



OSGi Alliance IoT Vision

March 2020



The Complexity Crisis and IoT

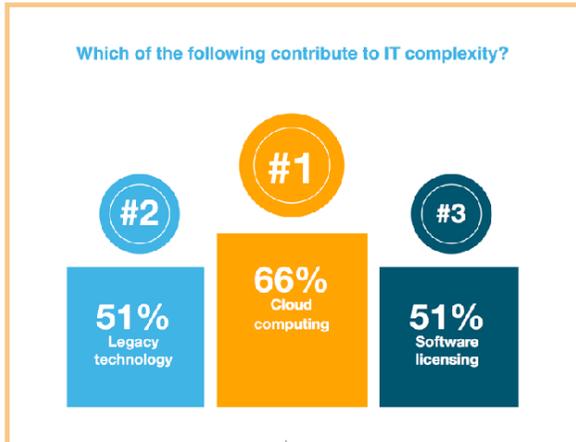
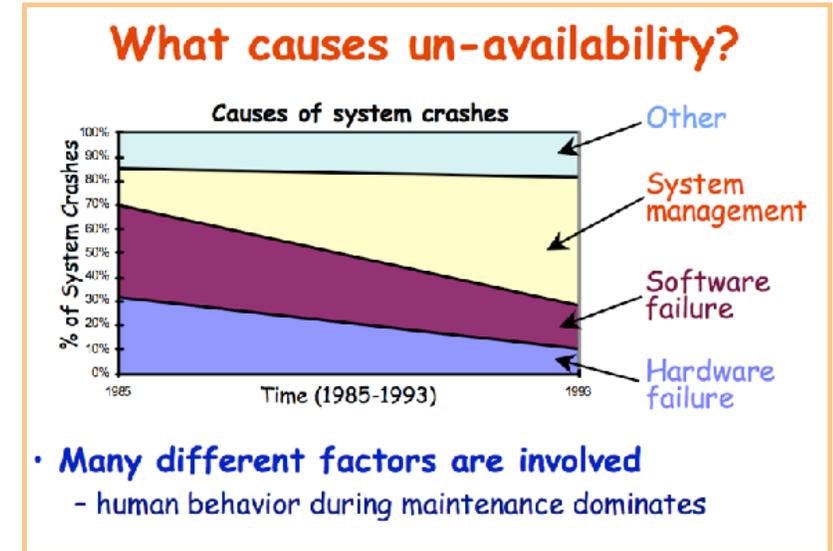
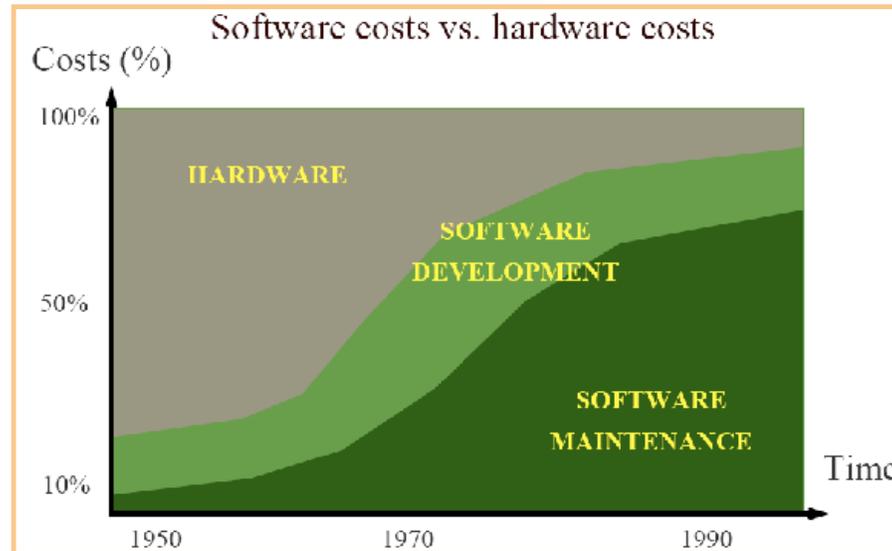
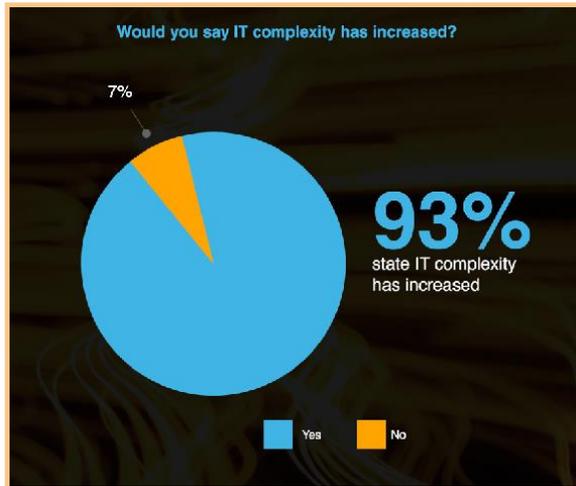
Smart City, Industry 4.0, Pervasive 5G, and Mobile Edge Computing all have vast Economic potential!

