilities of the OPC Classic specifications. OPC UA is functionally equivalent to OPC Classic, yet capable of much more:

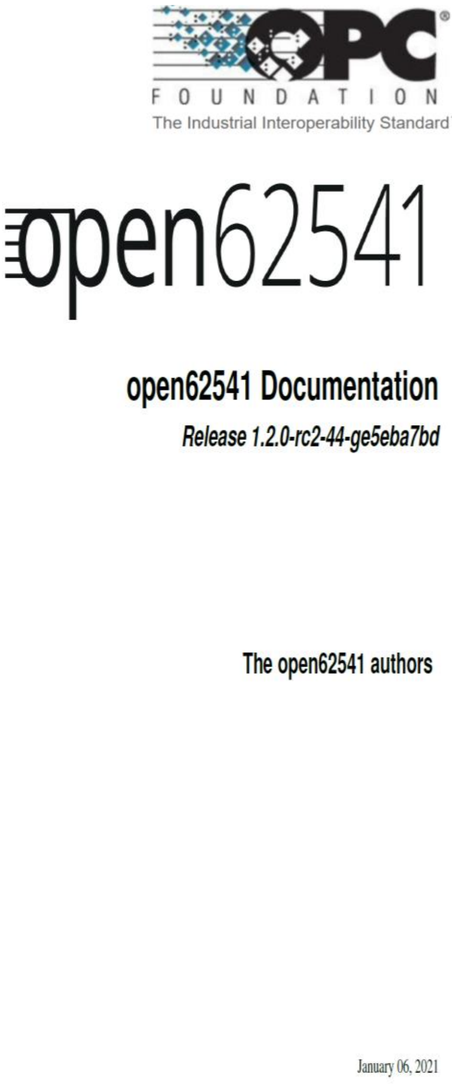
1. 4 Akraino IoT Area - 4



- oneM2M IoT Service Layer (SL) Platforn
  - 3GPP 5G HMTC (High Performance M
  - oneM2M Cloud Vendor Independent
  - oneM2M IoT SL and AI/ML use
  - oneM2M IoT SL and CIM NGSI-LD (C
  - oneM2M IoT SL Architecture
  - oneM2M IoT SL Common Service Fur
  - oneM2M IoT SL pre-integrated with !
  - oneM2M IoT SL Release Roadmap
  - oneM2M Semantic enablement and /
  - oneM2M Test Suite Structure (TSS) ar
  - oneM2M Use Cases (UCs) and SAREF
  - 5 **OPC UA Standard IEC 62 541 for O|**
- Project Cassini - IoT and Infrastructure I
- Tami COVID-19 Blueprint Family

For further information on the OPC UA, please see attached below the OPC UA Open IEC 62 541 (current) Documentation from Jan 2021.

Title	Description	Title	Description
Part 1: Overview and Concepts	This specification provides a high-level introduction to the Unified Architecture technology covering: More >	Part 11: Historical Access	This specifications describes how data can be archived and retrieved from a Historian/database, covering: More >
Part 2: Security Model	This specification describes OPC UA Security, covering: Introduction of the security objectives and More >	Part 12: Discovery and Global Services	This specification describes how UA products can be discovered and managed on a computer, network infrastructure, or More >
Part 3: Address Space Model	This specification provides a detailed description of an address space within an OPC UA Server, for OPC UA Clients to More >	Part 13: Aggregates	This specification describes the use of Aggregate functions for UA applications, covering: The concepts of More >
Part 4: Services	This specification is the most important of all OPC UA specifications, covering: The UA Services More >	Part 14: PubSub	This specification defines the OPC Unified Architecture (OPC UA) PubSub communication model. The PubSub communication More >
Part 5: Information Model	This specification provides a detailed description of how the OPC UA address space, nodes, and references are used to More >	Part 15: Safety	The specification "OPC UA Safety" describes services and protocols for the exchange of data using OPC UA mechanisms. More >
Part 6: Mappings	This specification describes how data and information are transferred between OPC UA Servers and Clients, covering: More >	Part 17: Alias Names	This specification provides a definition of AliasNames functionality. AliasNames provide a manner of configuring and More >
Part 7: Profiles	This specification describes categories of behaviors that OPC UA Servers and Clients can implement, covering: More >	Part 19: Dictionary Reference	This specification defines an Information Model of the OPC Unified Architecture. The Information Model describes the More >
Part 8: Data Access	This specification describes Data Access applications, covering: Overview and concepts of Data Access and More >	Part 100: Device Information Model	Companion Specification featuring an Information Model for Devices. The information model specification More >
Part 9: Alarms and Conditions	This specification describes the Alarms & Conditions applications, covering: Overview and concepts of More >	Part 200: Industrial Automation Model	This specification contains modelling concepts used in industrial automation. Version 1.00 contains modelling concepts More >
Part 10: Programs	This specification describes Programs and how they can be used in OPC UA applications, covering: Concepts of More >	Errata and Amendments	These documents contain changes to the OPC UA Specifications. These changes may impact interoperability and compliance. More >
		Specification Release Candidates for Review	These documents are draft and release candidate versions of OPC UA Specifications for member review. Information on how More >
		OPC UA Companion Specification Template	The companion specification template (OPC 11020) together with guidelines (OPC 11021) can be found here.


