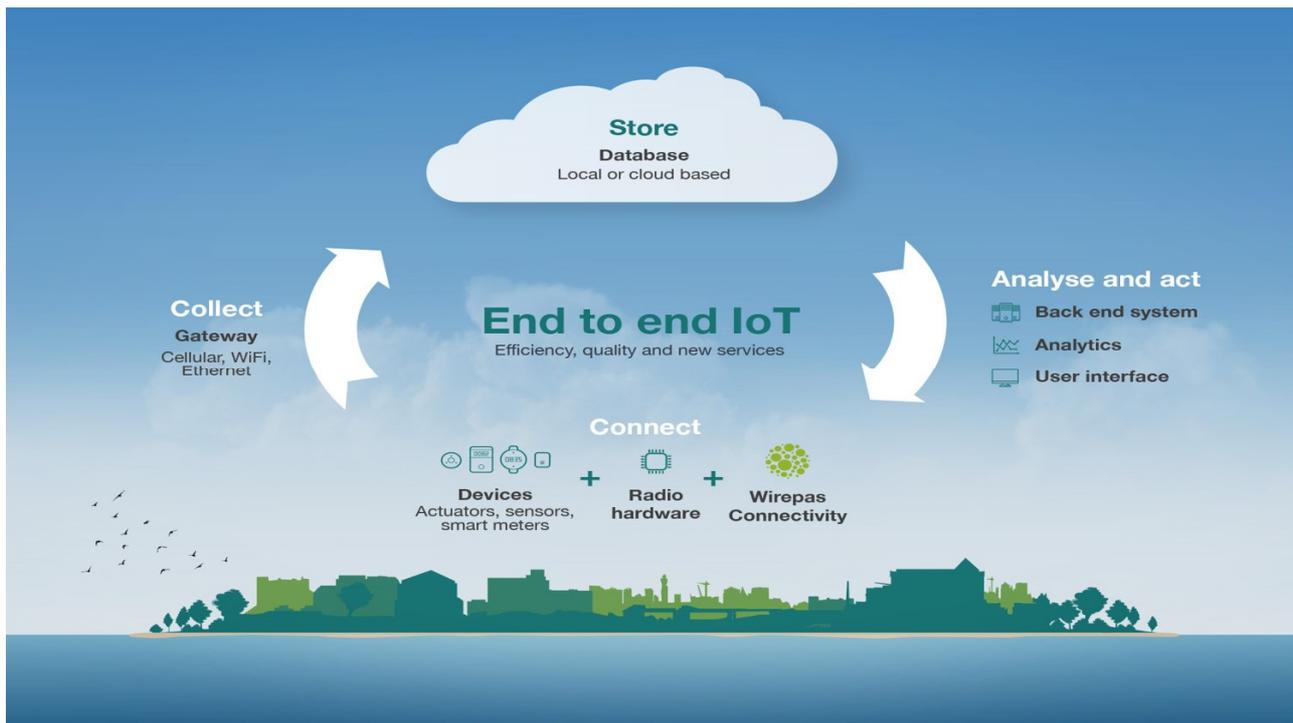


It's all about the connectivity

At the core, the basic idea of IoT is quite simple. It is all about connecting vast amounts of devices and utilizing the data in order learn faster than was possible before and in order to do things better. It holds a great potential in terms of efficiency and new services – in terms of making the world a better place.

The same competencies are needed basically in all IoT applications such as lighting, asset tracking, metering, sensing and logistics. We need device manufacturers, radio hardware, connectivity protocols, database or cloud service providers, IoT platforms, analytics and system integrators.

The key however is the connectivity. The diversity of IoT applications and their requirements introduces a paradigm shift for connectivity solutions. The ability to flexibly optimize the connectivity solution to the needs of the customer's business case and application is crucial to the development and growth of IoT based business.



The requirements for connectivity vary considerably between different IoT applications such as smart metering, sensing, logistics and lighting for example. Because the use cases vary so much, one connectivity solution does not fit for all. Moreover, the requirements evolve over time per application, and it is important to be able update applications when necessary. In fact, in many cases, if the connectivity solution is not optimized for the application in terms of power, bandwidth, range, latency, upgradeability etc., the underlying business case does not apply anymore. On a very high level it comes down to scalability, reliability, total cost of ownership and functional value.



