



# Internet of Things (IoT) Best Practices: Building Controls and Automation

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# Agenda

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- Introduction
- Benefits of a Smart Building
- Understanding HVAC and BAS
- What IoT Offers
- Critical Steps to Help Ensure Cyber Security
- Takeaways
- Questions...

# Introduction



- Senior systems engineer at Trane
- 32 years of experience including 18 at Trane
- Hold 13 patents and a Six-Sigma Black Belt
- Sharing experience from perspective of Industrial Controls on Internet of Things
- Currently leading Trane's development effort for the Requirements Management, Process Automation, and Test Management systems in Integrity
- Contact me at [smccoy@trane.com](mailto:smccoy@trane.com)



# About Trane



- A brand of Ingersoll Rand, a \$13 billion global business committed to a world of sustainable progress and enduring results
- Trane provides indoor comfort solutions and services include: heating ventilation and air conditioning (HVAC) equipment: chillers, building automation, equipment controls, building systems, process cooling
- HVAC mechanical repair services, energy and controls services
- Global presence in over 100 countries



# Connectivity Not New for HVAC



- HVAC cared about connectivity and the Internet long before IoT
- For decades, heating, ventilation and air conditioning (HVAC) systems have had capabilities touted by IoT technology
- Today's energy management systems enable organizations to manage building systems to improve operational and energy efficiency and positively impact the bottom line.



# Benefits of a Smart (Intelligent) Building



- Technology, data availability enable new levels of real-time service across many industries
- A smart building can driver better decision-making to help achieve organizational missions and key financial/operational objectives
- Creates value by turning the ‘raw data’ into actionable ‘information’ that is easy to use
- IoT is driving changes for building facilities teams



# Understanding Build Automation Systems



- Building automation systems (BAS) provide centralized control of a building's HVAC, lighting and other systems to improve occupant comfort, optimize building system performance and reduce energy and operation costs.
  - ✓ A BAS can be used to remotely control, monitor, alarm, trend, and schedule the operation of HVAC equipment.
  - ✓ BAS components include: chillers, boilers, air handlers, air handlers, thermostats, sensors, meters, etc.
  - ✓ For example...





# Case Study: Movie Theater Chain



## Requirements

- Primary focus customer comfort—reliable equipment and no loss revenue
- HVAC and lighting energy efficiency
- Real-time, enterprise wide updates

## Approach

- Remote resolution of system alarms 24/7
- Intelligent dispatching to tech handhelds
- System level optimization through analytics
- Energy usage reporting and visualization
- Real-time synchronization with ticket sales and schedules at show times



## TECHNOLOGY ENABLERS

- Server on client network for enterprise BAS control
- Lighting integration and control
- Cloud-enabled enterprise schedule and set point changes
- Energy meter data through BAS into Cloud for analysis and reports



# The Story: How BAS Met the Internet



Millions of buildings are still running today with pre-Internet technology

BAS and the Internet have a history together:

- BACnet/IP standard drafted in 1998
- Private (or isolated) networks moved to shared networks
- Desire/demand for “instant response” time
- Many legacy BAS installations are now wired onto the Internet via gateways
- Trane has a cloud-based Internet solution



# A Typical Building Employing BAS



# IoT – What Does it Bring to the Technology?



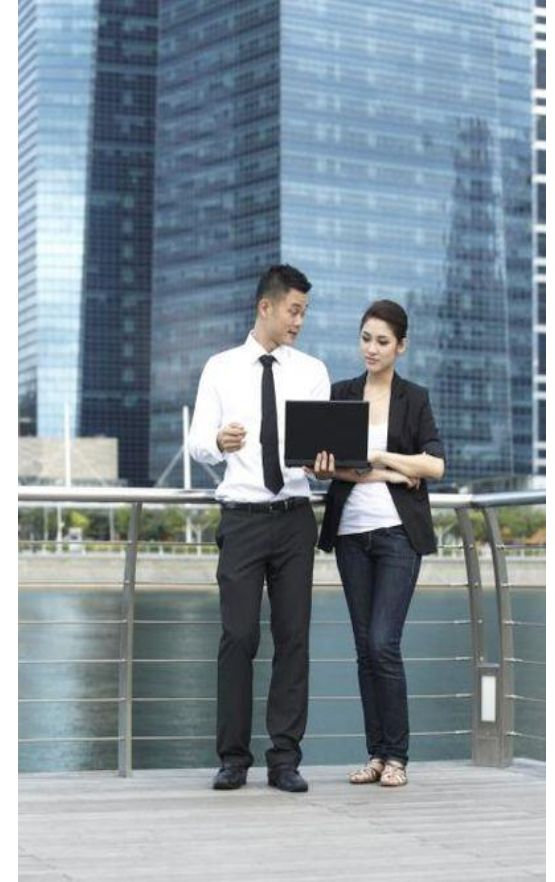
- Conflict: designing a product to last 30+ years vs. a product to last two years
- The “hot technology” from last year falls out of favor a year later
- Verification is increasingly more challenging
  - Required knowledge of new technology
  - Increased variability in products
  - Increased number of products and components to integrate



