Operations Technology Evolution

WILLOWGLEN SYSTEMS

InstMC Herts Section
September 27, 2023

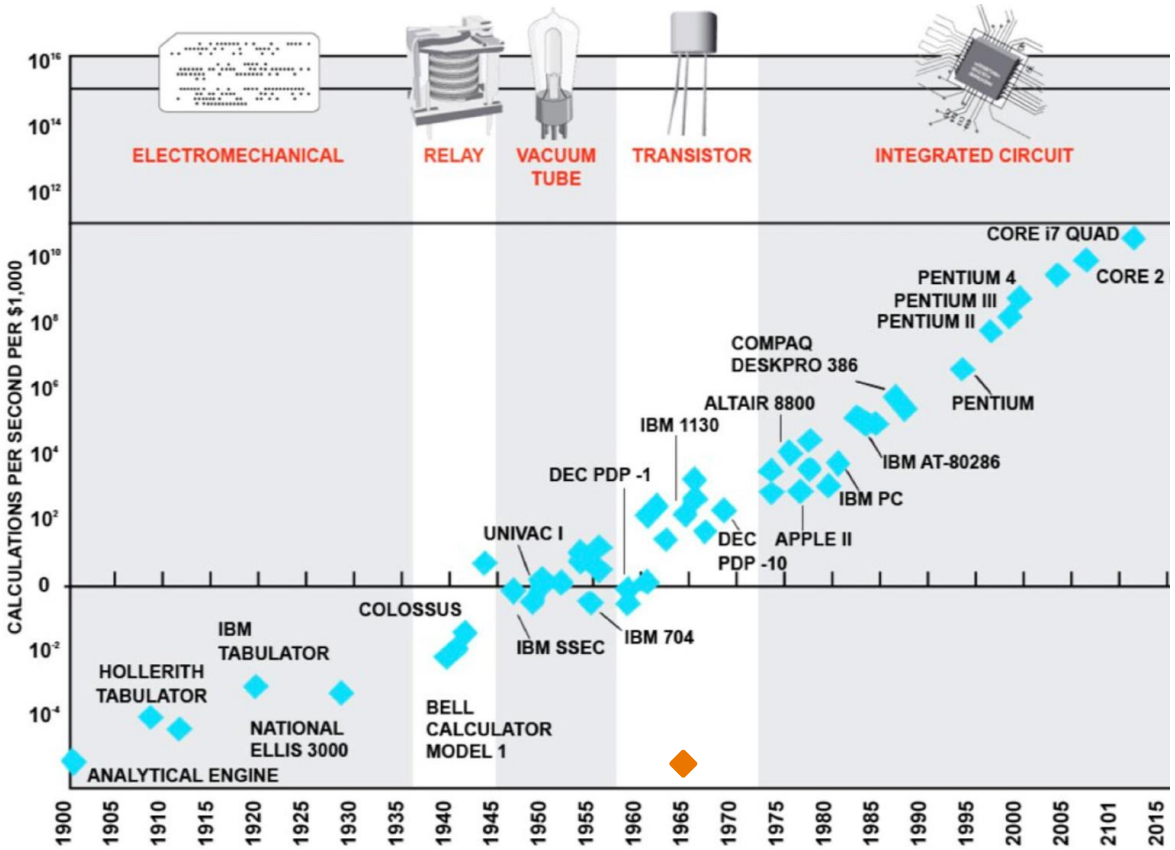
Agenda

1. A long long time ago …
2. The big merge (IoT & IIoT)
3. Change Drivers
5. The future …

Historical Perspectives

115 years of Moore's Law

- Moore's law was "published" in 1968
  - number of transistors in a dense integrated circuit (IC) doubles about every two years.