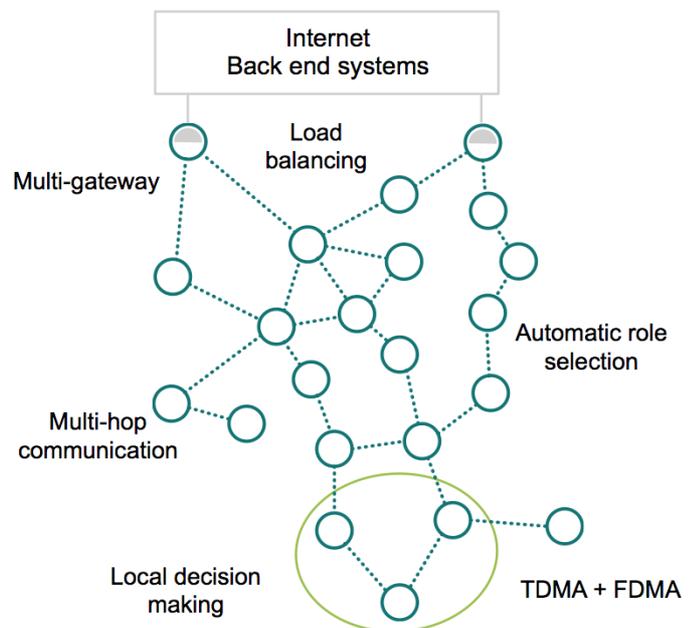
	Scalability and autonomy	Data Capacity	Latency	Deployment and maintenance cost	Battery operated	Density	Mobility	Security	Reliability
Electricity metering	medium / high	median	important	important	No	medium/low	No	high	high
Water metering	High	low	low / median	important	Yes	medium/low	No	high	high
Gas metering	High	low	low	important	Yes	medium/low	No	high	high
Lighting	High	low	important	medium	No	medium	No	medium	medium
Logistic	High	low	low / medium	important	Yes	high	Yes	medium	High/medium
Asset tracking	High	low	important	important	Yes	high	Yes	high	High/medium

IoT connectivity for large-scale industrial IoT, Smart City or Smart Traffic should be a solution that scales to any number of connected devices, enables 24/7 device availability, works on any open market radio hardware, enables over the air updates, is secure, and can be monitored and diagnosed real time. Finally, one must be able to adjust bandwidth, latency and power at run time per device in the network to fit for the purpose.

Fit-for-purpose

The only technology, capable of realizing these diversified of needs simultaneously is a de-centralized network where all the intelligence is in the network itself, and where the devices themselves form the network. The decentralized device network topology offers several benefits for large-scale IoT:

- Lowest total cost of ownership:** decentralized network minimizes both capital costs (CAPEX) and operational costs (OPEX). No extra infrastructure is needed as the devices themselves form the network, the fully automatic operation enables easy and quick installation, and the firmware runs on low cost radio hardware. During the system lifetime, the data plan costs are minimized as backhaul connectivity is needed only for small fraction of devices, and the self-healing operation maintains the network continuously. It also removes the risk of single point of failure, and the need for external interventions and field maintenance.
- Open and flexible wireless solution:** Easy-to-use open API for applications to use the network services, and the network can be integrated to any system and used in any application. All the protocol intelligence is implemented in the firmware and de-coupled from the physical layer which



