IOT-103

Wired-to-Wireless System Transition

Chad Steider
Senior Product Marketing Manager

SILICON LABS

Wired vs Wireless

Wired – Networks that rely on physical connections and infrastructure for connectivity

- **Reliability**: Higher levels of reliability due to stable, physical connections

- **Speed:** Well established wired protocols can achieve higher speeds than wireless protocols

Wireless – Use RF technologies to connect devices in the physical world

- **Mobility**: Provide layout optimization and flexibility options by eliminating reliance on physical connections

- **Scalability**: Increases scalability of networks by allowing for easy addition of devices

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Advantages of Removing Wires

Reduces Cost

Lower installation and maintenance cost when compared to wired networks

Interoperability and Flexibility

Increase physical flexibility and allow for more system interoperability

Improve Security

Lower possibility of physical attacks by removing vulnerable connection points

Environmental Efficiency

Improve overall network efficiency and allow for battery powered devices

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Driving Cost Out of Connected Systems

Lower initial installation cost and complexity

- Fewer physical components lower cost of physical equipment

Easier maintenance and replacement of individual components

- Lack of wires lowers risk of damage to interconnections that can be costly to replace and troubleshoot

Make better use of overall space

- Lack of reliance on physical connections can improve overall space usage

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More Flexibility and Better Interoperability

Increasing Layout Flexibility

- Connected equipment can be placed where it makes sense to optimize process and efficiency

Various connectivity options to meet device needs

- Can pick the best technology for needs of individual nodes to optimize overall performance

Removes dependency on infrastructure

- No need to run additional infrastructure as network scales removing cost and complexity

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Increased Physical and Network Security

Removes potential points of physical compromise

- Less exposed connection points lowers overall device vulnerability to physical tampering

More layers of security for data in motion

- Network standards increase security of data in motion with increased levels of encryption

Optimized security solutions for different node types

- Security scheme can be optimized based on connectivity needs of each node
- Different connectivity standards can be used for nodes that need higher levels of security

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Improve Device and System Level Energy Consumption
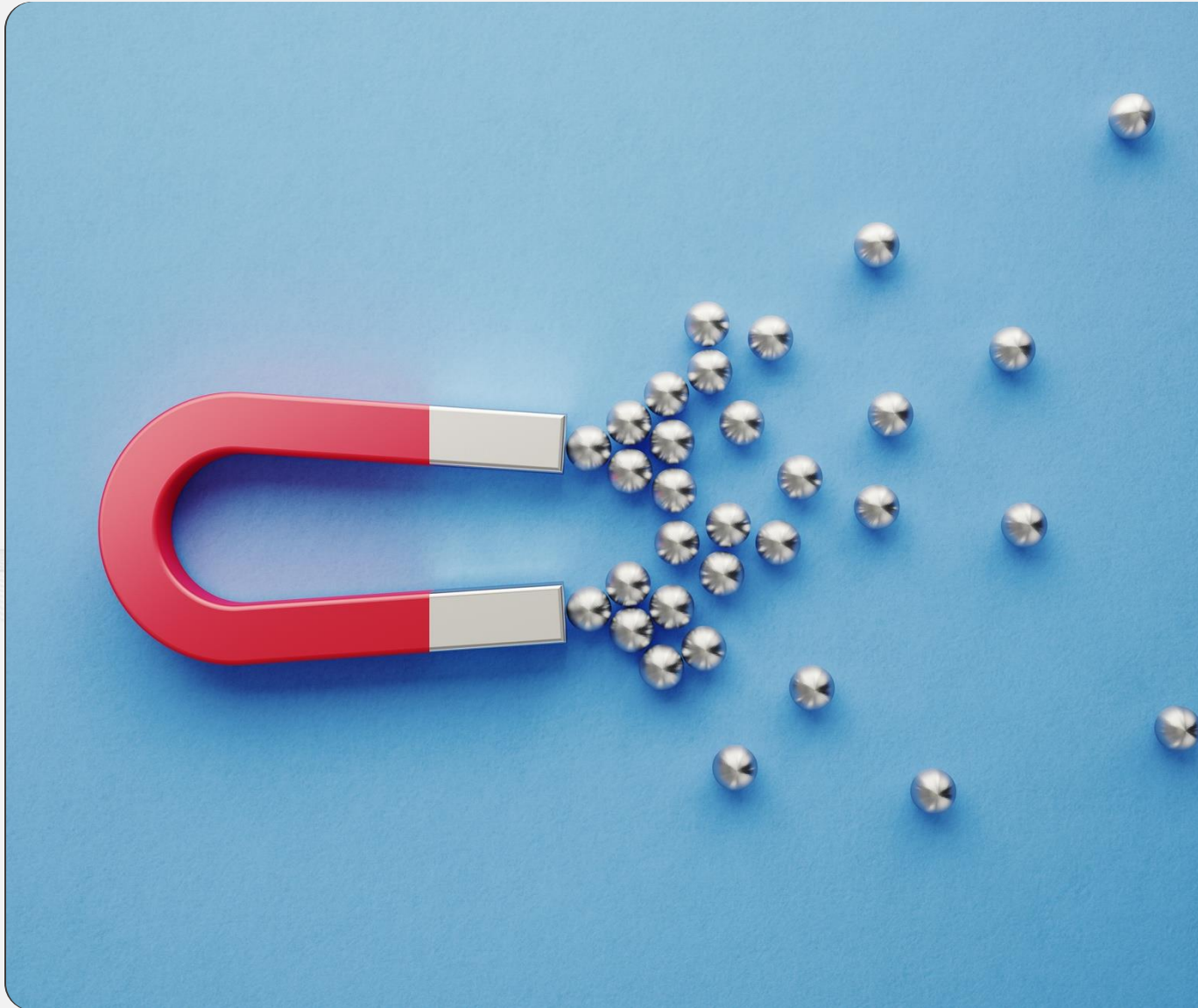
Power architecture decisions can be made at a node level