OPC FOUNDATION

The Industrial Interoperability Standard™

open62541

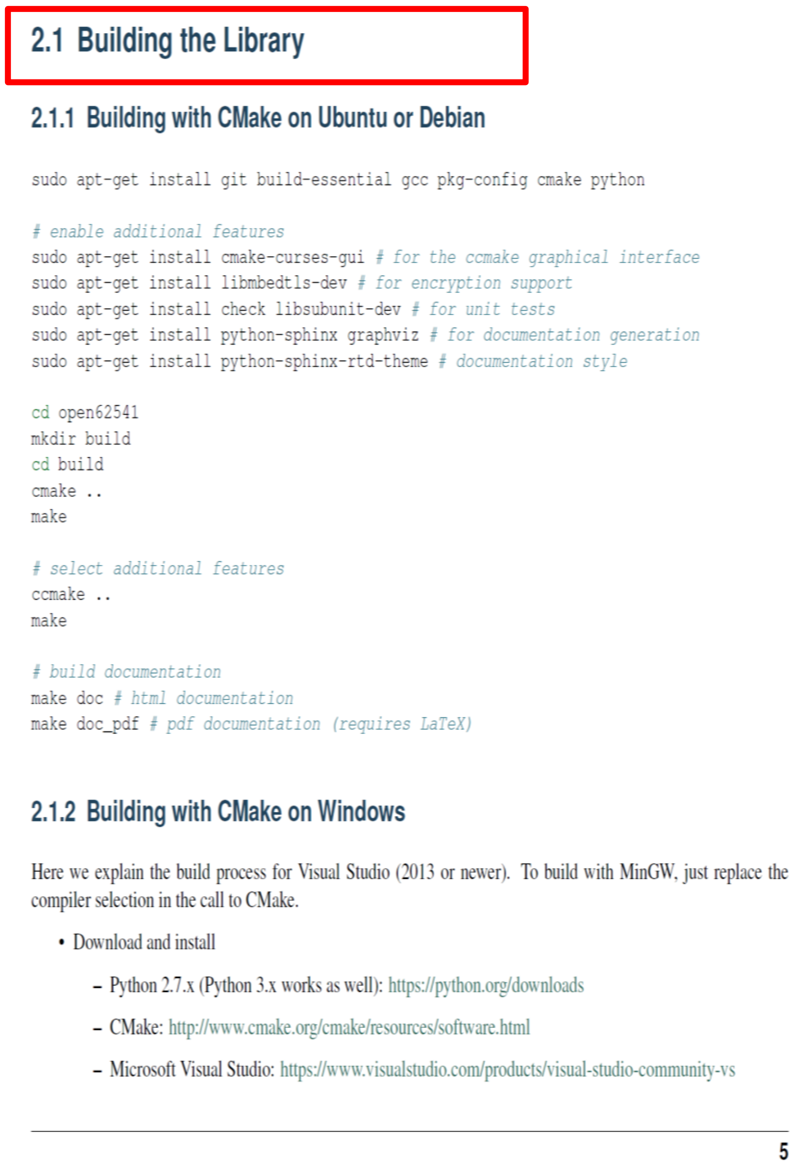
open62541 Documentation

Release 1.2.0-rc2-44-ge5eba7bd

The open62541 authors

January 06, 2021

1. 4 Akraino IoT Area - 5 (OPC UA IEC 62 541)