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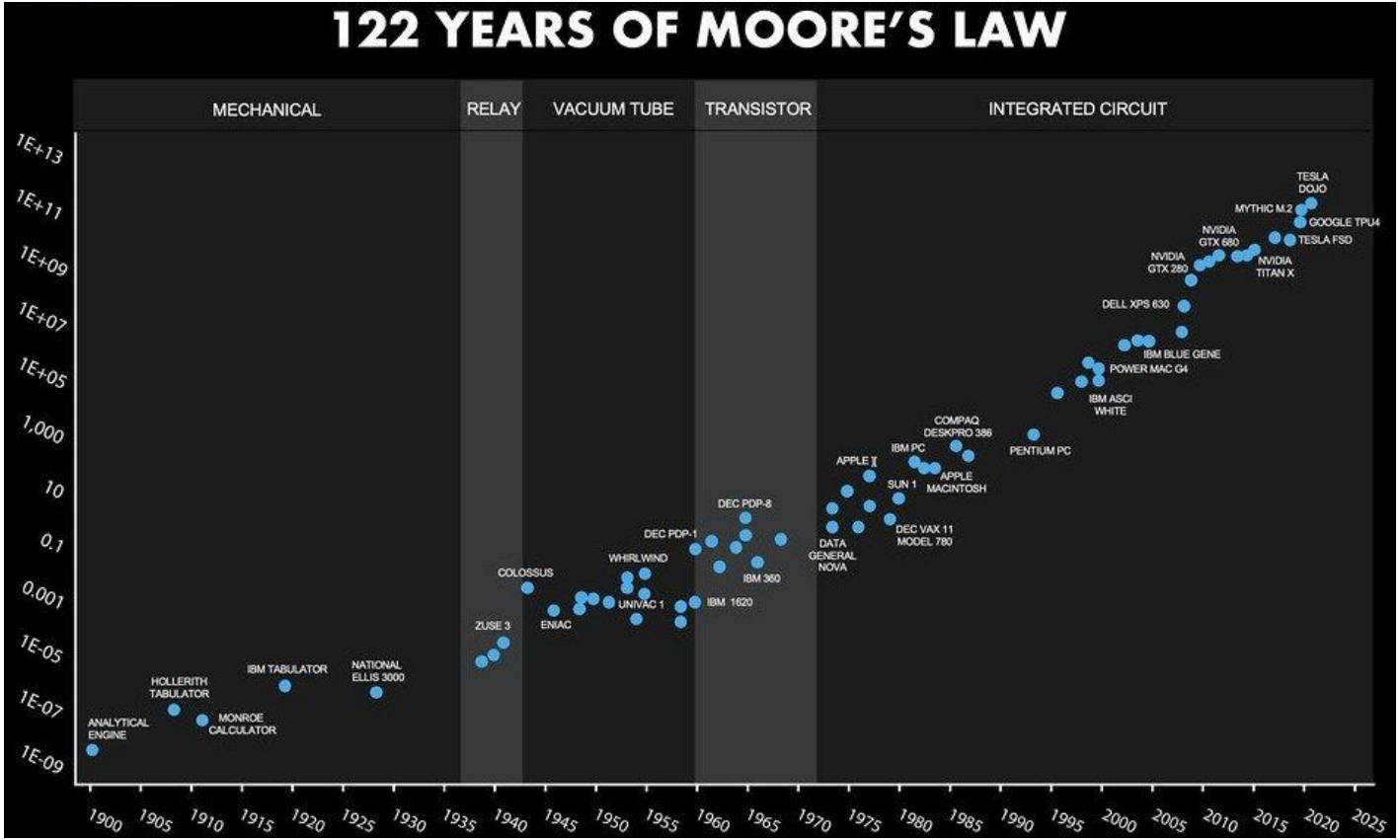
Source Flickr https://www.flickr.com/photos/jurvetson/25046013104

Moore's Law trend continues



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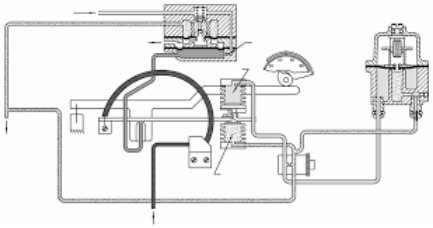
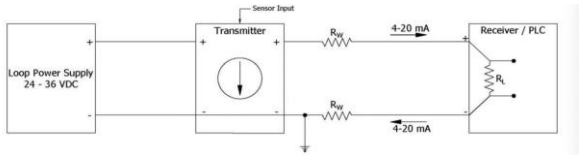
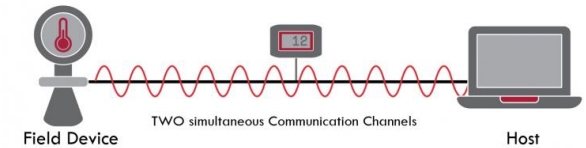
Source: https://www.unite.ai/moores-law/