- Removing wires allows for battery powered devices to be added to networks

Lower overall infrastructure requirements decreases system level power needs

- Distributed architecture of wireless networks removes need for high powered network management equipment

Lower system level power loss caused by wired connections

- Wired connections can increase overall power consumption due to power loss over cabling

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Leading the Wired to Wireless Transition

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Wireless Options for Wired Transition
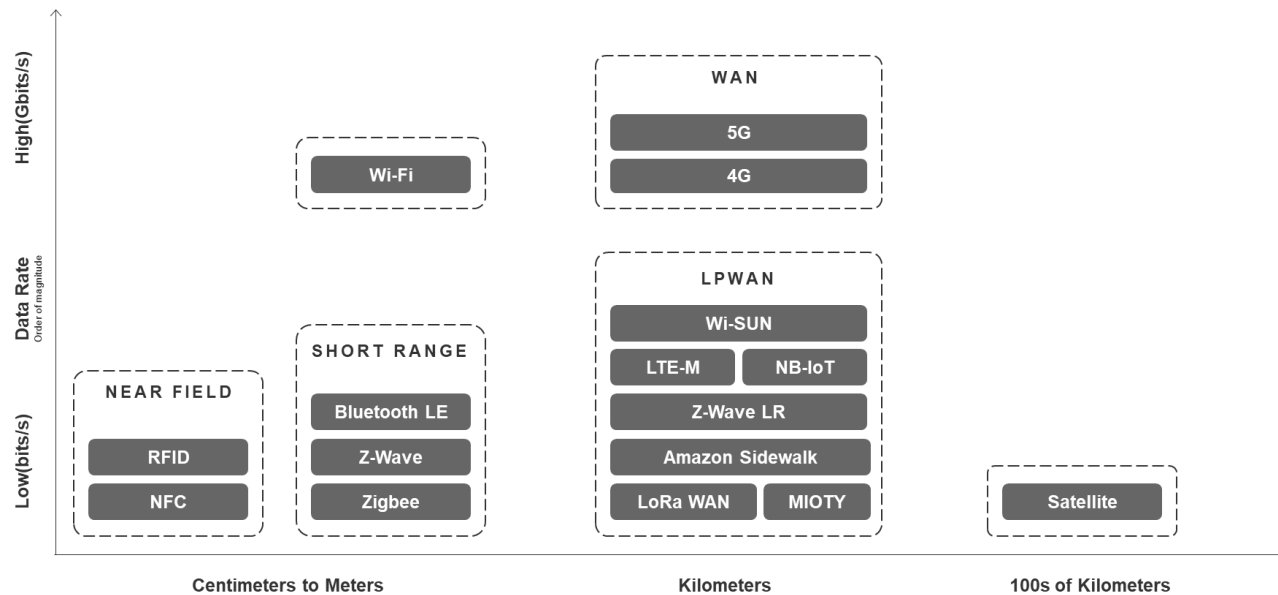
Wi-Fi