2.1 Building the Library

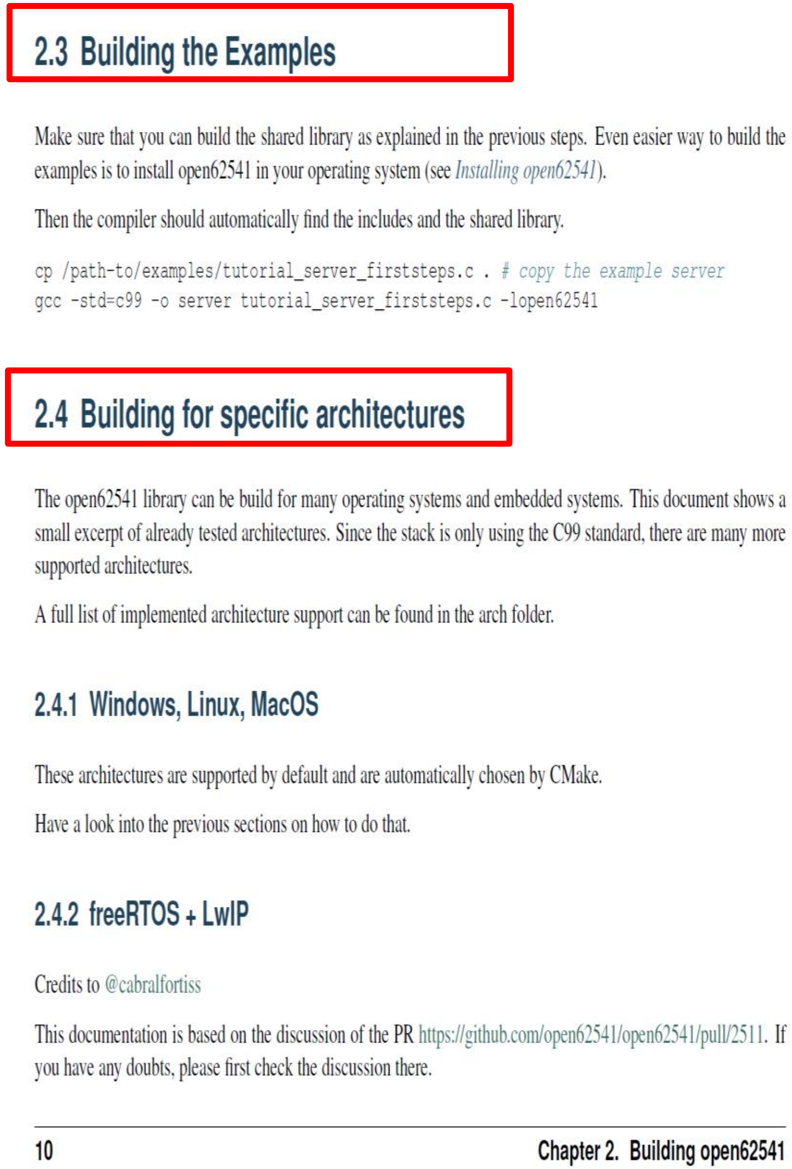
2.1.1 Building with CMake on Ubuntu or Debian

```
sudo apt-get install git build-essential gcc pkg-config cmake python

# enable additional features
sudo apt-get install cmake-curses-gui # for the ccmake graphical interface
sudo apt-get install libmbedtls-dev # for encryption support
sudo apt-get install check libsubunit-dev # for unit tests
sudo apt-get install python-sphinx graphviz # for documentation generation
sudo apt-get install python-sphinx-rtd-theme # documentation style

cd open62541
mkdir build
cd build
cmake ..
make

# select additional features
ccmake ..
make

# build documentation
make doc # html documentation
make doc_pdf # pdf documentation (requires LaTeX)
```

2.1.2 Building with CMake on Windows

Here we explain the build process for Visual Studio (2013 or newer). To build with MinGW, just replace the compiler selection in the call to CMake.

- Download and install
  - Python 2.7.x (Python 3.x works as well): https://python.org/downloads
  - CMake: http://www.cmake.org/cmake/resources/software.html
  - Microsoft Visual Studio: https://www.visualstudio.com/products/visual-studio-community-vs



2.3 Building the Examples

Make sure that you can build the shared library as explained in the previous steps. Even easier way to build the examples is to install open62541 in your operating system (see *Installing open62541*).

Then the compiler should automatically find the includes and the shared library.

```
cp /path-to/examples/tutorial_server_firststeps.c . # copy the example server
gcc -std=c99 -o server tutorial_server_firststeps.c -lopen62541
```

2.4 Building for specific architectures

The open62541 library can be build for many operating systems and embedded systems. This document shows a small excerpt of already tested architectures. Since the stack is only using the C99 standard, there are many more supported architectures.

