Setting the Standard for Automation™

Radiocommunications in industry : the key features of ISA 100 solutions

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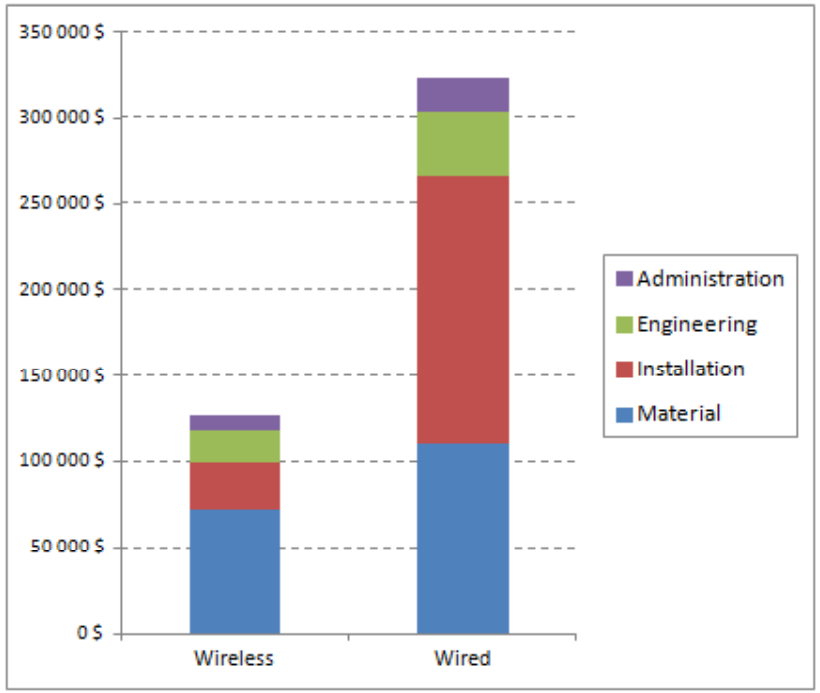
Today's world lives at the time of wireless

- GSM and other 2G systems : 5.3 billions subscriptions in 2012 - 1000 operators
- 3G, HSPA, HSPA + : 1.0 billion subscriptions
- 4 G (LTE) : 28 millions subscriptions
- 200 000 SMS sent each second in the world
- 570 millions smart phones sold in 2012
- 1 Billion Bluetooth connections sold each year
- Billions of new Wi-Fi connections per year
- Fast development of RFID, pay-per phone (NFC), etc.

Wireless is everywhere in our daily lives

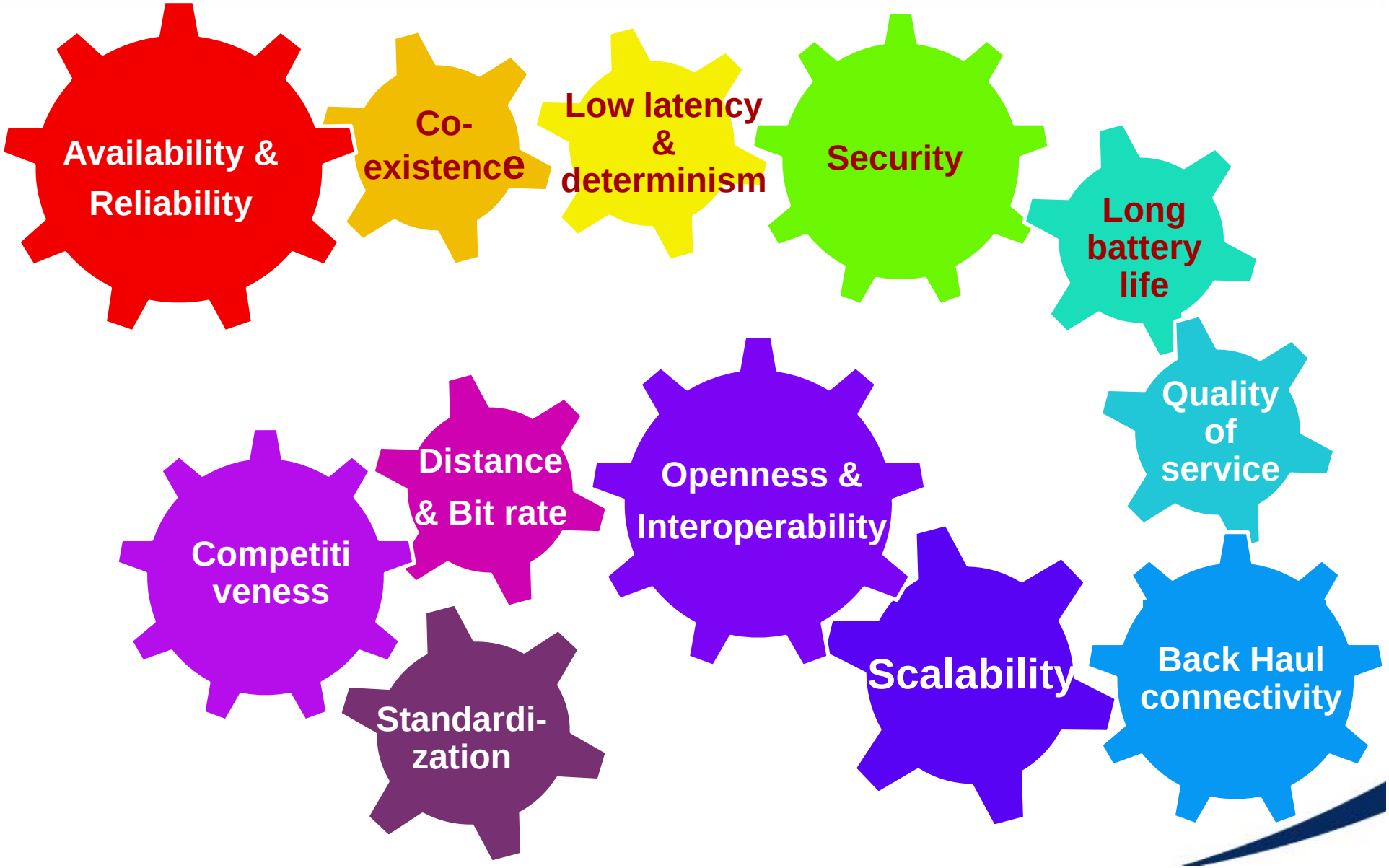
Industry can benefit from wireless

- **Reduce Capital-ex**
  - No cabling engineering
  - No cable installation
  - Easier commissioning
- **Reduce Operational-ex**
  - Less down time
  - Higher Productivity
  - Less Field Maintenance effort
- **Improve Safety & Product Quality**
  - More monitoring points
  - Environmental monitoring
- **More flexibility**
  - Easier to modify