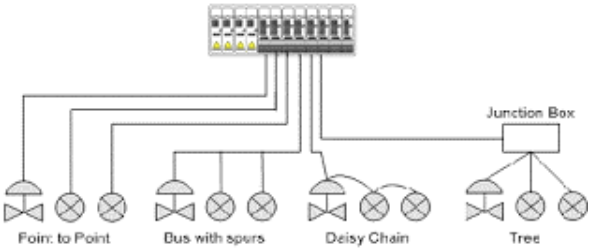
Generations of Industrial Field Connectivity

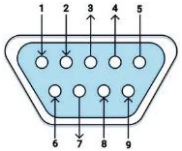
1930's	1950's	1970's	1980's	1990's	2000's	2010's	Today
Pneumatic	Current loops	Serial communications	HART	Fieldbus	IP Packets	Wireless Sensor Networks	5G+

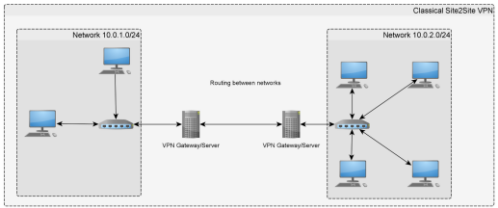


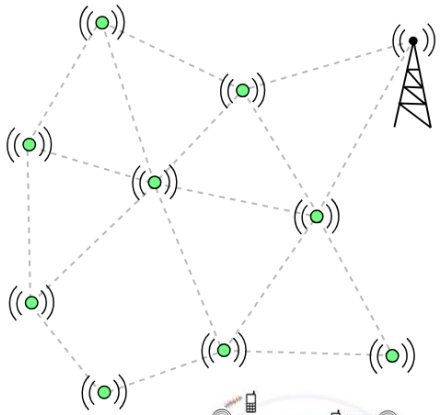


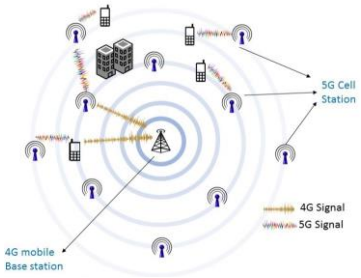












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Generations of Control Systems

	1st Gen Monolithic	2nd Gen Distributed	3rd Gen Networked	4th Gen Web based	5th Gen Adaptable
Changes	• Availability of radio modems • Affordable Mainframe computers • RTUs become feasible	• Availability of LAN & WAN using telecom • Increased bandwidth • Adoption of PC-based systems • Software for business practices	• Standard Network Protocols • PC-based servers • Windowing based HMIs • Integration with back office systems	• Acceptance of the Internet for business • Availability of browser-based technology • Acceptable COTS hardware / infrastructure • Cybersecurity awareness	?
Needs	• Networked Communications • Centralized Monitoring	• Networked communications • Centralized control	• Back office connectivity • Operator Interface & Human Factors	• Communications over multiple networks • Concurrent operators • Cybersecurity support	?
Characteristics	• Local data aggregation • Long distance data transmission • Centralized HMI • Remote shutdown capability	• Analog and discrete inputs and outputs • Ability to change control settings • Fault-tolerant servers • HMI from a server database	• Data Historians • Ethernet-based data transmission • Graphical interfaces • Fault tolerance / redundancy	• Standardized network communications • Encrypted data transmission • Central authentication • Web based interface(s)	?

Impact of CoTS & Packet Power

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Control Systems — Evolution or Revolution?