A full list of implemented architecture support can be found in the arch folder.

2.4.1 Windows, Linux, MacOS

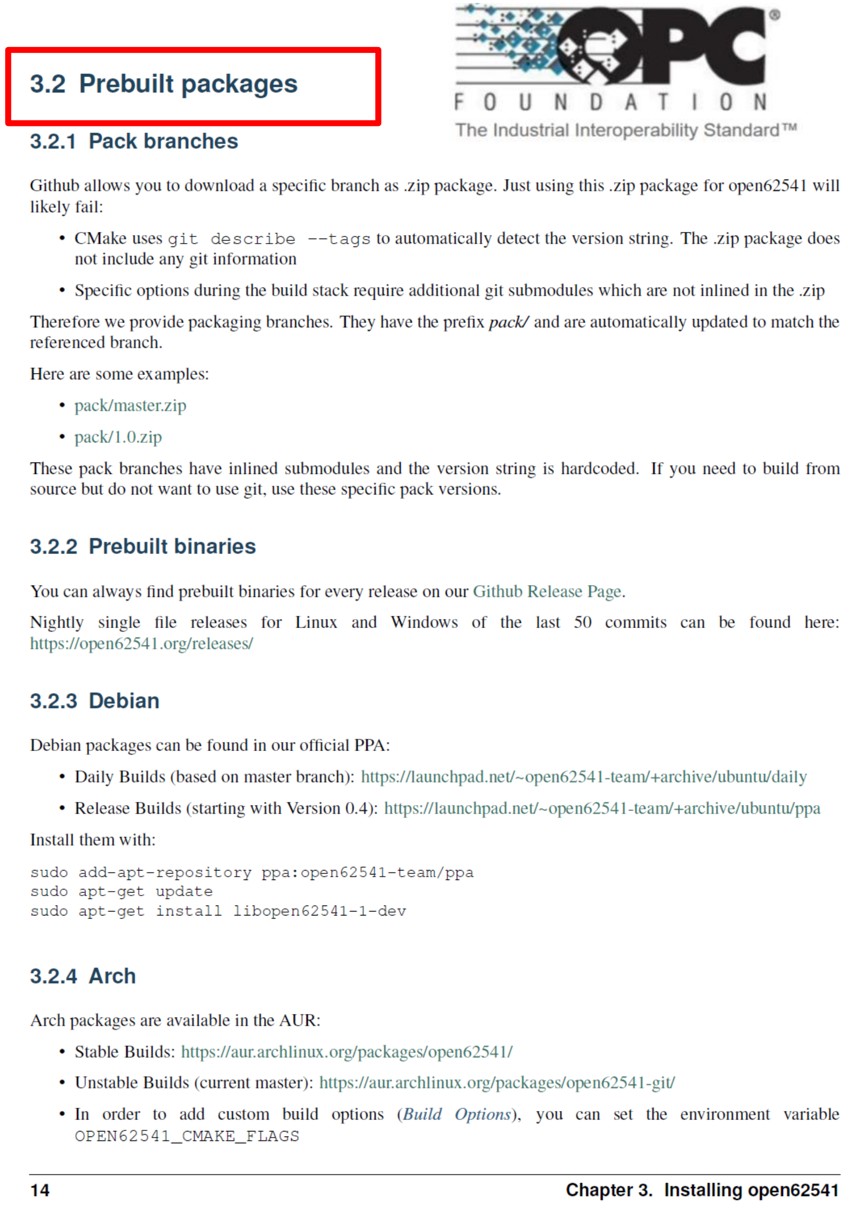
These architectures are supported by default and are automatically chosen by CMake.

Have a look into the previous sections on how to do that.

2.4.2 freeRTOS + LwIP

Credits to @cabralfortiss

This documentation is based on the discussion of the PR https://github.com/open62541/open62541/pull/2511. If you have any doubts, please first check the discussion there.



3.2 Prebuilt packages

3.2.1 Pack branches

Github allows you to download a specific branch as .zip package. Just using this .zip package for open62541 will likely fail:

- CMake uses `git describe --tags` to automatically detect the version string. The .zip package does not include any git information
- Specific options during the build stack require additional git submodules which are not inlined in the .zip

Therefore we provide packaging branches. They have the prefix *pack/* and are automatically updated to match the referenced branch.

