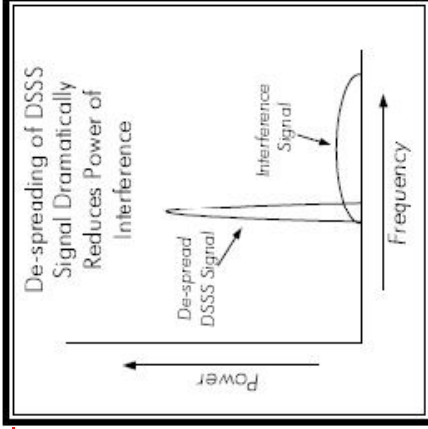
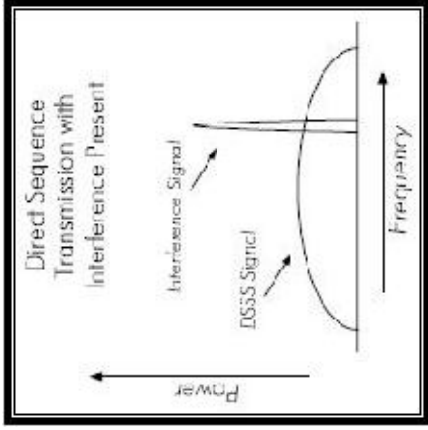


Wireless Product Design CTQs

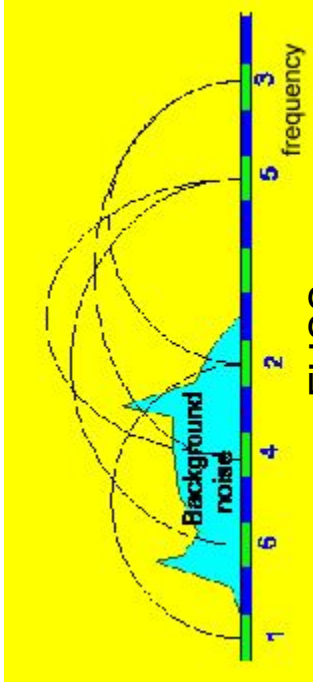
- **Reliability**
- **Range & coverage**
- **Network capacity**
- **Latency**
- **Security**
- **Power consumption**
- **Data rate**
- **Cost**
- **Compactness**
- **Mobility**

Addressing the CTQs - Reliability

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Source: stanford.edu



FHSS Source: google.com

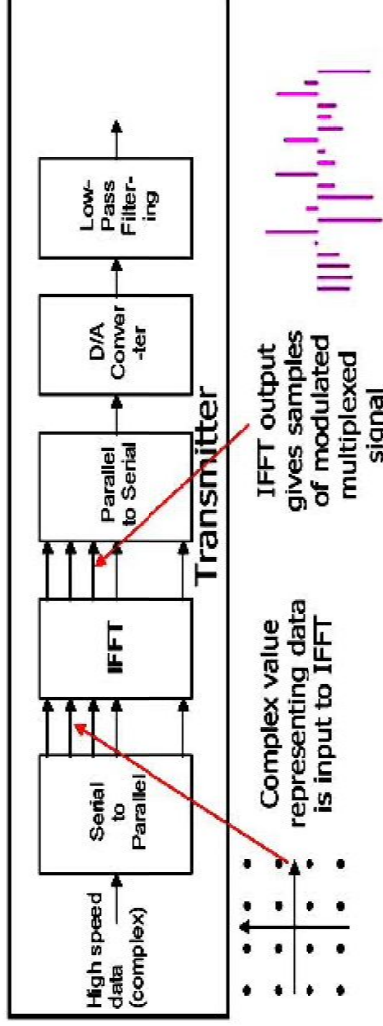
- **Advanced radio techniques**

- **Direct Sequence Spread Spectrum (DSSS) & Frequency Hopping Spread Spectrum (FHSS)**

- ♦ Noise and interference immunity

- **Orthogonal Frequency Division Multiplexing (OFDM)**

- ♦ Robust high data rate communication



Source: google.com

OFDM

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ISA100 uses FHSS and DSSS together