# IoT – What Does It Bring to the Business?



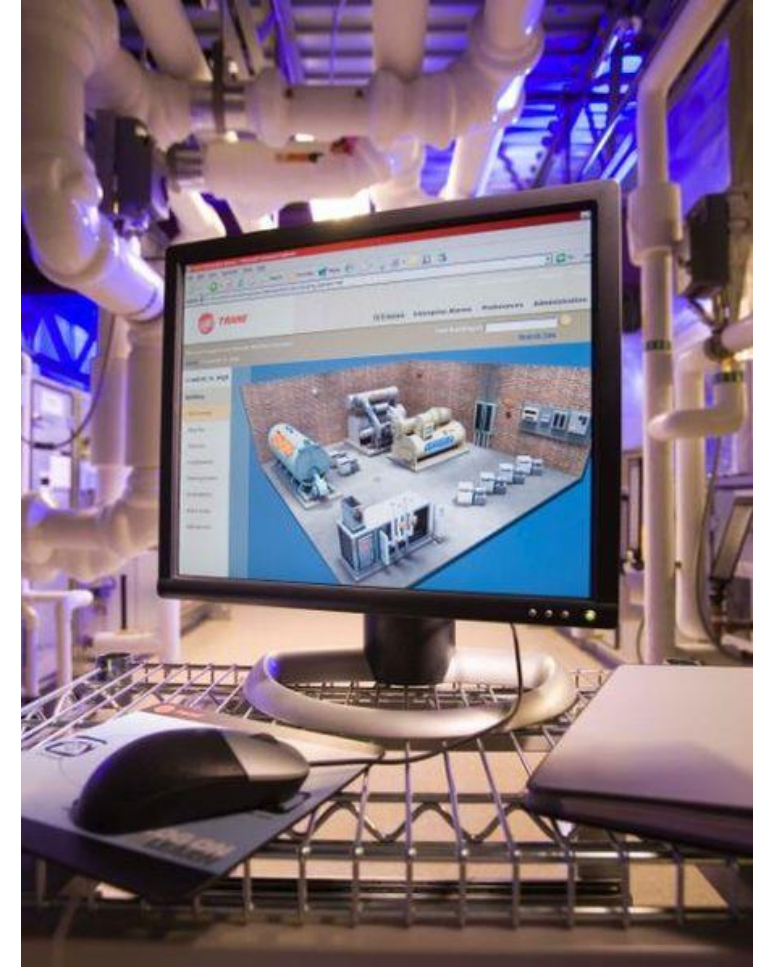
- New business opportunities
- A solid business-case for updating an aging system
- BAS made of up integrated commodity components
- Competitors become partners and partners become competitors
- Software As A Service (SaaS)
- Integration with personal devices (phones and tablets) and social media
- Need for increased security: a company's intellectual property 'IP' needs greater protection
- Opportunity to change product support with “Augmented Reality” like capabilities
- Software is everywhere





# IoT – What Does it Bring to Products and Systems?

- More interfaces, more variability, more flexibility
- Systems integrated from components
- Systems aren't set-and-forget anymore
- More complicated systems and more complex systems
- No real standards determined
- It's difficult to make a product that has no software component
- Integration of disparate systems – sometimes forced
- How do we determine reliability and resolve warranty issues?



# Why Cyber Security is Critical

*There are two types of companies: those that have been hacked, and those who don't know they have been hacked.”*

*– John Chambers, CEO of Cisco*

- While security vulnerabilities are real, awareness is the first step
- Human error is the root cause of 52% of security breaches (source: CompTIA 2015 study)
- Taking specific preventive measures can help prevent or minimize the effects of a potential security breach





# Educate Yourself, Team Up

- Do your homework - understand the level of risk in the deployment environment
- Update legacy systems to help ensure IT security
- Know the capabilities of the products that are allowed to interoperate with yours
- When integrating multiple systems, be sure to include a systems engineer
- Avoid the “hero model”... There is no need to be an expert on everything; bring in consultants
- Remember to educate external audiences about the realities associated with Internet connectivity, including: customers, executives, technologists, business partners, etc.



# Play It Safe

Practice safe networking and solid IT policies

- Use routers and firewalls
- Lock down ports that aren't used and the “easy access points” into systems.
- Audit your systems - are updates being applied, are SSL certificates being renewed?
- Force password changes
- Limit administrative privileges



# Take Preventive Steps

Prepare for the worst so it never happens:

- Design your software to scrub both input and outputs for questionable intrusions
- Perform security design reviews and audits
- Use tools that can scan for security vulnerabilities
- Avoid the “it’s easy” traps - always confirm and verify
- Include failure modes and effects analysis FMEAs in your process



# Use a Checklist

When deciding to put something on the Internet, always be thinking...

- How do I protect the customers?
- How do I protect the operational system(s)?
- How do I protect the company's brand?





# Takeaways...

- Value and opportunities exist with IoT – minimize the risks in order to maximize the benefits
- IoT is changing the landscape – business, products, systems, and technology
- Established standards likely do not exist
- Context is everything - what applies to one does not always translate to another
- Preparation and prevention can help you and your time reap the benefits and minimize the risks



QUESTIONS?





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