Here are some examples:

- pack/master.zip
- pack/1.0.zip

These pack branches have inlined submodules and the version string is hardcoded. If you need to build from source but do not want to use git, use these specific pack versions.

3.2.2 Prebuilt binaries

You can always find prebuilt binaries for every release on our Github Release Page.

Nightly single file releases for Linux and Windows of the last 50 commits can be found here: https://open62541.org/releases/

3.2.3 Debian

Debian packages can be found in our official PPA:

- Daily Builds (based on master branch): https://launchpad.net/~open62541-team/+archive/ubuntu/daily
- Release Builds (starting with Version 0.4): https://launchpad.net/~open62541-team/+archive/ubuntu/ppa

Install them with:

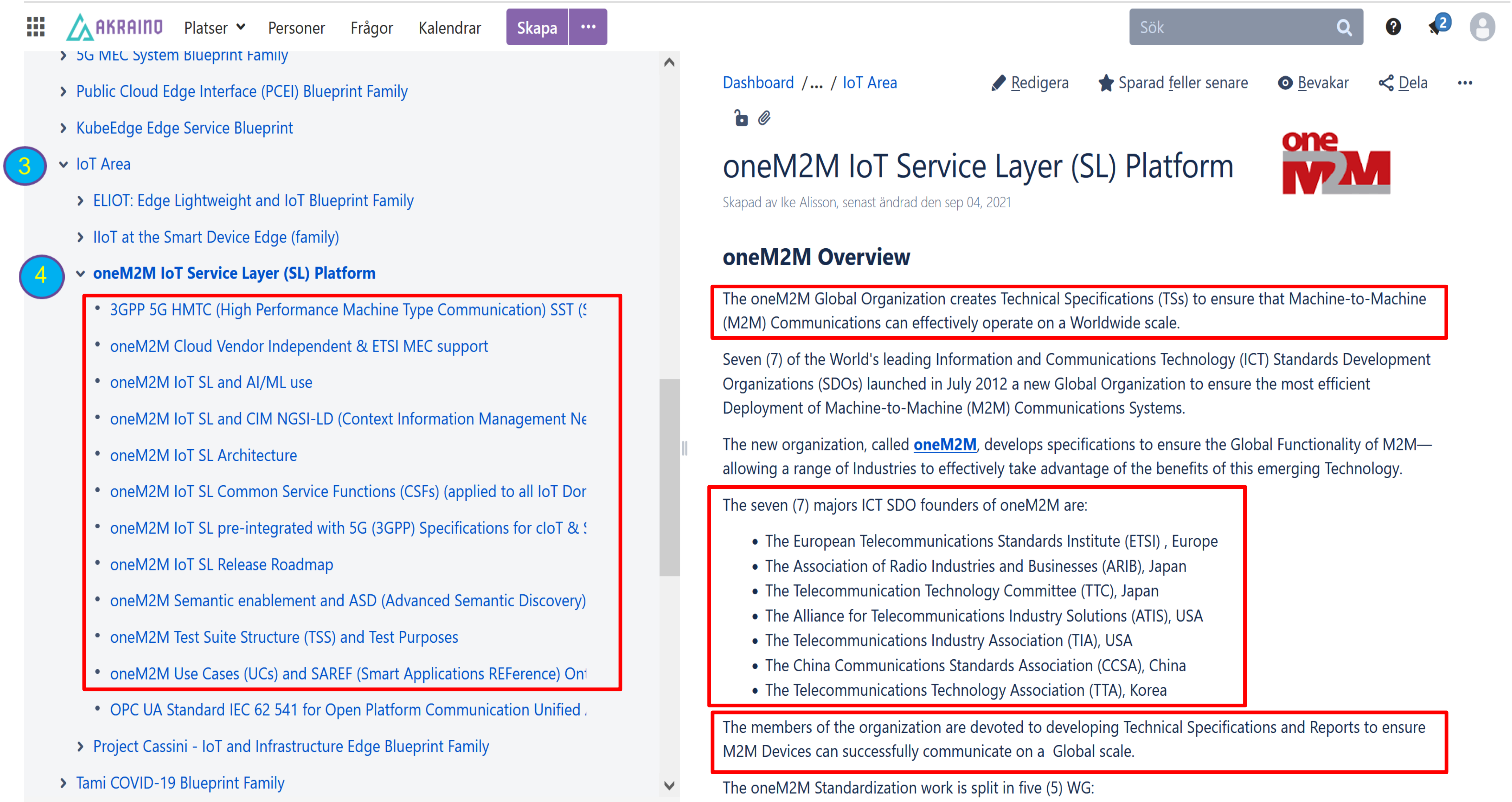
```
sudo add-apt-repository ppa:open62541-team/ppa
sudo apt-get update
sudo apt-get install libopen62541-1-dev
```