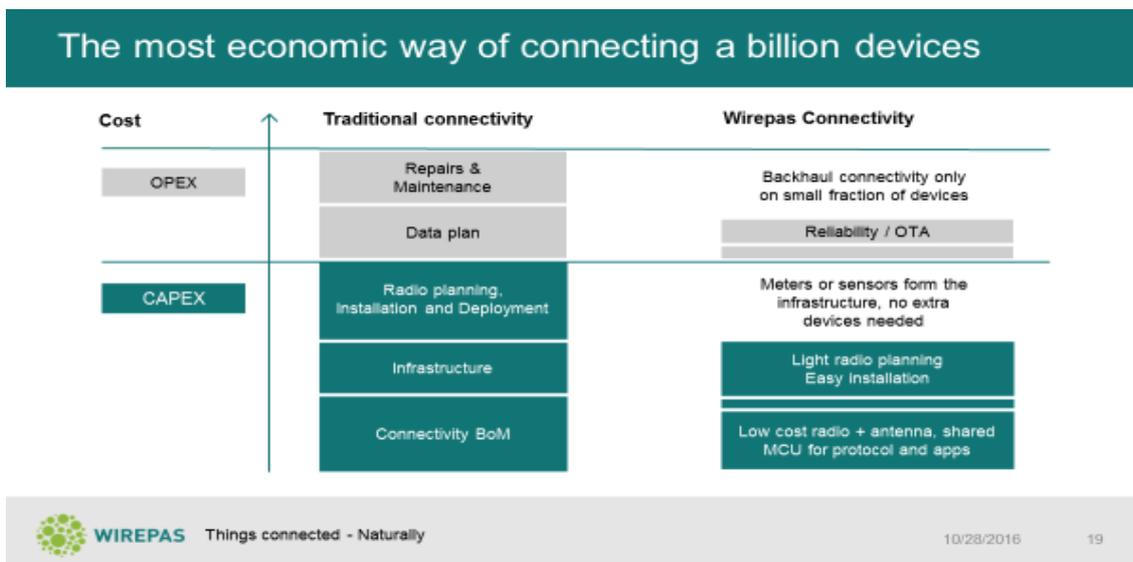
enables the use various radio solutions. Thus, the firmware can run on any radio hardware and frequency band.

- **Support for any installation topology:** It works in any type of installation. The networks can include large number of devices, it can serve high device density as well as sparse network deployments. The networks can cover large geographical areas as every device is expanding the coverage and provide connectivity in hard to reach places such as deep indoors and basements.
- **High reliability and availability:** There are multitude of self-healing and interference avoidance methods built into the network technology. These enable high reliability and availability. This means that when data is sent it is also goes through reliably and the devices are connected and available 24/7. All this is independent of the environment dynamics and interferences thanks to the autonomous, de-centralized operation.
- **Low power and low latency:** With the highly energy-efficient operation, all devices (including routers) in the network can be battery-operated whilst still enabling multi-year lifetime. Also, low latency multi-hop message transfer is supported, which makes this topology suitable for latency critical applications such as lighting control solutions.

Total cost of ownership

Communication should be part of the device purchase price and not the running fee. This allows businesses to develop service models which adapt to changes in the business environment and enable scaling to high volumes.

Let's take asset tracking or lighting as an example. When we are talking about millions of small connected devices, it is obvious that the connected hardware cannot cost dollars in double digits. My point is that connectivity should be part of device cost – for good. This truly allows customers to develop business models which are flexible, scalable and predictable.





At the end of the day, IoT connectivity is clearly a question of functionality i.e. which connectivity delivers the best fit for the business need. At the same time, we also see that in many IoT applications a shift in cost paradigm is needed. And when we are talking about cost, we should talk about the lifetime cost. To put it simply, in most Industrial IoT applications unlimited data for the lifetime of the hardware cannot cost more than a bottle of beer and the connectivity should be an inherent functionality of the product or a device.

Jussi Numminen – Head of Radio and IPR, Wirepas

Jussi Numminen is a technology expert with more than 20 years of experience from creating, developing, and delivering innovative global technology products and solutions. He has a long experience in radio communication system design and international standardization work in 3GPP, where he participated in creation of WCDMA/HSPA and LTE systems. He has multiple patents in communication technology area.



Jussi Numminen joined Wirepas in November 2015 as Director, Radio Strategy and IPR. Wirepas offers a singular connectivity technology with unique business model. The completely de-centralized device connectivity helps customers to lower the cost of data acquisition while keeping the SLA levels high at any scale.

Before joining Wirepas Jussi has held several demanding positions at Nokia, ST-Microelectronics, ST-Ericsson, Ericsson and Microsoft.

Wirepas in Brief:

Wirepas is focused on providing the most reliable, optimized, scalable and easy to use device connectivity for its customers. Wirepas Connectivity is a de-centralized radio communications protocol that can be used in any device, with any radio chip and on any radio band. With Wirepas Connectivity there is no need for traditional repeaters because every wireless device is a smart router of the network. The connected devices form the network - easy as that. Wirepas has its headquarters in Tampere, Finland and offices in France, Germany, South Korea, the UK and the United States.

The technology was developed in a 10-year research program at the Tampere University of Technology. The company was founded in 2010.

Wirepas is focused on large-scale industrial and infrastructure level IoT applications such as smart metering, asset tracking and lighting, and is working with leading global companies within those areas.