1970 to Today

1. PLC/RTU
2. Hardware defined
3. System point minimization
4. Significant manual effort to change
5. Operational stability via the ‘no touch rule”
6. Security through isolation

Expensive and prohibitive to make changes

The Future

1. Self-configuring low cost edge devices
2. Software defined functionality
3. Orders of magnitude more points
4. Ad hoc device addition
5. Operational stability via high availability methods
6. End-to-end integration plant floor to cloud with integrated security

Incremental improvements or changes with minimal effort

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Business Integration and Alignment

- Plant floor/Field to cloud/customer
- Integration with business systems
- Monetization of data inventory, integration with back ends
- Integration of disparate systems
- IoT / IIoT enabler

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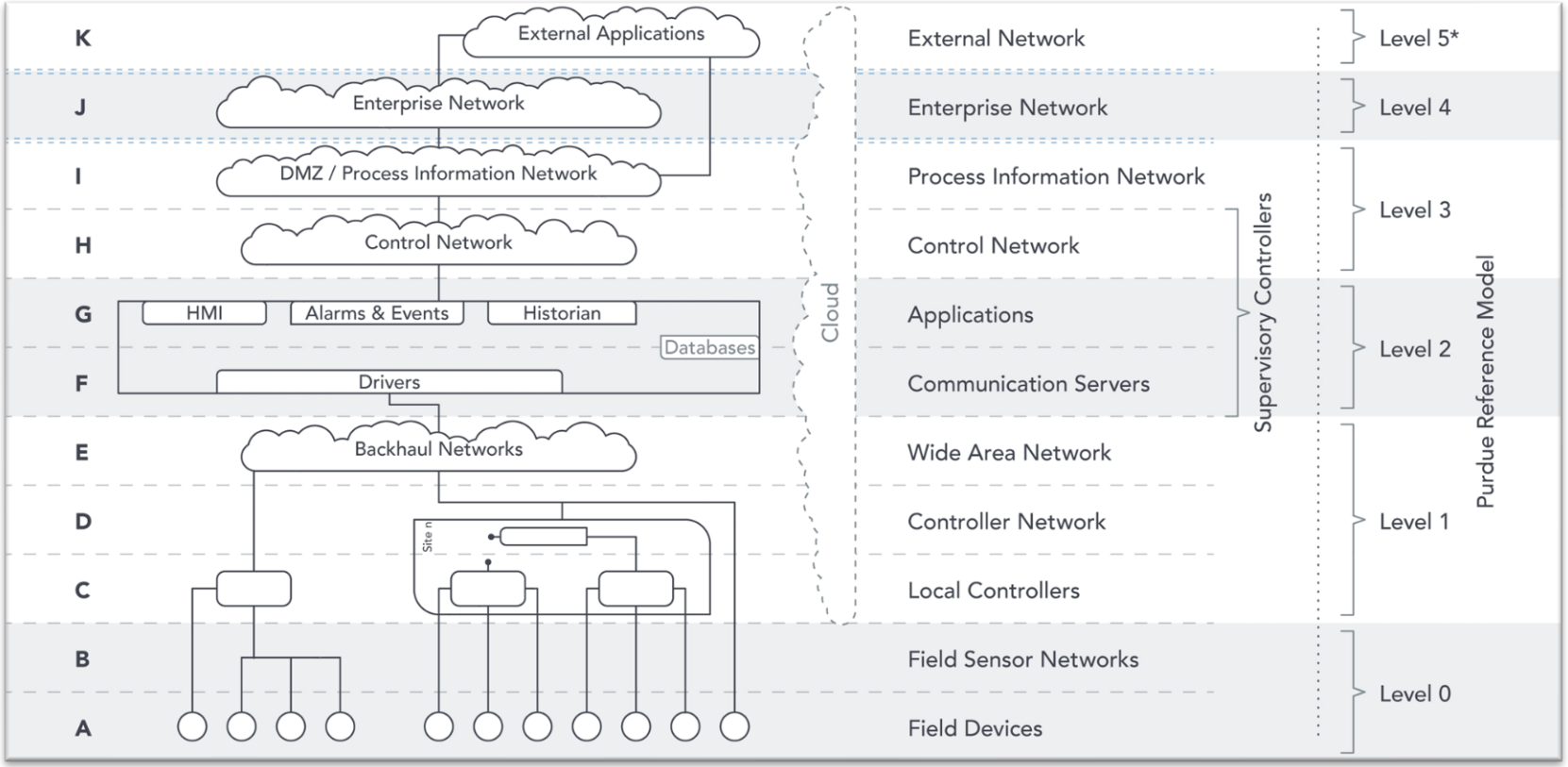
ISA-112 SCADA Architecture