- All of these are distributed IoT software eco-systems need to be **orders of magnitude more sophisticated** than anything we currently have. The Internet is defined by a hand full of simple fixed specifications - in contrast each Smart City will be a complex co-evolving software eco-system
- Such solutions must be **Economically Sustainable, Maintainable, Agile** and **Evolvable** over many decades
- These Economic opportunities are currently inhibited by the current **Software Complexity Crisis**

The Complexity Crisis

“76% of CIOs Say It Could Become Impossible to Manage Digital Performance, as IT Complexity Soars”

(Jan 2018 – Source: <https://bit.ly/3a8ZQzz>)



Operational Complexity
Increases OPEX
Decreases Agility

Anne Thomas Manes (Gartner):
SOA Symposium, Berlin, October 2010

Operational Complexity
Increases the Likelihood and Duration of Service Failures

Berkley's ROC initiative:
http://roc.cs.berkeley.edu/papers/ROC_TR02-1175.pdf

A Sustainability/Longevity Crisis for IoT Solutions



“Modern-day software systems, even those that presumably function correctly, have a useful and effective shelf life orders of magnitude less than other engineering artifacts.

*While an application's lifetime typically cannot be predicted with any degree of accuracy, **it is likely to be strongly inversely correlated with the rate and magnitude of change of the ecosystem in which it executes.**”*

DARPA BRASS initiative April 2015



OSGi Alliance: *Formed in 1999 with a mission to address this fundamental problem!*

Modularity

As long as the design rules (specifications) are obeyed:

- Modularity makes complexity manageable by breaking down a big tangled ball into smaller, well defined components that fit together well
- Modularity enables parallel work allows people to work on different problems all at the same time; and
- Modularity is tolerant of uncertainty because can plug in and plug out without concern of the overall structure

“Tolerant of uncertainty” means that elements of a modular design:

- May be changed
- After the fact and
- In unforeseen ways

As Long as ALL Dependencies are Managed

Specific Challenges for IoT...

Nested Hierarchy of Structures

- Smart Home is part of Smart Grid, Smart Grid is part of Smart City

Increasingly distributed Edge Centric Architectures

- No longer solely with a Cloud Hub and IoT devices as Spokes
- Sensor, Edge Devices, IoT Gateways, on site MicroCloud/Edge Compute, Fog Architectures, Clouds ...

Highly fragmented Market

- 450 IoT Platforms in 2017 (Source: IoT Analytics)
- Many companies start with building their own “Micro”-ecosystems

OSGi – Addressing this Chaotic Standards Landscape

OSGi provides a coherent and risk minimizing approach to addressing an increasingly heterogeneous IT Standards landscape

- Allowing solutions based on different Functional Specifications (e.g., OneM2M and W3C/WoT) to interoperate without creating brittle / change resistant / APIs
- Via standardized protocol adapters: e.g., Zigbee, EnOcean
- Enabling solutions to embrace Future - currently unknown - Standards

OSGi provides the ideal platform to implement functional for Device Management, Device Connectivity & Software Provisioning

- Specifications for TR-069 and OMA-DM available for many years
- Specifications for Protocols: e.g., ZigBee, EnOcean

Future areas of relevance

- Domain Specific Semantics: EEBus, AGORA,...
- Protocol support for e.g., Bluetooth LE, OPC-UA,...