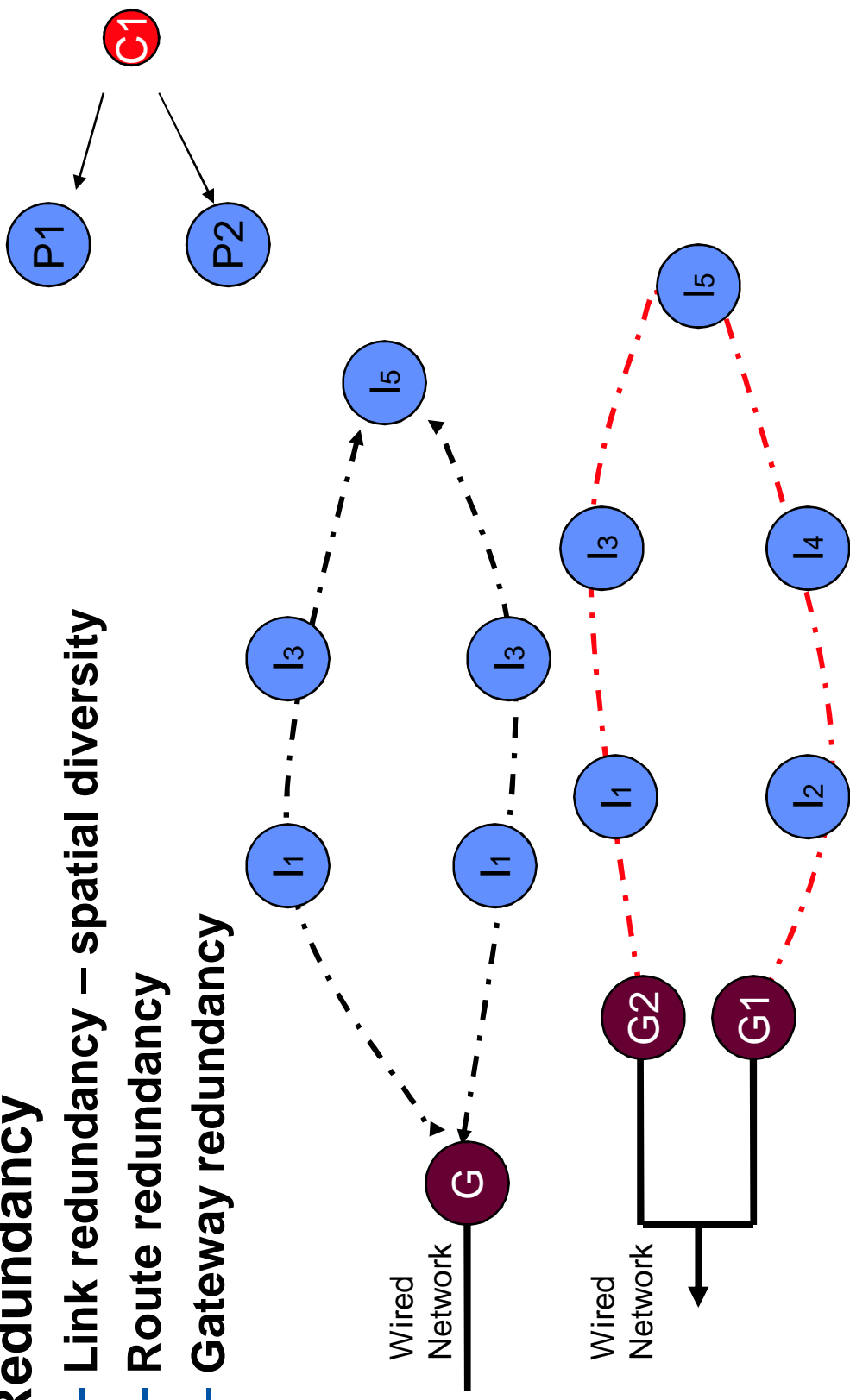
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Reliability ...continued