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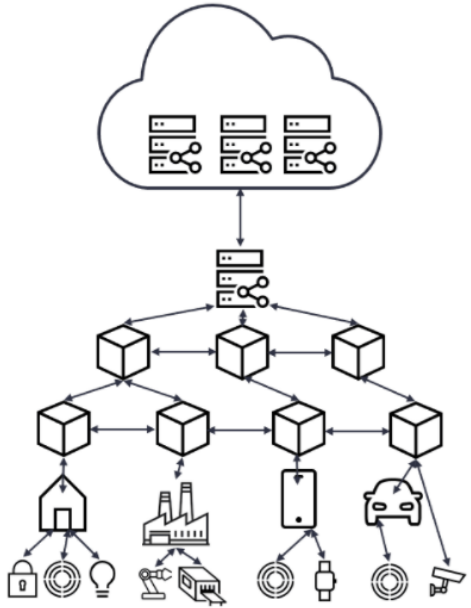
Edge Components

Category	Types of compute resources	Sample architecture	Typical compute characteristics: Distance from data sources (km)	Typical compute characteristics: Latency (ms)
Cloud	National data centers		10+	10+
	Regional data centers (Core)			
	Local data centers (Aggregation)			
Edge (3 types of edge): A Thick Edge, B Thin Edge, C Micro Edge	1 Cell tower data centers (Access)		1 to 10	1 to 10
	2 On-premise data centers			
	3 Computers			
	4 Networking equipment		.001 to 1	.1 to 1
	5 Controllers			
	6 Sensors / devices		<.001	<.1

Traditional SCADA

Source: IoT Analytics Research 2020, https://iot-analytics.com/iot-edge-computing-what-it-is-and-how-it-is-becoming-more-intelligent/

IIoT is …

- Infrastructure of interconnected entities, people, systems and information resources together with services which processes and reacts to information from the physical world and virtual world (IEC definition)
- A concept where components are connected via a computer network and where one or more of those components interact with the physical world (Industrial Internet Consortium)
- Interconnected sensors, instruments, and other devices networked together with computers' industrial applications, (Wikipedia)

Common Keywords

- Field devices
- Networked
- Interact with physical world

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Digital Twin as another part of data driven future

- Digital Twin model verification through multiple data streams
  - Operational
  - Diagnostic
  - Position

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Control System Evolution Continues