- Widely adopted standard with large installed infrastructure
- Challenges with IT vs OT usage and interference

Bluetooth

- Huge adoption in short range, low data rate applications
- Challenges in larger range and some high node count applications

802.15.4 / Matter / Thread / Zigbee

- Proven 2.4GHz Mesh technology with high reliability
- Limited availability of off the shelf options for infrastructure create implementation challenges

Sub-GHz

- Long point to point range and better object penetration than 2.4 and 5GHz standards
- Limited data rates and options for interoperable networks

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Why Silicon Labs for Wireless?

DIVERSE PRODUCT PORTFOLIO

- SoCs, MCUs and Modules that address a wide variety of applications
- Simplicity studio IDE and mobile app with ready-to-go demos and development tools for rapid prototyping
- Simplified hardware and firmware design across product platforms
- Software stack that supports the latest standards such as BLE, Bluetooth 6 and Wi-Fi 6
- Devices that are compatible with all major protocols such as Bluetooth, Wi-Fi, Wi-SUN, Matter, Zigbee and Proprietary

LOW-POWER, HIGH PERFORMANCE RF

- Best in class sensitivity and up to +20 dBm output power ensures robust and reliable communication
- Ultra-Low power SoCs and Modules in an extremely small form-factor delivering high performance wireless connectivity
- AI/ML Hardware Accelerator to speed up inferencing at the edge
- Always-on wireless cloud connectivity based on intelligent power management
- Multiple sleep modes and low active current across transmit and receive for longer battery life

FLEXIBLE AND SCALABLE ARCHITECTURE

- Mesh architecture allows for easy scalability of existing infrastructure, shortening the time to reach large-scale network configurations
- Cost-effective expansion due to the modular design of wireless networks
- Dynamic routing automatically adjusts to network changes, ensuring optimal data flow and minimizing latency
- Highly reliable self-healing nodes for continuous operation and improved system integration

ROBUST, BEST-IN-CLASS SECURITY

- Secure Vault™ technology protects the device from local and remote cyber attacks
- EFR32 wireless MCUs have the highest PSA Level 3 Certification
- Custom Part Manufacturing Service (CPMS) can pre-program security keys into devices to prevent exposure in manufacturing environment
- Secure boot and OTA (Over-the-air) firmware updates mitigate the risk of malicious attacks

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Considerations for Wired to Wireless

Protocol selection can be most challenging part of transition

- Lack of wireless expertise may cause difficulty in protocol selection process
- Understanding key parameters for your application can help narrow down selection

Many applications have use cases for multiple connectivity options

- Different use cases can be served with optimized connectivity solutions
- Creates design complexity and challenges if not addressed properly