3.2.4 Arch

Arch packages are available in the AUR:

- Stable Builds: https://aur.archlinux.org/packages/open62541/
- Unstable Builds (current master): https://aur.archlinux.org/packages/open62541-git/
- In order to add custom build options (*Build Options*), you can set the environment variable `OPEN62541_CMAKE_FLAGS`

1. 4 Akraino IoT Area - 6



- 5G MEC System Blueprint Family
- Public Cloud Edge Interface (PCEI) Blueprint Family
- KubeEdge Edge Service Blueprint
- IoT Area
  - ELIOT: Edge Lightweight and IoT Blueprint Family
  - IIoT at the Smart Device Edge (family)
  - **oneM2M IoT Service Layer (SL) Platform**
    - 3GPP 5G HMTC (High Performance Machine Type Communication) SST (S
    - oneM2M Cloud Vendor Independent & ETSI MEC support
    - oneM2M IoT SL and AI/ML use
    - oneM2M IoT SL and CIM NGSI-LD (Context Information Management Ne
    - oneM2M IoT SL Architecture
    - oneM2M IoT SL Common Service Functions (CSFs) (applied to all IoT Dor
    - oneM2M IoT SL pre-integrated with 5G (3GPP) Specifications for cIoT & S
    - oneM2M IoT SL Release Roadmap
    - oneM2M Semantic enablement and ASD (Advanced Semantic Discovery)
    - oneM2M Test Suite Structure (TSS) and Test Purposes
    - oneM2M Use Cases (UCs) and SAREF (Smart Applications REFerence) Ont
    - OPC UA Standard IEC 62 541 for Open Platform Communication Unified
  - Project Cassini - IoT and Infrastructure Edge Blueprint Family
- Tami COVID-19 Blueprint Family

Dashboard / ... / IoT Area

oneM2M IoT Service Layer (SL) Platform

Skapad av Ike Alisson, senast ändrad den sep 04, 2021

oneM2M Overview

The oneM2M Global Organization creates Technical Specifications (TSs) to ensure that Machine-to-Machine (M2M) Communications can effectively operate on a Worldwide scale.

Seven (7) of the World's leading Information and Communications Technology (ICT) Standards Development Organizations (SDOs) launched in July 2012 a new Global Organization to ensure the most efficient Deployment of Machine-to-Machine (M2M) Communications Systems.

The new organization, called **oneM2M**, develops specifications to ensure the Global Functionality of M2M—allowing a range of Industries to effectively take advantage of the benefits of this emerging Technology.

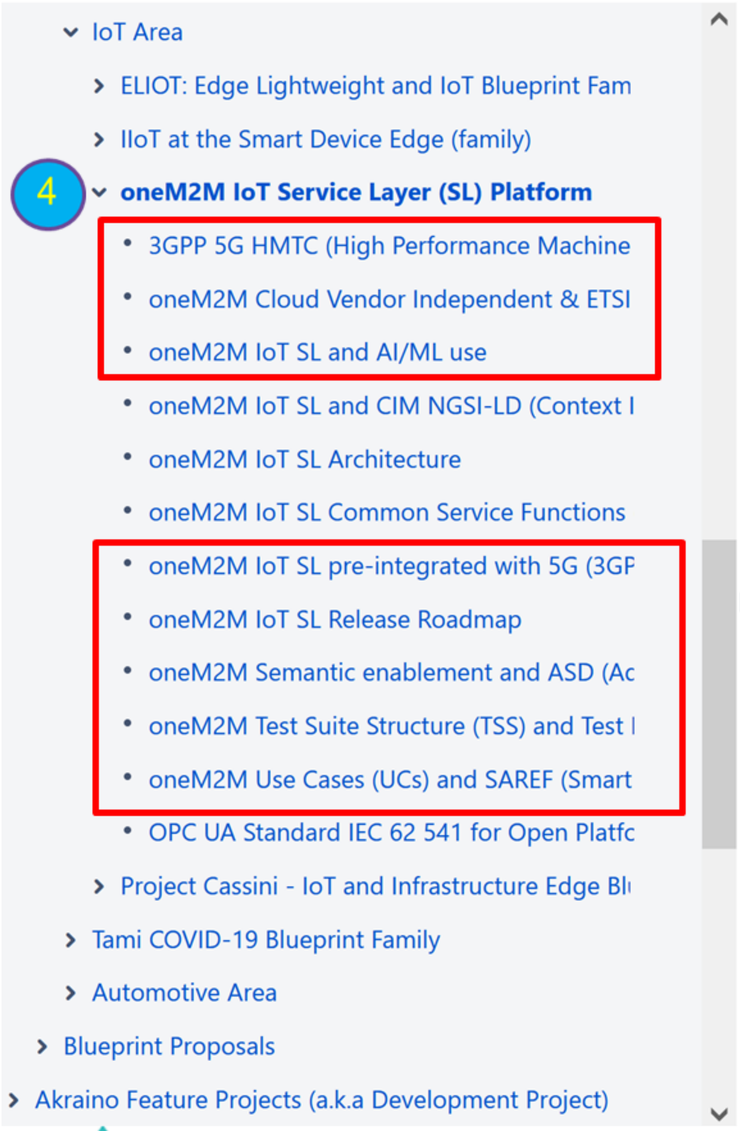
The seven (7) majors ICT SDO founders of oneM2M are:

- The European Telecommunications Standards Institute (ETSI) , Europe
- The Association of Radio Industries and Businesses (ARIB), Japan
- The Telecommunication Technology Committee (TTC), Japan
- The Alliance for Telecommunications Industry Solutions (ATIS), USA
- The Telecommunications Industry Association (TIA), USA
- The China Communications Standards Association (CCSA), China
- The Telecommunications Technology Association (TTA), Korea

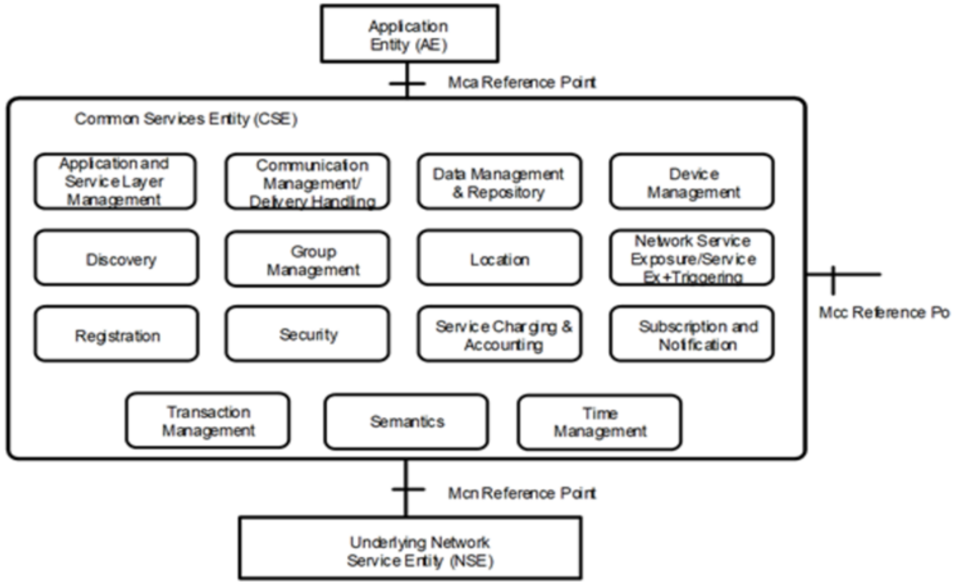
The members of the organization are devoted to developing Technical Specifications and Reports to ensure M2M Devices can successfully communicate on a Global scale.

The oneM2M Standardization work is split in five (5) WG:

1. 4 Akraino IoT Area - 7

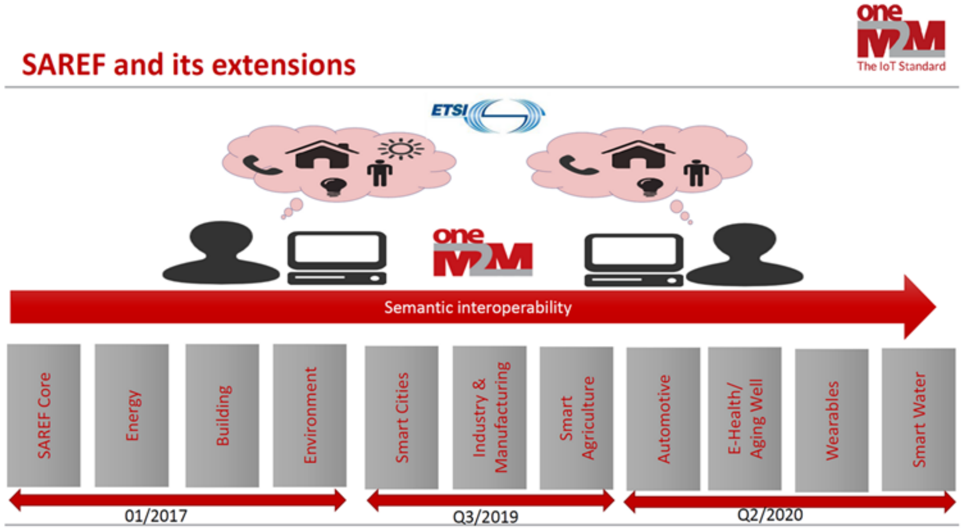


- IoT Area
  - ELIOT: Edge Lightweight and IoT Blueprint Fam
  - IIoT at the Smart Device Edge (family)
  - 4 **oneM2M IoT Service Layer (SL) Platform**
    - 3GPP 5G HMTC (High Performance Machine
    - oneM2M Cloud Vendor Independent & ETSI
    - oneM2M IoT SL and AI/ML use
    - oneM2M IoT SL and CIM NGSI-LD (Context I
    - oneM2M IoT SL Architecture
    - oneM2M IoT SL Common Service Functions
    - oneM2M IoT SL pre-integrated with 5G (3GF
    - oneM2M IoT SL Release Roadmap
    - oneM2M Semantic enablement and ASD (Ac
    - oneM2M Test Suite Structure (TSS) and Test I
    - oneM2M Use Cases (UCs) and SAREF (Smart
    - OPC UA Standard IEC 62 541 for Open Platfc
  - Project Cassini - IoT and Infrastructure Edge Bl
- Tami COVID-19 Blueprint Family
- Automotive Area
- Blueprint Proposals
- Akraino Feature Projects (a.k.a Development Project)



Application Entity (AE)
Mca Reference Point
Common Services Entity (CSE)
Application and Service Layer Management
Communication Management/ Delivery Handling
Data Management & Repository
Device Management
Discovery
Group Management
Location
Network Service Exposure/Service Ex+Triggering
Registration
Security
Service Charging & Accounting
Subscription and Notification
Transaction Management
Semantics
Time Management
Mcc Reference Po
Mcn Reference Point
Underlying Network Service Entity (NSE)

Fig. 6.2.0-1: Common Service Functions



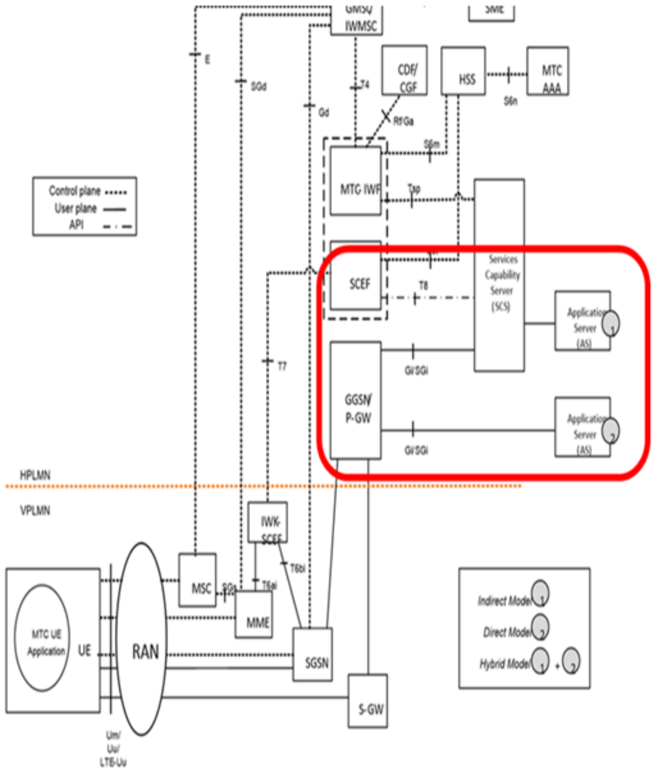


Figure 4.2-1b: 3GPP Architecture for Machine-Type Communication (Roaming)

Welcome and Enjoy Akraino IoT Area Regional Developer Meetup!