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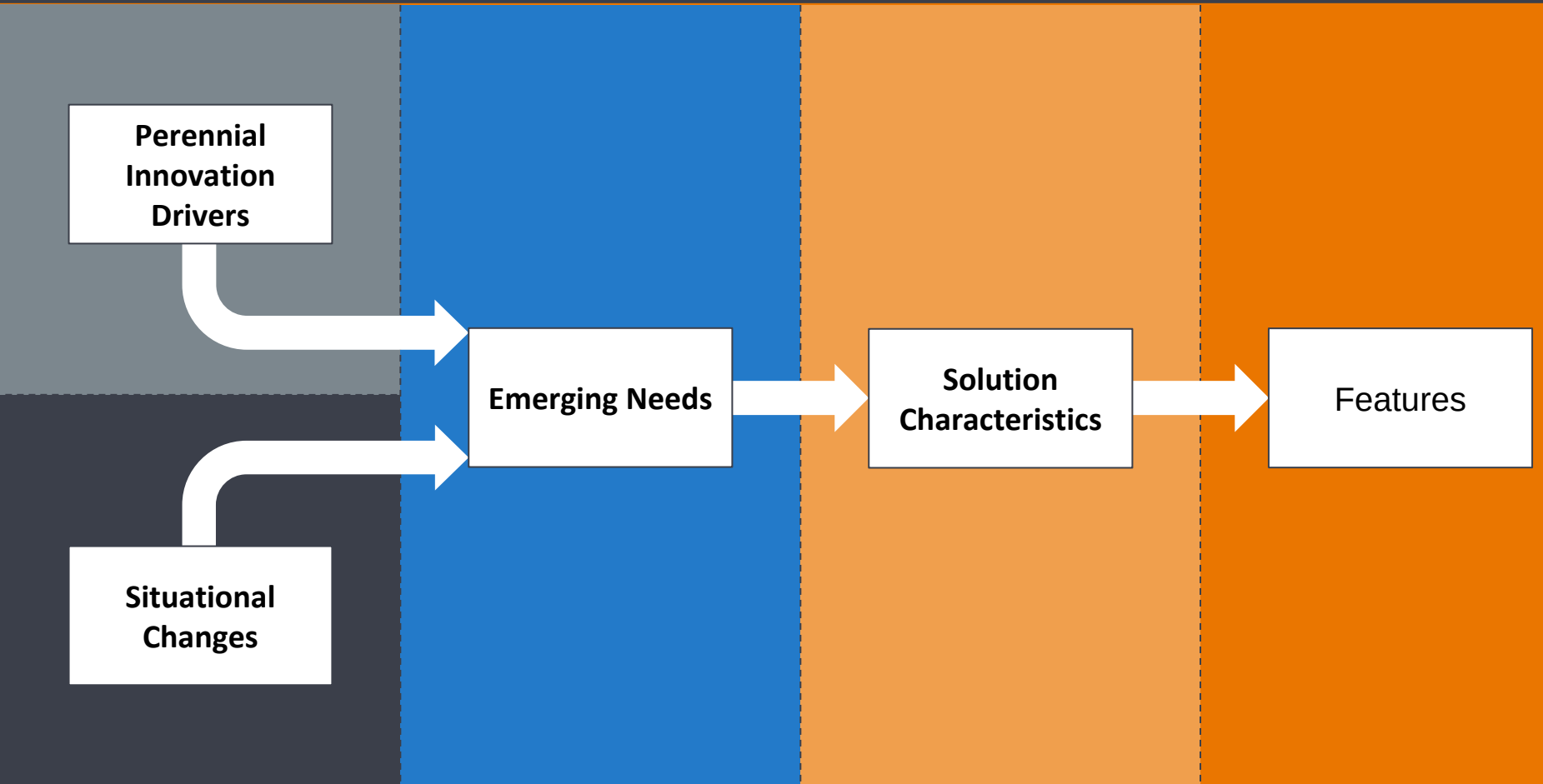
Methodology



Perennial Innovation Drivers

These are the key innovation drivers common across all generations of control technologies.

- **Maximizing System Reliability (no unscheduled downtime)**
  - **Affects profits for commercial operations (pipelines, etc.)**
  - **Affects user satisfaction for public operators (metro rail, etc.)**
- **Minimizing Operational costs**
- **Minimizing Capital expenditures**
- **Minimizing Risk**
- **Expansion of Service**
- **Competitive pressures**

Impediments to change

- Risk Management
  - Impact of something going wrong is significantly higher in OT environment
  - Proven in Use
    - Show it working elsewhere first
- Knowledge
  - Understand the underlying technology

5th Generation Situational Changes

These are the key situational changes that are triggering the 5th generational changes.