Sub-GHz vs 2.4GHz still dominates conversation

- Worldwide support for 2.4GHz simplifies product development but congestion and range remain challenges
- Lack of modular solutions and limited data rates hamper sub-GHz adoption
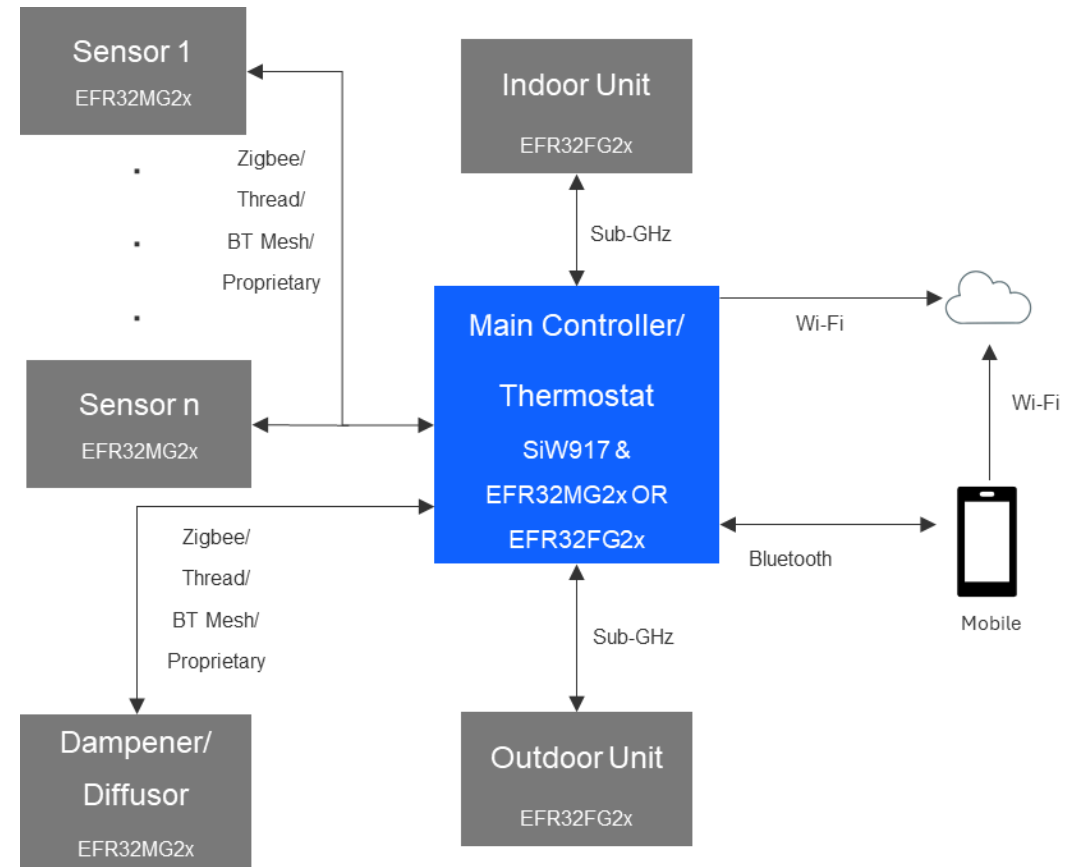
Focused Applications

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HVAC Systems

CHALLENGES WITH WIRED

- Installation of new systems can be challenging due to limited options for wire routing
- System maintenance can be complicated if connection points and wires are not easily accessible
- Reconfiguration and scaling can be difficult with wired systems
- Legacy interfaces limit communication options and can limit overall flexibility of systems

ADVANTAGES OF WIRELESS

- Sensors and equipment can be easily added to systems
- Configuration of new systems or features within systems simplified with wireless connectivity
- Maintenance and debugging can be simplified with more intelligent nodes and system mapping
- Simplified installation lowers overall cost and complexity

Sensor 1
EFR32MG2x

Sensor n
EFR32MG2x

Zigbee/
Thread/
BT Mesh/
Proprietary

Dampener/
Diffusor
EFR32MG2x

Zigbee/
Thread/
BT Mesh/
Proprietary

Indoor Unit
EFR32FG2x

Sub-GHz

Main Controller/
Thermostat
SiW917 &
EFR32MG2x OR
EFR32FG2x

Wi-Fi

Wi-Fi

Bluetooth

Mobile

Sub-GHz

Outdoor Unit
EFR32FG2x

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Protocols for HVAC Systems

BLUETOOTH

- Ideal for battery-operated devices, ensuring long battery life
- Widely supported by many devices and platforms, making it easy to integrate
- Suitable for small-scale applications or single-room control
- Provides quick response times, which is beneficial for real-time control

SUB-GHZ

- Better object penetration allows for reliable connectivity in hard to reach locations
- Can be tailored for specific node types for better optimization
- Proprietary networks can increase overall system security
- Typically provides more flexibility than standards based solutions

WI-FI

- Supports high-speed data transfer, suitable for streaming and large data exchanges.
- Existing infrastructure can be leveraged for wider coverage area
- Adoption across multiple devices and platforms allows for easy installation and troubleshooting
- Enables control and monitoring from anywhere with an internet connection.