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- **Redundancy**

- Link redundancy – spatial diversity
- Route redundancy
- Gateway redundancy

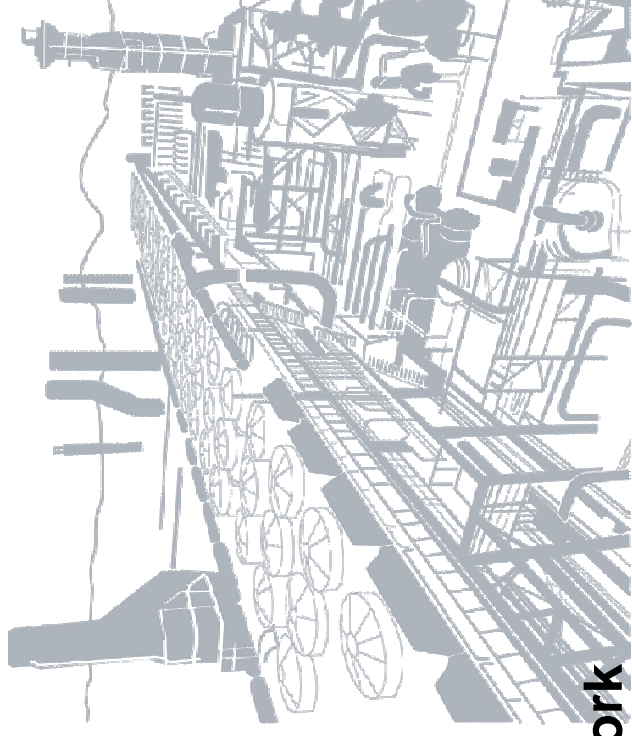


- **Channel blacklisting, adaptive hopping**

ISA100 uses link redundancy and allows configurable number of retransmissions
OneWireless configures 2 attempts to transmit to parent1, 1 to parent2
OneWireless recommends site survey before deployment

Range and Coverage

- **Range**
 - Maximum possible distance between two neighboring devices
 - Maximum Tx power is limited by regulatory bodies (FCC, etc)
 - Range improvement techniques
 - ♦ High gain antennas, directional antennas
 - ♦ Receiver diversity, antenna diversity
- **OneWireless supports 20dBm Tx power, receiver and antenna diversity**
- **Coverage**
 - Space covered under a wireless network
 - Wireless mesh networks
 - ♦ Analogous to multi-drop wired networks
 - ♦ Side effect
 - Latency, capacity, power consumption
 - ♦ Efficient routing techniques
 - Priority based routing
 - Efficient load distribution among routers
 - Use of high data rate infrastructure network



Capacity and Latency

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- Both can be improved by using efficient channel access mechanism*

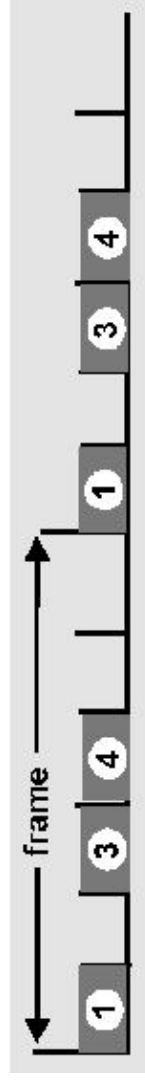
- Reduced collisions, re-transmissions
- Fair bandwidth sharing

- Channel access mechanisms

- CSMA: Carrier Sense Multiple Access
 - ◆ Listen before talk
- TDMA: Time Division Multiple Access
 - ◆ Strict time discipline, pre-allocated bandwidth
 - ◆ Best capacity and latency performance
- FDMA: Frequency Division Multiple Access
 - ◆ Separate frequency channel for each user
- CDMA: Code Division Multiple Access
 - ◆ Different code for each user

*For given data rate and per node traffic

ISA100 supports CSMA & TDMA, End to end ACKs, Configurable number of retransmissions if end-to-end ACKs fail



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Wireless Security

- **Need for Security**
 - Wireless communication is open in air
 - Eavesdropping
 - Unauthenticated access and attack
- **Wired Equivalent Privacy (WEP)**
- **Encryption and decryption**
 - Security keys
 - **Advanced Encryption Standards (AES)**
 - ◆ Longer key length is better for security
 - ◆ Execution time and packet overheads
- **Message integrity check**
- **Over the air provisioning & out of band provisioning**
- **MAC (802.15.4) and transport layer (ISA100) security**

ISA100 supports 128-bit AES encryption & 4-byte MIC, over-the-air provisioning, secure sessions of gateway with each device, session key update periodically.
OneWireless - Initial security key provisioning using a tool (out of band provisioning).