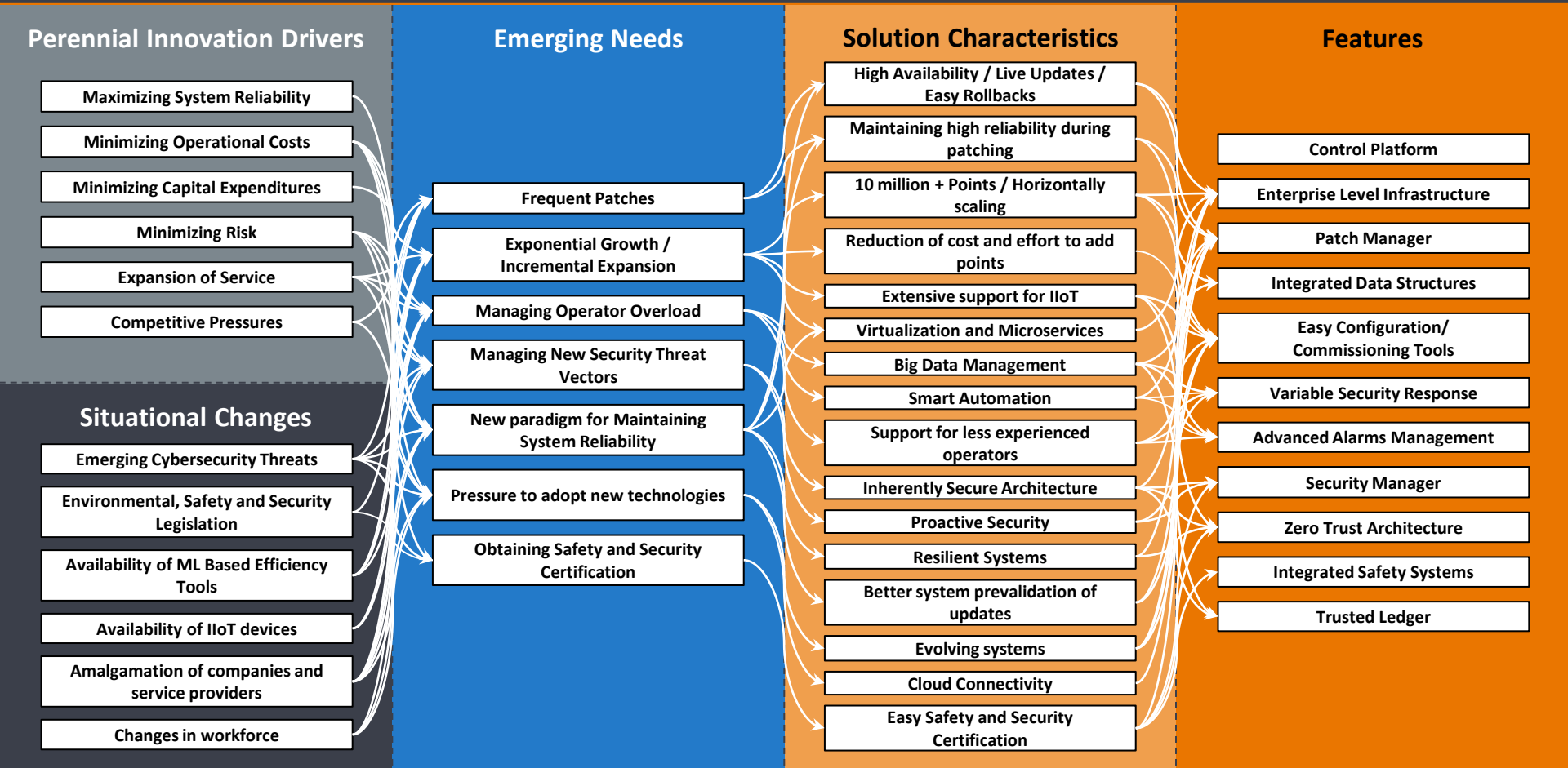
- **Emerging Cybersecurity Threats**
- **Environmental, Safety and Security Legislation**
- **Availability of ML-Based Efficiency Tools**
- **Availability of IIoT devices**
- **Amalgamation of companies and service providers**
- **Changes in workforce**

5th Generation Emerging Needs

These are the emerging customer needs created by the Perennial Innovation Drivers and the 5th gen Situational Changes.