Source : ISA

However Industry is a conservative and demanding market



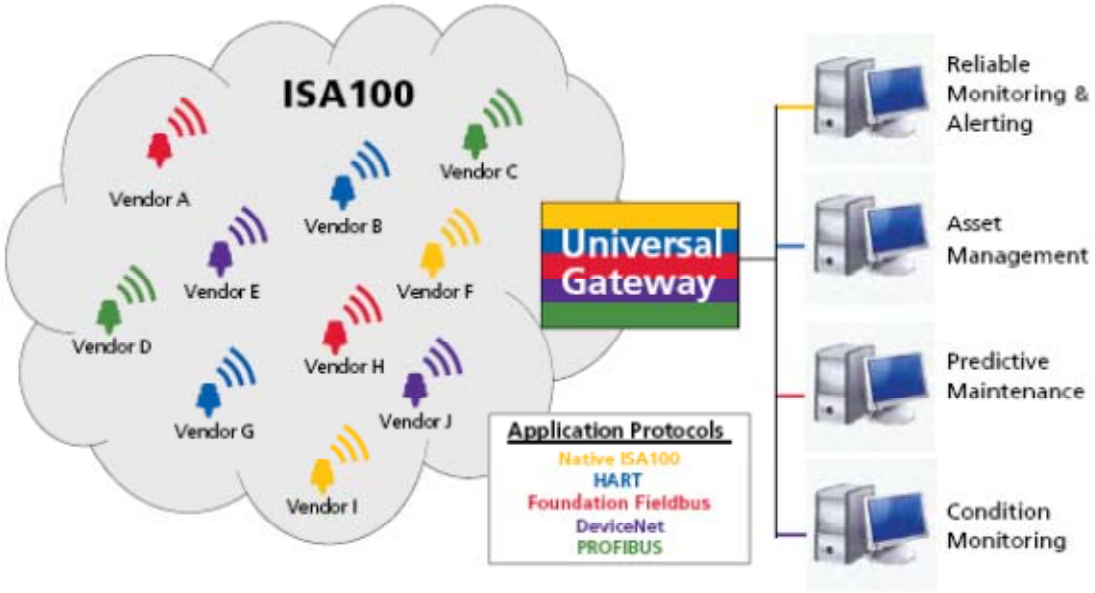
No general purpose solution meets all the requirements (1)

Requirements	Wi-Fi	Bluetooth	ZigBee	2G, 3G
Availability, Reliability				
Coexistence				
Low latency & determinism				
Security (Integrity, Authentication, Confidentiality)				
Long battery life				
Quality of Service				

No general purpose solution meets all the requirements (2)

Requirements	Wi-Fi	Bluetooth	ZigBee	2G, 3G
Back haul connectivity				
Scalability				
Openness & Interoperability				
Distance & bitrate				
Competitiveness				
Standardization				

ISA100 general objective



Many Applications, Many Protocols,

A Single Wireless Network

The ISA100 committee was formed in 2005 to establish standards and related information that will define procedures for implementing wireless systems in the automation and control environment with a focus on the field level.

First standard : ISA100.11a

Key objectives :

- **Low energy** consumption devices, with the **ability to scale** to address large installations
- **Wireless infrastructure, interfaces to legacy** infrastructure and applications, **security, and network management** requirements in a functionally scalable manner
- **Robustness in the presence of interference** found in harsh industrial environments and with legacy systems
- **Coexistence** with other wireless devices anticipated in the industrial work space (802.11x, 802.15x, 802.16x, cellular phones, RFID, motors, microwaves, etc.)
- **Interoperability** of ISA100 devices and **connectivity** with other standards

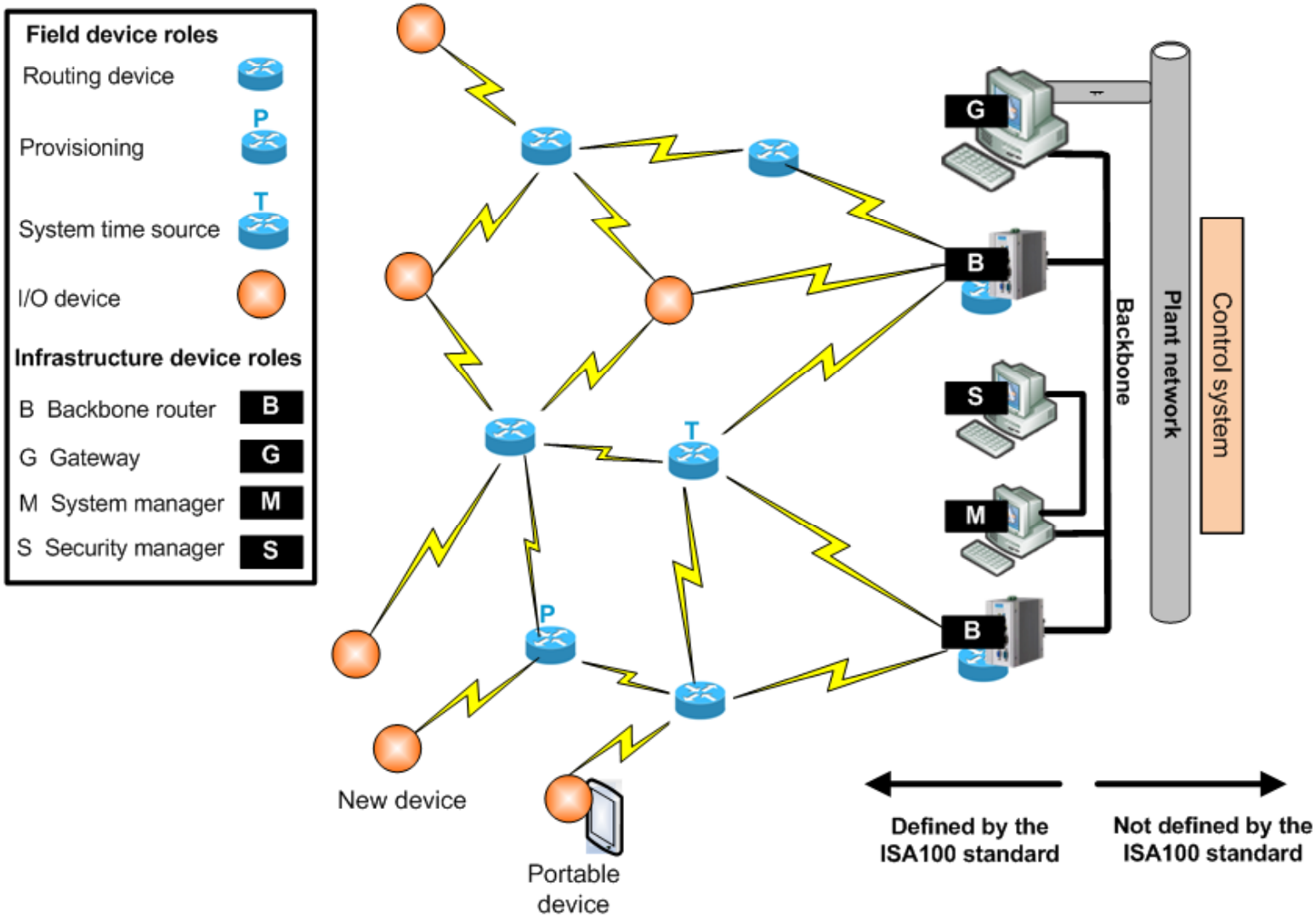
A Standard for Wireless Field Devices in scalable Plant-Wide Systems