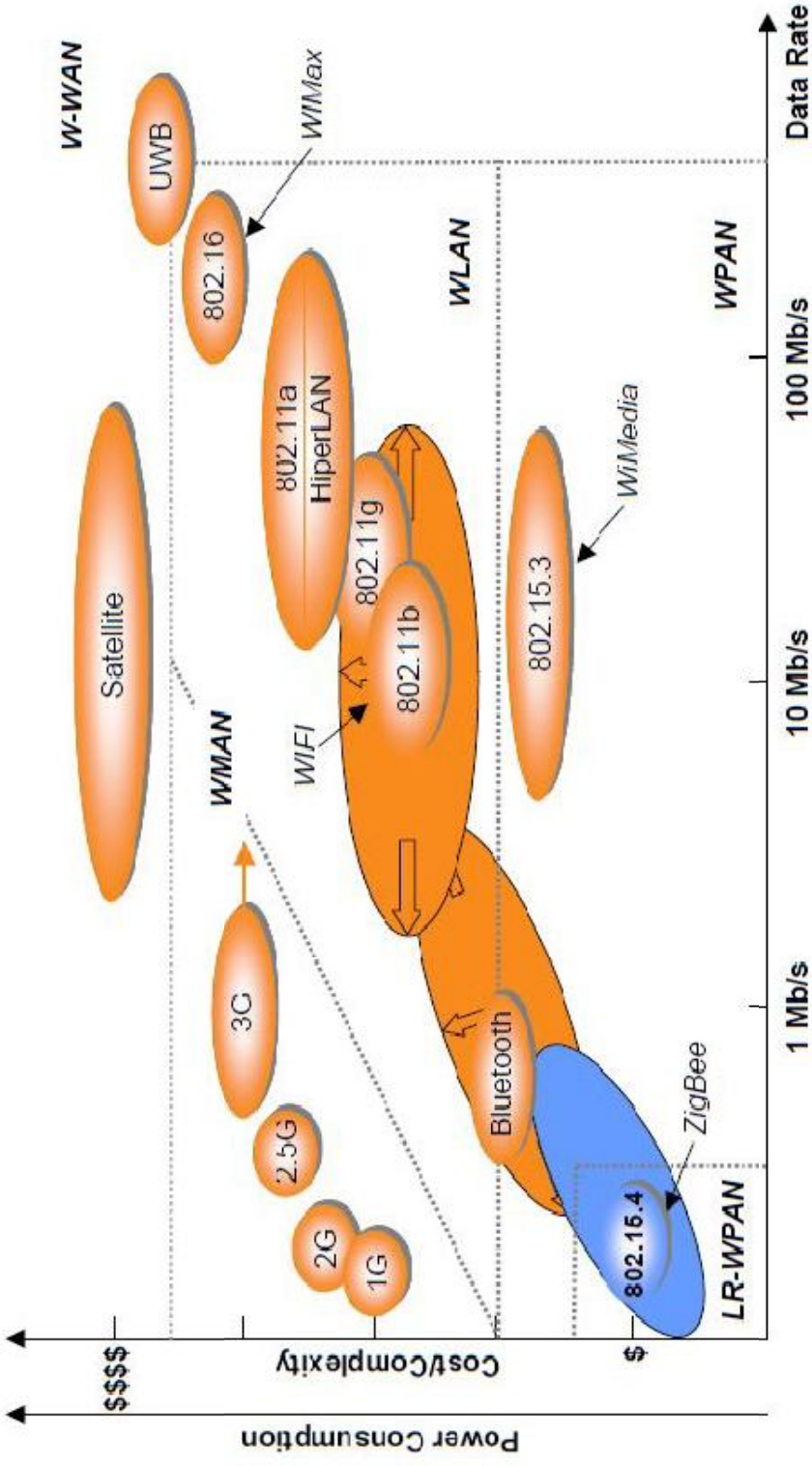
Power Consumption

- **Maximize sleep time of the device**
 - Time slotted operation
- **Use of high data rate powered backbone network**
 - Router has to spend lot of energy in relaying messages
 - Battery operated nodes should not be routers
- **Transmit power control**
 - Use minimal energy needed for reaching the destination node
- **Beam steering using antenna arrays**

ISA100 supports TDMA, use of a back bone router

Data Rate

- Data rate depends on