OSGi – Addressing IoT Requirements

Avoid Vendor Lock-in: OSGi is a mature Open Industry Standard

Economically Sustainable: OSGi is the standard for Java Modularity

OSGi avoids building Future Legacy by enabling:

- Pluggable Maintainability; Environmental Diversity; Adaption and Evolvability
- Ease of Integration of functional components from different suppliers / providers, based on different Standards

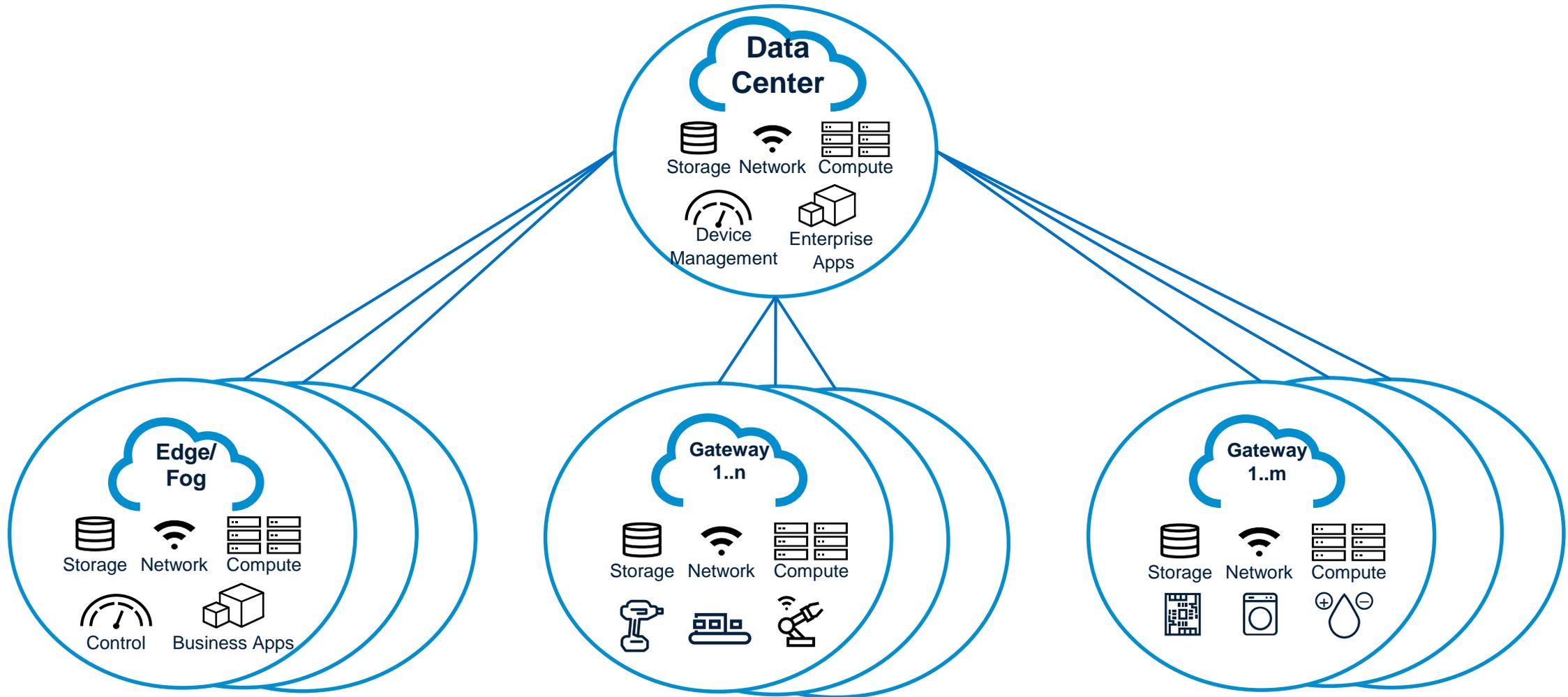
OSGi Developer Skills:

- Can be used or re-used at the IoT Edge and the Enterprise and/or Cloud Core

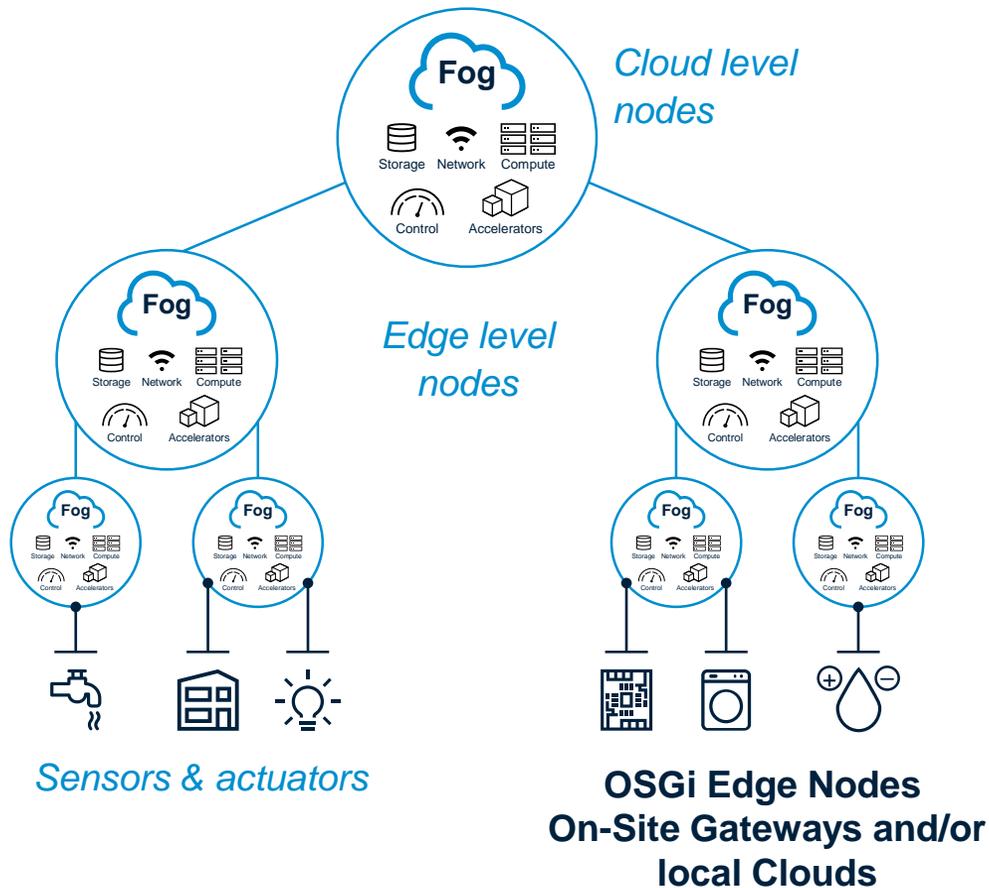
OSGi Self Describing Modules enable:

- Reusability of software components in different environmental contexts: e.g., enabling AI/Data processing components to be run in either the Core or the physical Edge
- Avoids loss of structural knowledge over time (dead sea effect) as developers leave. Modules are Self-Describing and dependencies are automatically calculated by the OSGi Resolution Process

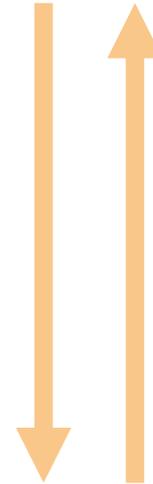
OSGi – Enabling Architectural Flexibility Cloud Hub and Spoke



OSGi – Enabling Architectural Flexibility A Federated Fog Architecture



Flow of Refined Data



Flow of behaviors
(OSGi bundles) – local
control & monitoring



An OSGi based Smart City/
Industry 4.0
AI / FOG platform
(EU Horizon 2020)

OSGi Alliance IoT Expert Group

The IoT EG was formally created in September 2015

- More than 12 OSGi member companies are contributing
- Co-Chairs: Tim Ward (Paremus) and Bruce Jackson (Thingstream)

The IoT EG areas of concern include:

- To support application developers to create IoT services
- Targeting embedded and cloud environments where they intersect with endpoint devices
- Data processing and management in IoT gateways
- Cross-industry and cross-protocol device connectivity on level of actors/sensors and IoT gateways
- Support the development and deployment of device abstraction layer and endpoint ontologies
- The virtualization of IoT services
- Connectivity to the cloud for endpoint devices and the interoperability with existing management systems and protocols
- Enable and enforce IoT end-to-end security

Call for Action: IoT is Best Done with Others

Relevance

- The value over time is shifting from hardware to software

Sustainability

- Avoid technical-debt
- Preserve existing value while enabling cost effective enhancements

Reuse

- Let's not reinvent the wheel again and again – We already have 450+ IoT platforms
- Let's share resources, investment and risk to ensure:
- Interoperability in IoT Solutions
- Software modularization from the edge to cloud
- Evolution of distributed software right from the beginning

Many IoT technologies and standards come and go – OSGi has been addressing the IoT domain for almost 20 years.

Join us and build the next generation of IoT



As Complexity is tamed - Total Cost of Ownership is reduced

Economically sustainable IoT Solutions will be modular; these solutions will have the characteristics imbued by OSGi technology

Tell me more!

- Modularity - <https://www.osgi.org/developer/modularity/>
 - Complexity, Modularity and Business/OPEX - <https://www.osgi.org/complexity-modularity-and-business/>
 - Start to build Modular Software Systems - <https://enroute.osgi.org>
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