How have these objectives been reached?

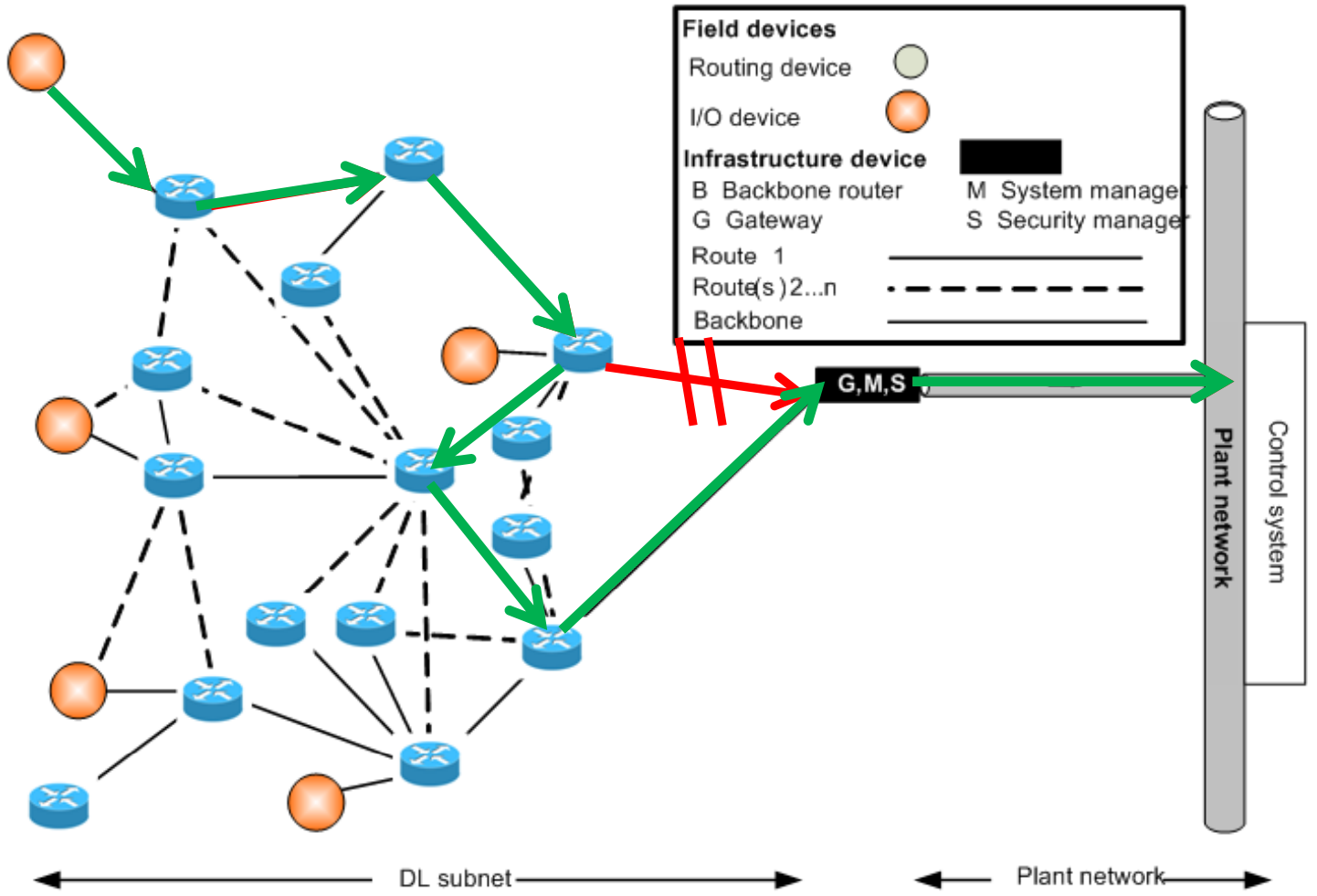
A solution based on

- An architecture flexible, scalable, transposing at the field level the Internet principles
- The most advanced radiocommunication technologies