ZIGBEE

- Provides robust and reliable communication through a self-healing mesh network.
- Designed for low-power operation, extending battery life.
- Highly scalable networks provides flexibility and future proofing
- Multiple routing options can provide varied paths within network increasing reliability
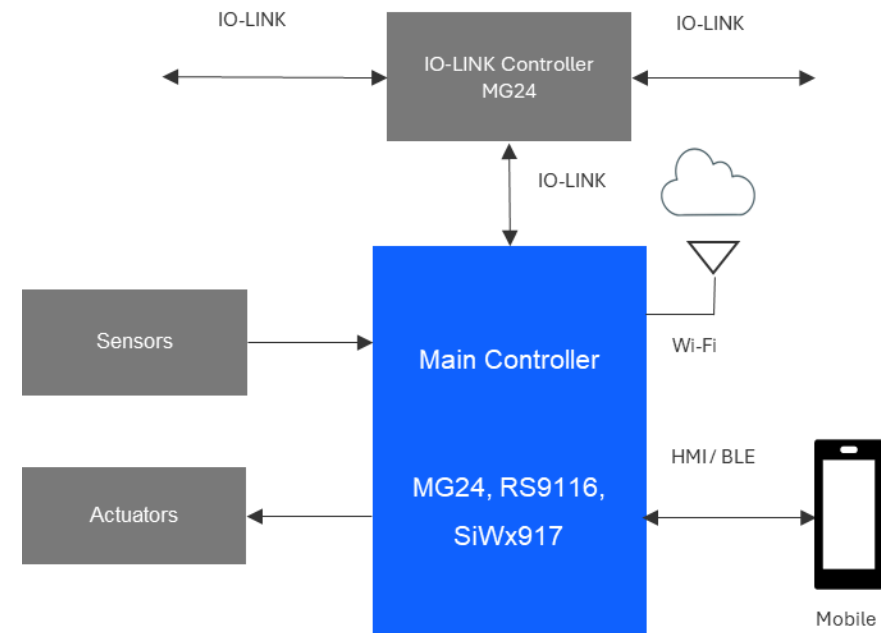
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Factory Automation

CHALLENGES WITH WIRED

- Installation and maintenance costs increase along with complexity of wired networks
- Space usage limited to ability to run wires to equipment and ensure protection of wires
- Limited flexibility for rearrangement of equipment to meet needs of people or process
- Multiple physical points of failure increase risk of down time

ADVANTAGES OF WIRELESS

- Simplified network scalability due to lack of physical connectivity needed
- Lowered safety risk by limiting amount of physical interaction
- Increased ease of deployment for new equipment
- Creates more flexibility in use of space to allow for better optimization

IO-LINK

IO-LINK Controller
MG24

IO-LINK

IO-LINK

Sensors

Main Controller

Wi-Fi

MG24, RS9116,
SiWx917

HMI/BLE

Actuators

Mobile

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Protocols for Factory Automation

BLUETOOTH

- Provides simplified local interface for troubleshooting and traceability

- Low power consumption to extend life of sensor nodes or safety tags

- Wide range of off the shelf options can simplify overall system development

- Channel sounding can provide very precise location data for assets within the factory setting

WI-FI

- Allows equipment to leverage existing infrastructure lowering overall installation cost

- Higher data rates allows for faster transmission of data and better real time monitoring

- Wi-Fi 6 offers tighter security measures ensuring protection of critical data

- Can provide local interface for maintenance and troubleshooting

PROPRIETARY

- Sub-GHz can provide longer range and better object penetration can ensure connectivity in complex physical environments

- Can be optimized for specific applications or use cases to increase performance and extend battery life