 - Radio techniques
 - Channel Bandwidth & carrier frequency
- Wireless standards

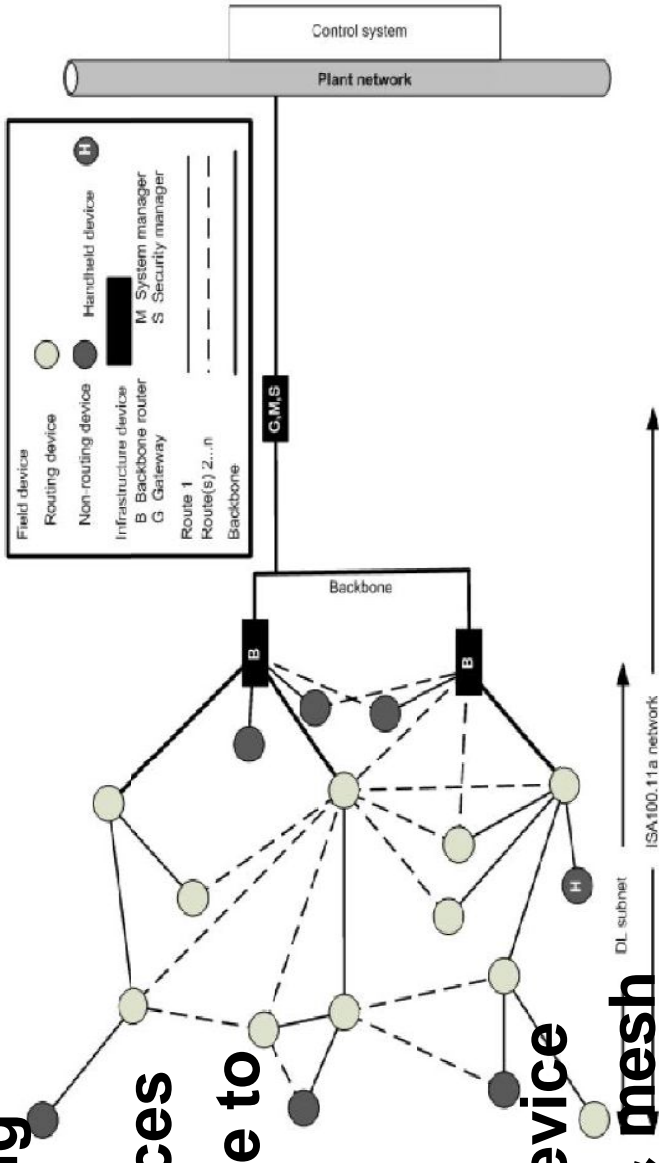


ISA100 is based on 802.15.4 radio – 250kbps.

1. OneWireless infrastructure is based on 802.11 (a, g, n) -54Mbps

ISA100 Highlights

- **Control and monitoring wireless network**
- **Battery powered devices**
- **Wireless infrastructure to extend coverage**
- **Devices with routing capability**
- **Simple non-routing device**
- **Combination of star & mesh network topologies**