ISA-100 typical architecture



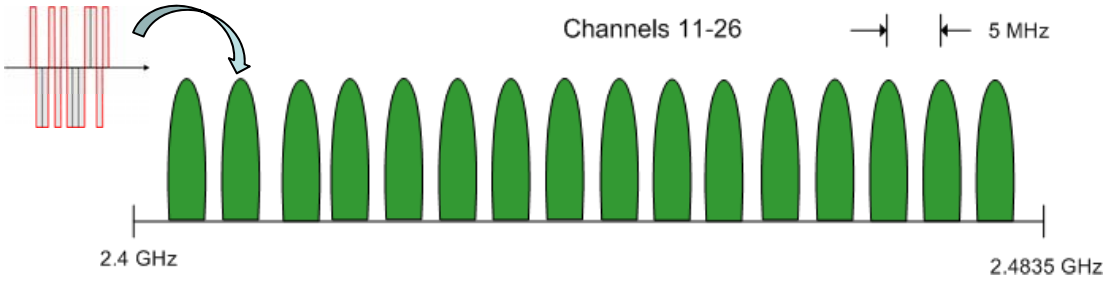
Availability, Reliability

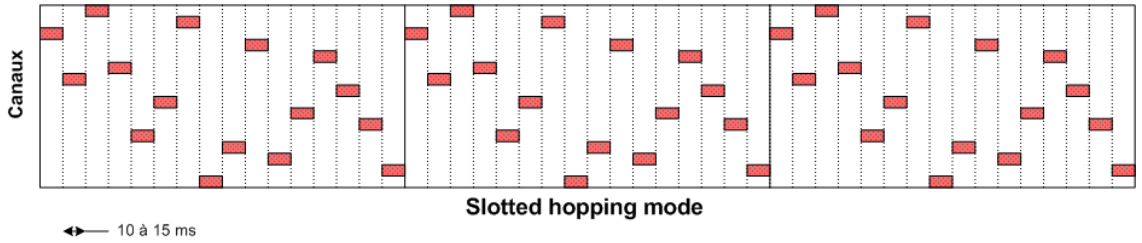


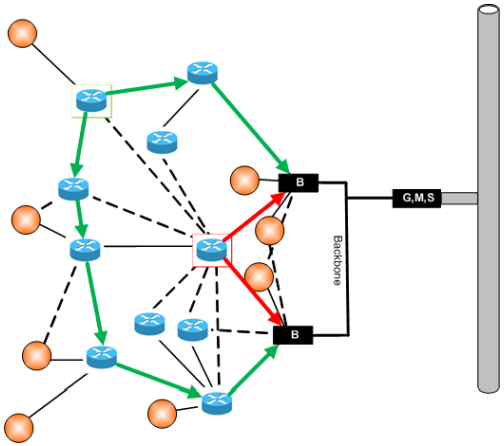
Meshed architecture permits self-healing i.e. rerouting of the packets if a segment is interrupted or saturated

Coexistence

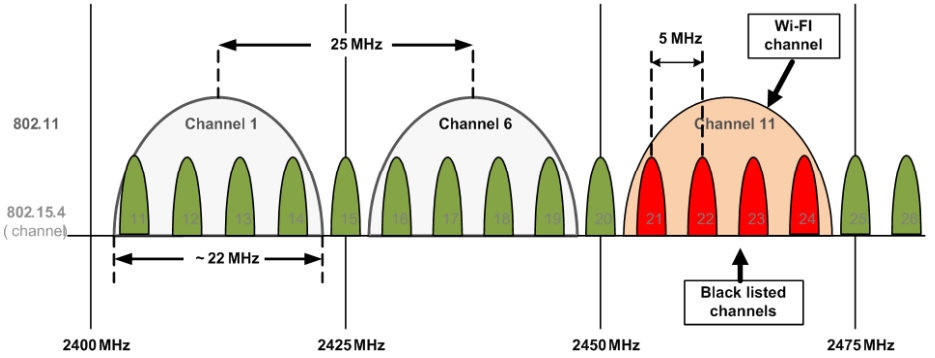
- Use of the 16 IEEE 802.15.4 channels with Direct Sequence Spread Spectrum in each channel
- Channel hopping for avoiding interference
- CCA : Clear Channel Assessment







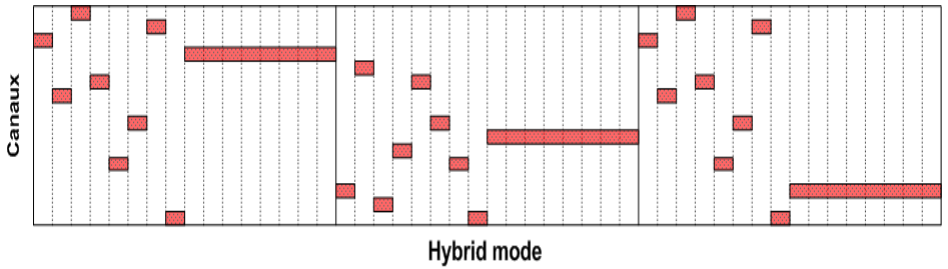
- Duocast mode



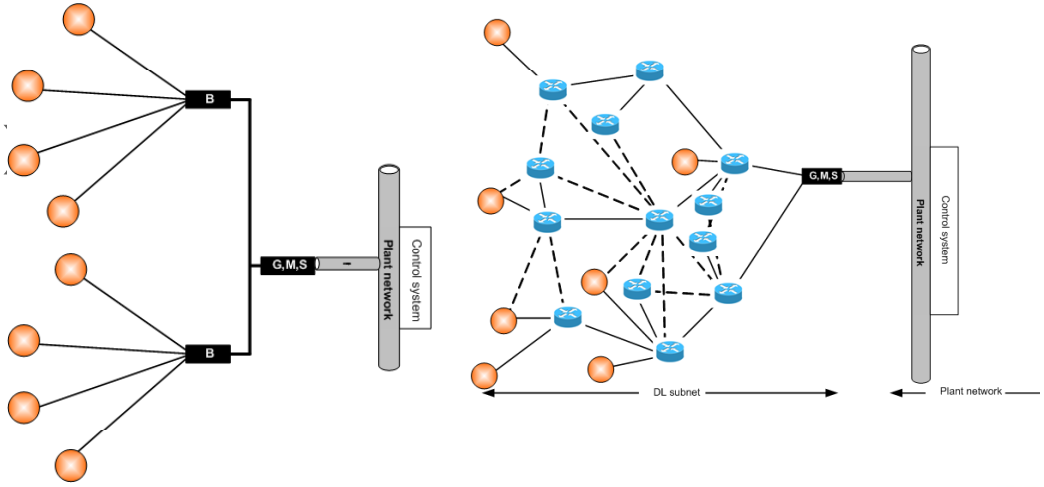
- Channel blacklisting for coexistence with WiFi

Low latency & determinism

- Short timeslots (10 to 12 ms)
- Fast hopping mode for deterministic traffic
- Slow hoping mode for large data transfer : messaging services, provisioning of new devices, collision avoidance mechanisms (CSMA-CA)