- **Frequent Patches**
- **Exponential Growth / Incremental Expansion**
- **Managing Operator Overload**
- **Managing New Security Threat Vectors**
- **New paradigm for Maintaining System Reliability**
- **Pressure to adopt new technologies**
- **Obtaining Safety and Security Certification**

Fifth Gen Emerging Needs



The future …

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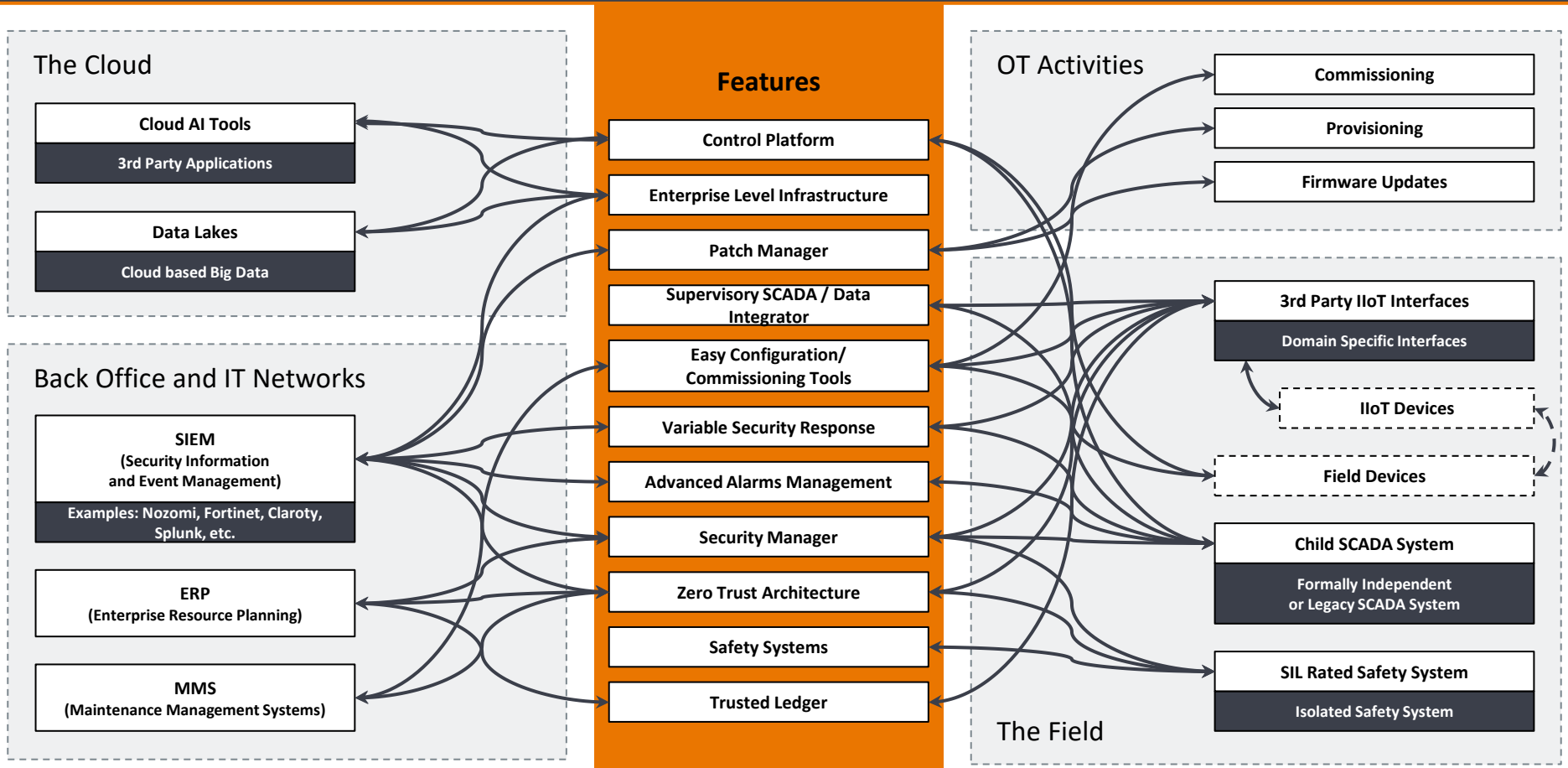
5th Generation SCADA as OT Orchestrator



Q&A

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