- Increased data rates allow for replacement of RS-232 or RS-485 connections

- Emerging standards, like IO-Link Wireless, provide reliability of wired connectivity with wireless flexibility
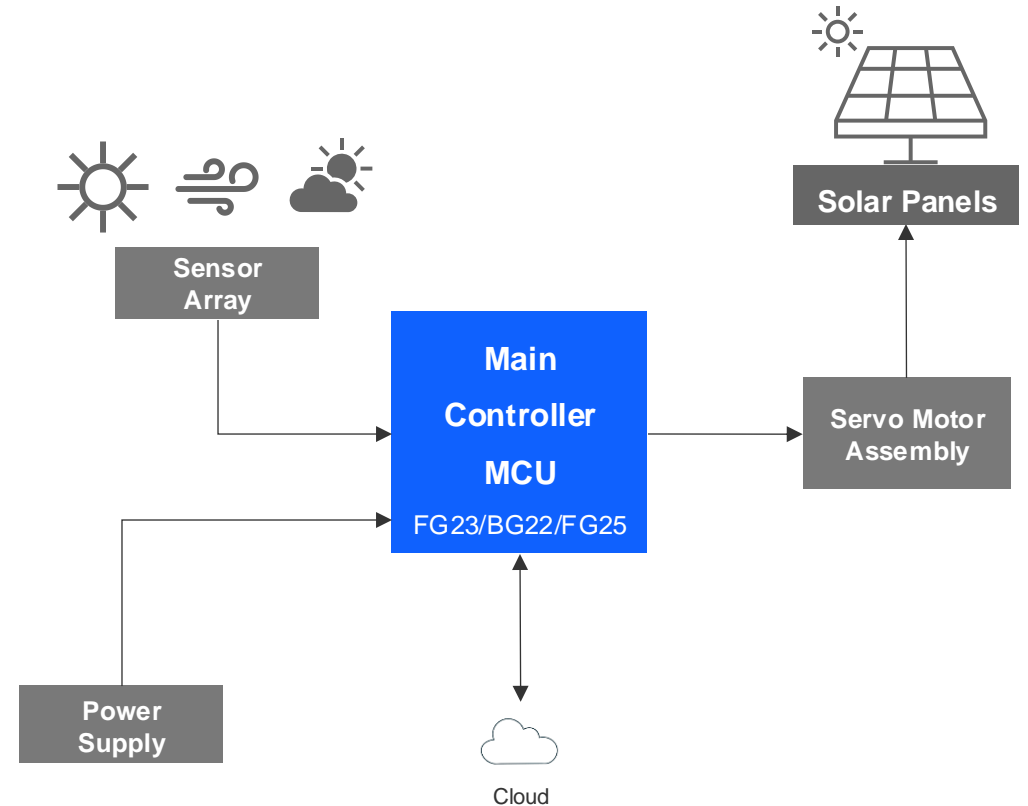
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Solar Trackers

CHALLENGES WITH WIRED

- Installations can be spread over large areas creating challenges in deployment of wired networks
- Scalability challenges as new equipment is added and needs to be supported
- Lack of a controlled environment creates maintenance and installation challenges
- Movement of panels throughout life can create weak points within wired connections

ADVANTAGES OF WIRELESS

- Can easily adapt to changing landscape and environment and ensure reliable connectivity
- Removes risk of physical connection failure due to accident or environmental exposure
- Highly scalable without the need of additional infrastructure
- Simplified identification of individual nodes in network with either local or remote interaction

Sensor Array

Solar Panels

Main Controller MCU

FG23/BG22/FG25

Servo Motor Assembly

Power Supply

Cloud

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Protocols for Solar Trackers

BLUETOOTH

- Provides simplified local interface for troubleshooting and traceability

- Can aide in identification and location of individual assets within network for maintenance

- Simple addition of off-the-shelf sensors to add intelligence to network

WI-SUN

- Standards based solution increases interoperability within other utility infrastructure use cases

- Growing adoption in metering and energy space

- Higher data rates allows for faster transmission of data and better real time monitoring

- High levels of security with added device certificates to ensure only authentic devices can access network

ZIGBEE

- Optimized for low power which minimizes need for battery replacement and maintenance of sensor nodes
- Self-healing mesh ensures reliable and robust communication providing seamless re-routing and uninterrupted operation
- Highly scalable network capable of accommodating thousands of nodes

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Driving Innovation by Expanding Connectivity

Lower installation and maintenance costs

- Reduce number of wires running to each machine reducing labor and material costs
- Remove connection points that are frequent points of failure

Improvement in space usability and flexibility

- Allow for spaces and process to be optimized for the efficiency by removing constraints of existing infrastructure
- Equipment can be easily re-arranged as needed in shorter time

Increase system security

- Leverage security features built in to existing wireless protocols and ICs
- Remove vulnerable network connections lowering risk of physical tampering

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Thank You

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