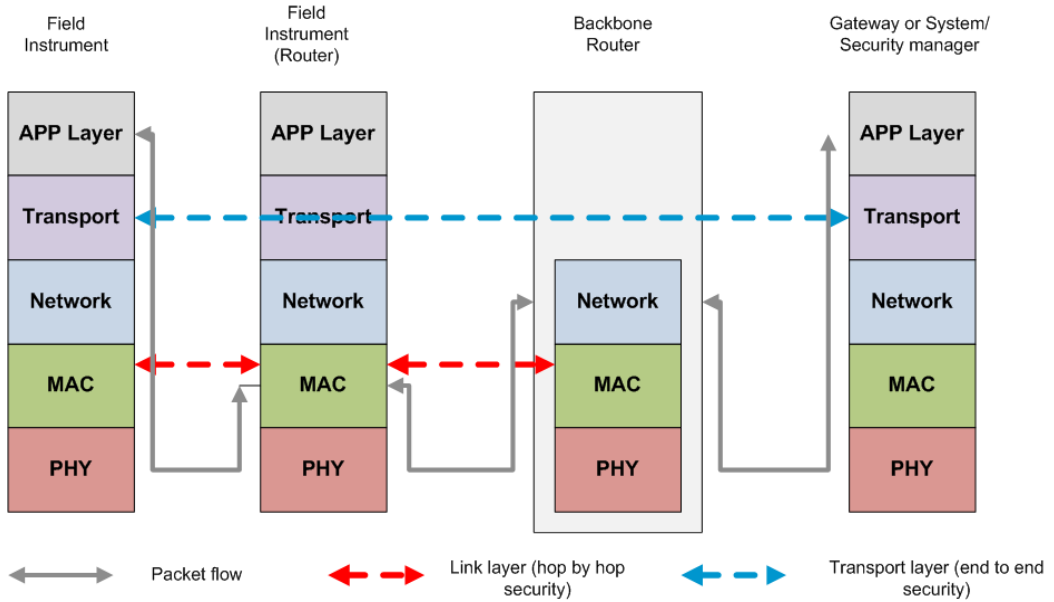
- Support of « star » (high speed) or « meshed » (availability) or hybrid architectures
- Possible to limit the number of hops



Security

Security concerns are often overplayed !

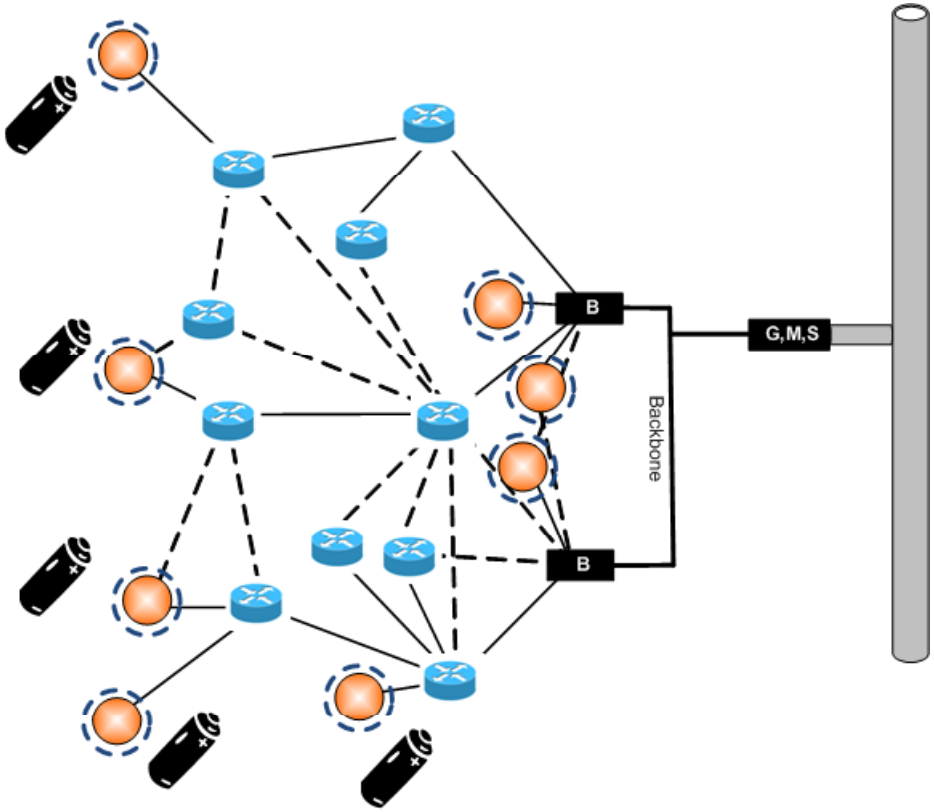
- Two layers security
  - DLL security (Hop by hop)
  - Transport layer (End to end)



- AES 128 encryption (extremely secure)
- Over the air provisioning with authentication using asymmetric keys (optional)
- Sophisticated key management : join keys used only once

Long battery life

- Not all the subscribers are routers ! Non-Routing sensors are very low power devices
- Power Management:
  - ISA100.11a mandates that each device reports its estimated battery life and energy capacity related attributes to the System Manager
  - System Manager allocates communication links to devices based on their reported energy capabilities