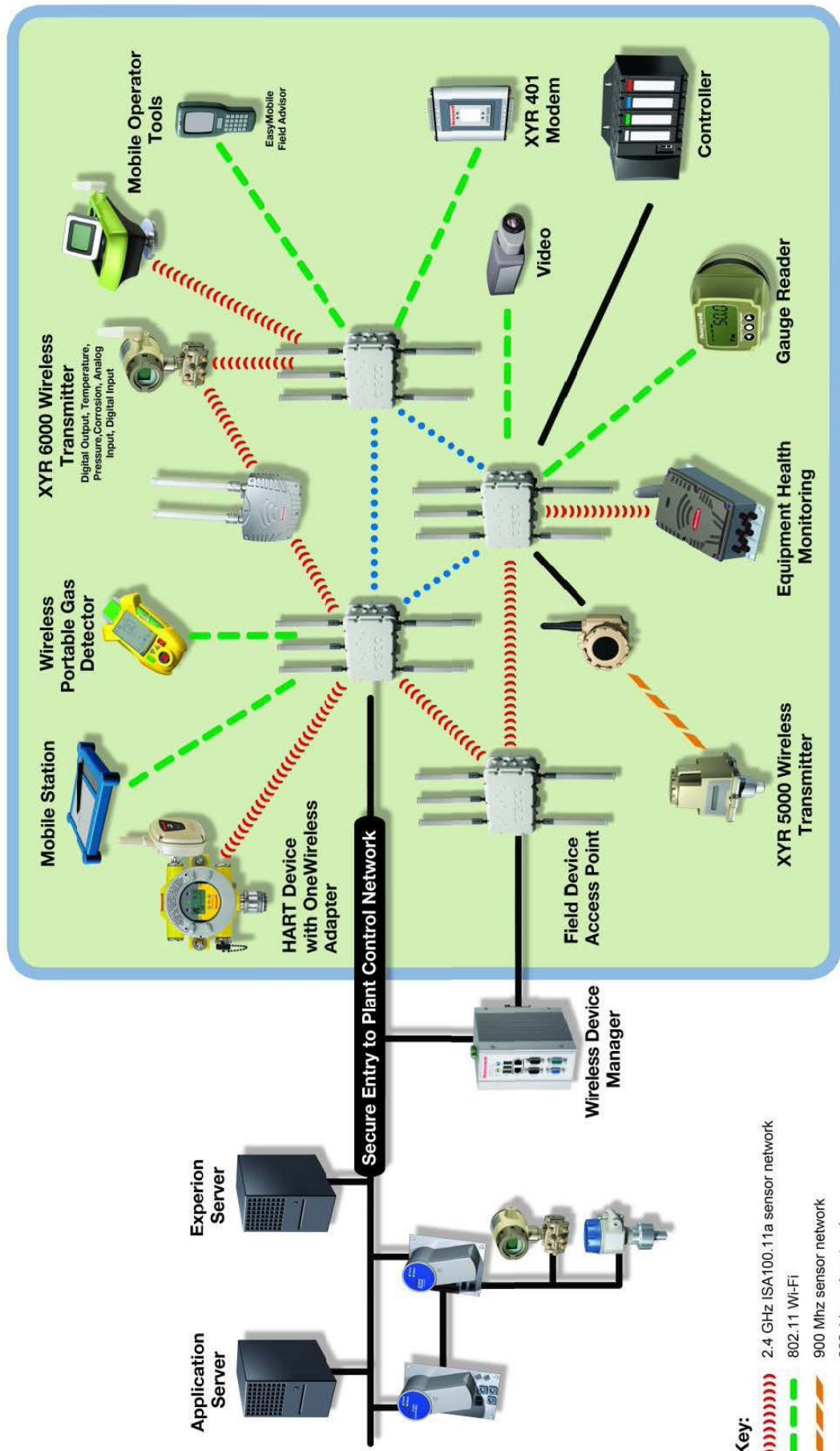


- **Redundancy to improve reliability**
- **Time division multiple access for deterministic performance**

- **128-bit security**
- **Provisioning to handle security key and network configuration management**
- **Co-existence with wireless plant networks with multiple frequency hopping patterns**

OneWireless

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One Wireless Network for All Applications

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Honeywell Wireless Applications Overview

Petroleum & Natural Gas Industries Automation Domain (PNID)

5th October 2012

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Wireless Market Development Leader (India), HPS

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