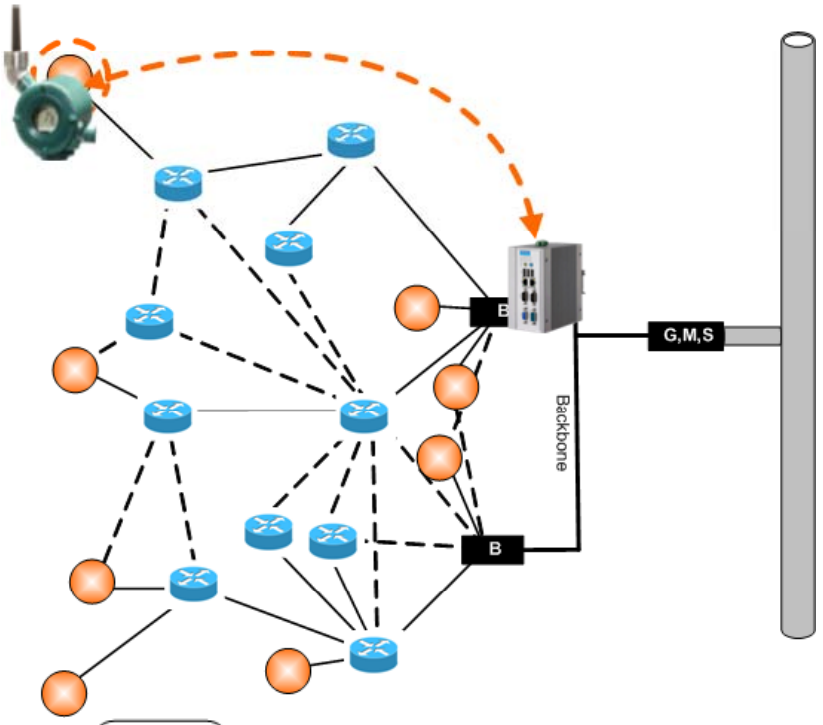


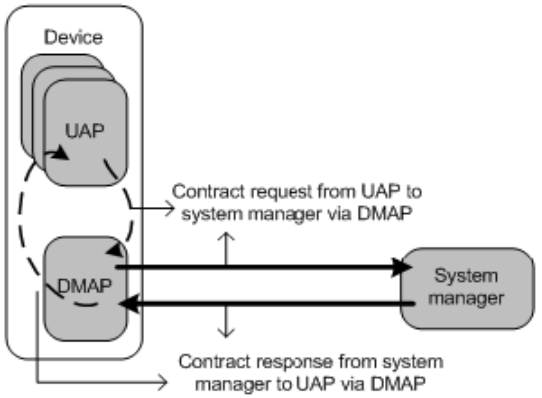
Quality of service

Quality of service

QoS is provided under “**contracts**”

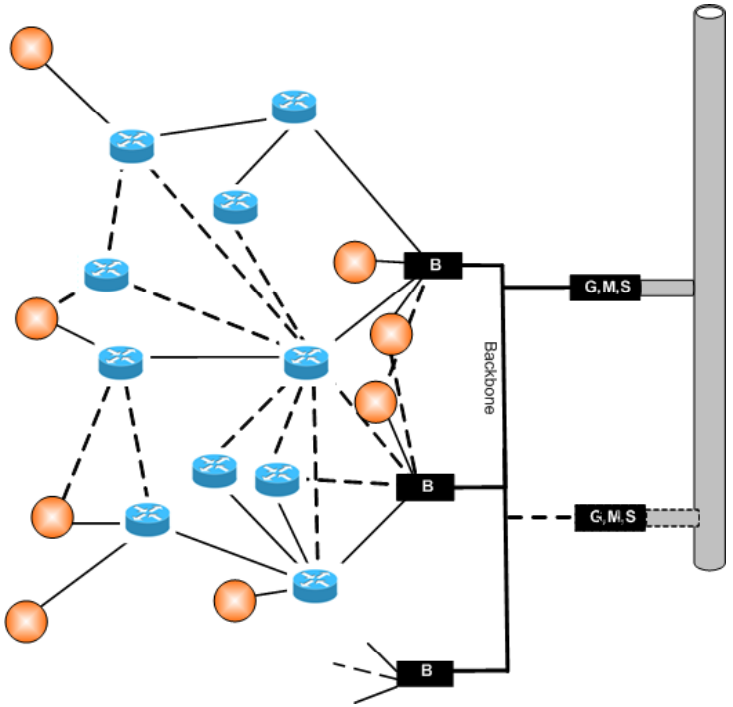
- System communication configuration is achieved through the contract services provided by the **system manager**.
- A contract refers to an agreement between the system manager and a device in the network that shall involve the allocation of network resources by the system manager to support a particular communication need of this device. This device is the source of the communication messages and the device it wants to communicate with is the destination.





Back haul connectivity

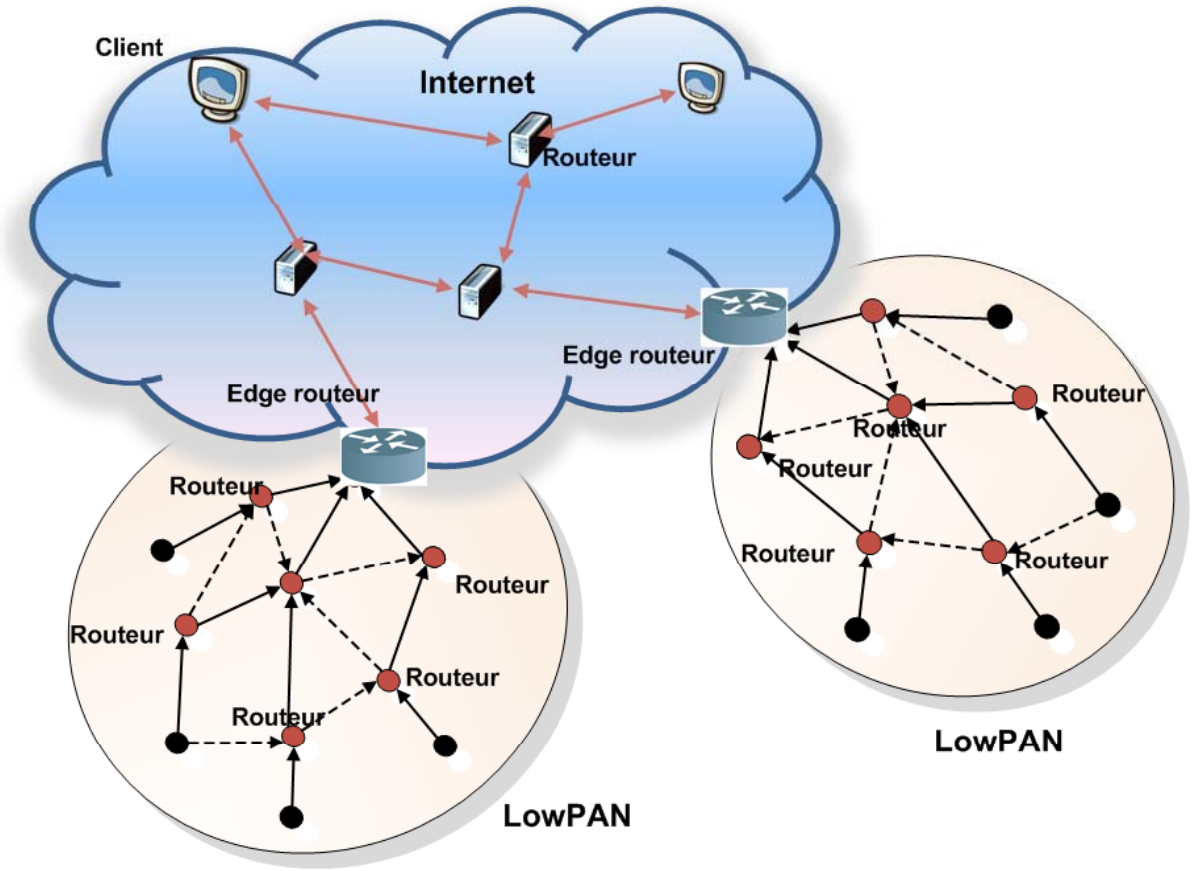
- In control systems, information has to be transferred to higher levels via backbone networks. The set of software allowing such a transfer is called « backhaul »
- Most generic communication systems do not provide such a connectivity
- The architecture in “subnets” headed by a backbone router, permits :
  - Scalability
  - Connectivity to a diversity of backbone networks



ISA100.11a: Internet of Things ready

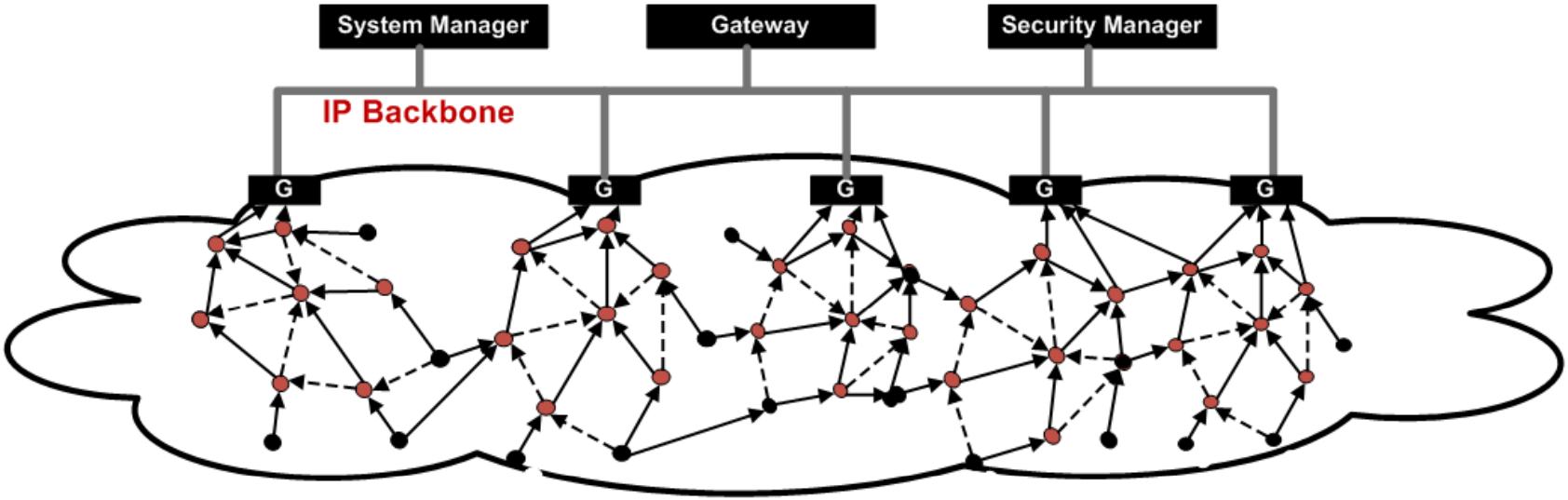
Back Haul connecti vity

- ISA100.11a supports the IETF 6LowPAN standard permitting the connectivity between Low Power LANs and IPV6 compliant networks (header compression, segmentation, etc.)
- ISA100.11a networks will become local representations of Internet of Things



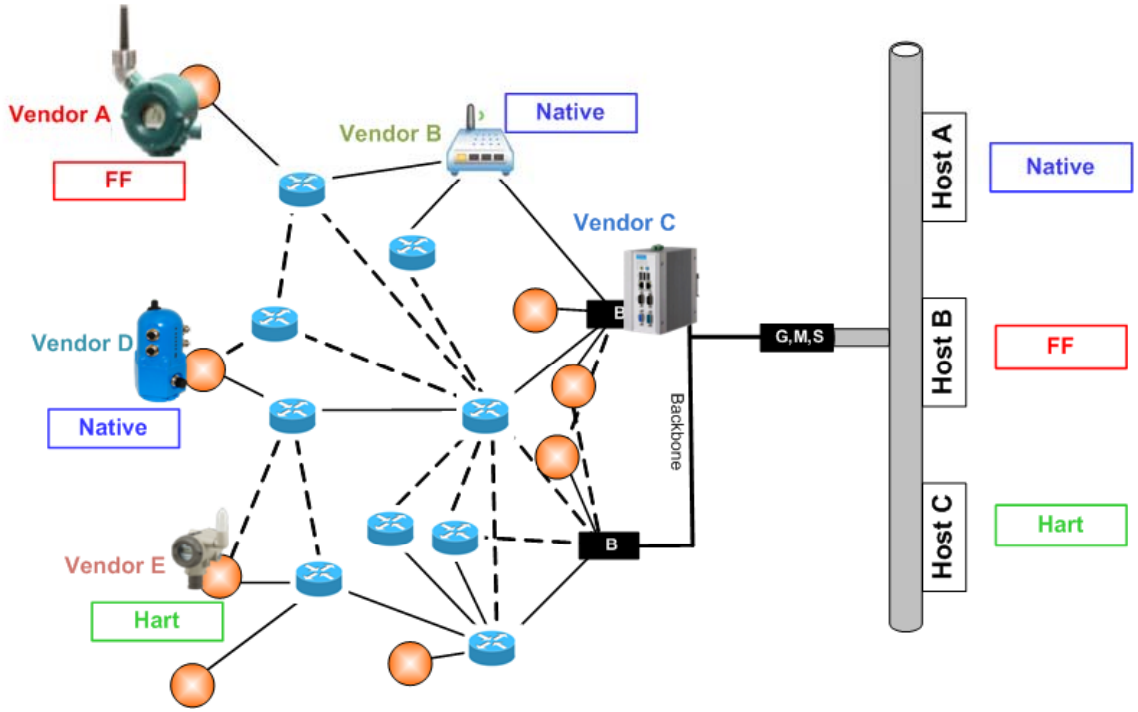
Scalability

- ISA100.11a networks are scalable
  - In numbers : > 10 000 sensors/actuators
  - In space : facility areas of several km^2
  - In rate : report every 30 minutes as well as every 250 ms
- The reason : an IP based backbone



Openness & Interoperability

- ISA 100.11a offers tunneling mechanisms permitting non-native (e.g. legacy) fieldbus commands/services to be connected over ISA100.11a

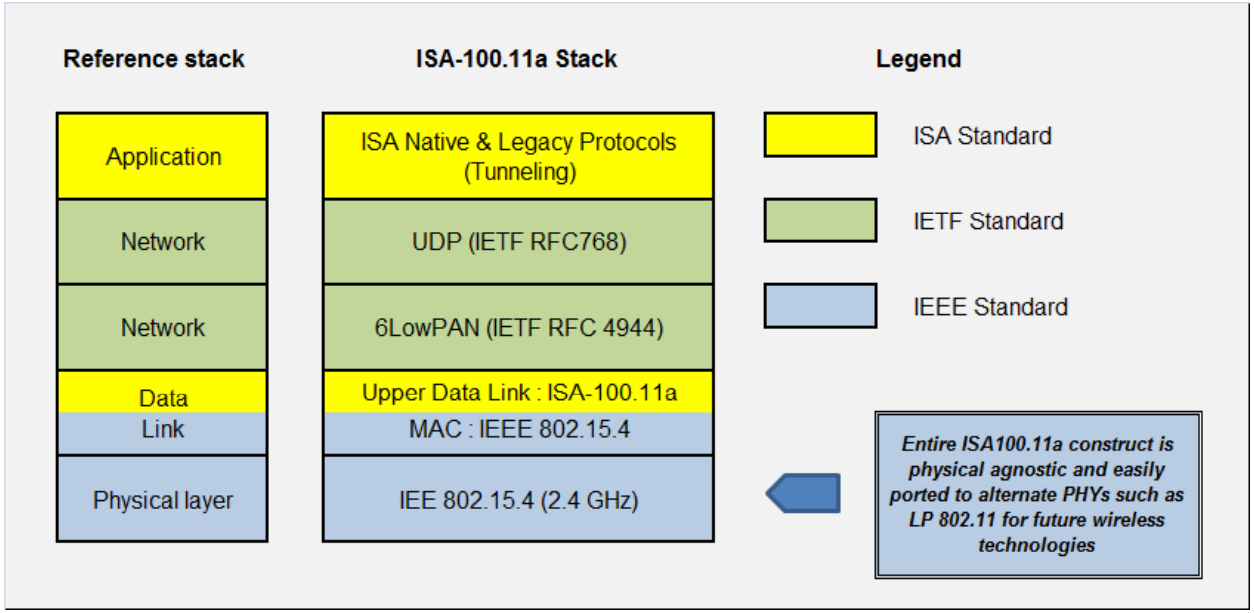


Distance & bitrate

- Current radio is based on IEEE 802.15.4 standard operating in the ISM 2.4 GHz band
- Bitrate/distance are dependent on the emitting power authorized by local regulations (generally 100 mW)
- They may be improved by antennas of high gain
- Typically, throughput is in the range of 250 kbit/s over a distance of a few dozen of meters
- In the future, other radios (such as MIMO solutions) may be used at various frequencies

Competitiveness

- ISA100.11a implementation relies on low cost chips already in mass production (IEEE 802.15.4 chips)
- Software stack is based on existing bricks
- Ready for moving to alternate PHYs



Standardization

- ISA standard since 2009 (updated in 2011)
- ANSI standard since December 2011
- CDV (Comité Draft for Vote) 65C/714F/CDV at CEI level. Final votes to be received by 18 janvier 2011

ISA100 Wireless Compliance Institute established in 2010

ISA100Wireless

- Conduct independent testing and certification of wireless devices and systems for the ISA100 Wireless Systems for Industrial Automation standards
- Provide education, tools, and technical support to users and suppliers

Key differences with competing solutions

- Better scalability (subnets architecture)
- IPV6 ready (6LowPAN)
- Higher security (two security levels, keys used only once ➔ no “man of the middle attack”)
- Longer battery life : only selected nodes are routers
- Multiprotocol and openness
- More flexibility :
  - Frequency hopping (time slots, patterns per subnets)
  - QoS (notion of contracts)
  - Provisioning by wire or by air (with asymmetric keys)

ISA100.11a supported by numerous companies

Appprion

GE

Honeywell

YOKOGAWA

perpetuum

NIVIS

bp

Fuji Electric
Innovating Energy Technology

R3 SENSORS

GASTRONICS

John Crane

FLOWSERVE

RCS

ELTAV

azbil

ExxonMobil

Chevron

TLV

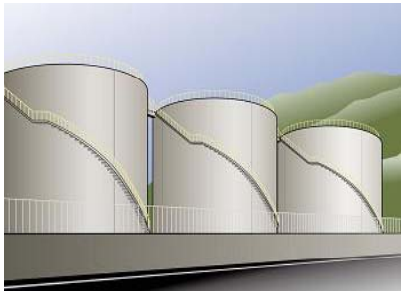
ISA100 interoperabilty demonstrated

ISA Automation week
Orlando October 2012

A lot of ISA100 applications are in operation

- Elevated Assets
  - Enables uneconomical measurements on flare stack and vacuum columns

- Distributed Assets
  - Loading Piers and Tank Farms are ideal areas to deploy wireless networks, enhancing asset management while minimizing infrastructure

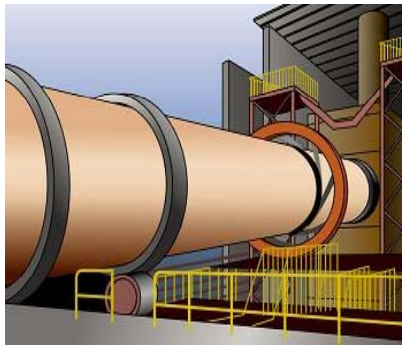


- Isolated Assets
  - Robust measurement solutions for difficult to reach areas; Well heads, production platforms and pipelines

•Source : Yokogawa

A lot of ISA100 applications are in operation

- Rotating & Modular Equipment
  - Wireless free these assets from the complexity of high maintenance cabled solutions



- Temporary Measurements
  - Such as those required to diagnose a problem with a production asset are simple and convenient to implement wirelessly

- Storage Measurements
  - Warehouse management for perishable goods, such as food and pharmaceuticals

•Source : Yokogawa

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Thank you for your attention

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