

Trane LET'S GO BEYOND™

Trane Smart and Building Connected Solutions

Wireless Controls

by Ir Glorisun Wong
Senior Manager
Trane Hong Kong

Agenda

- Trane Controls Digital Direction
- Trane Building Connected Solution
- Wireless Systems
 - Why Wireless
 - Wireless Technologies
- Trane Air-Fi Wireless System
- Demo

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Trane Controls & Energy Services

40 years of building on a strong foundation of innovation

Gen 1: 1978
• Hardwired electronics

Gen 2: 1985
• DDC
• Communicating

Gen 3: 1993
• Graphical user interface
• Applications
• Networking

Gen 4: 2000
• Open, Standard
• Web based
• Modular

Gen 5: Today
• Easy to Use
• Mobile
• Flexible
• Optimized
• Intelligent


Trane Connected Buildings – Digital Strategy & Innovation

Customer-Centric
View everything through the eyes of the customer(s).

Trane Controls & Energy Services

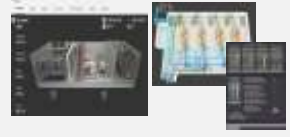
A True Systems Approach...

- Configurable, pre-engineered equipment and systems components
- Factory-programmed, tested and documented
- Advanced tools streamline engineering, implementation and commissioning



Delivers Tangible Customer Value

- Flexible, Energy Efficient System Operation
- Consistent, Intuitive User Interfaces
- Reliable, Proven Performance
- Sustainable & Repeatable Solutions
- Low Risk and High Performance!




Trane Controls


Delivering VALUE that impacts your business.

Tracer Controls


Open




Easy




Flexible




Optimized



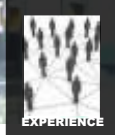
Intelligent



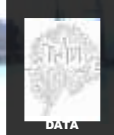
Find Your Building's Potential with



TECHNOLOGY



EXPERIENCE



DATA

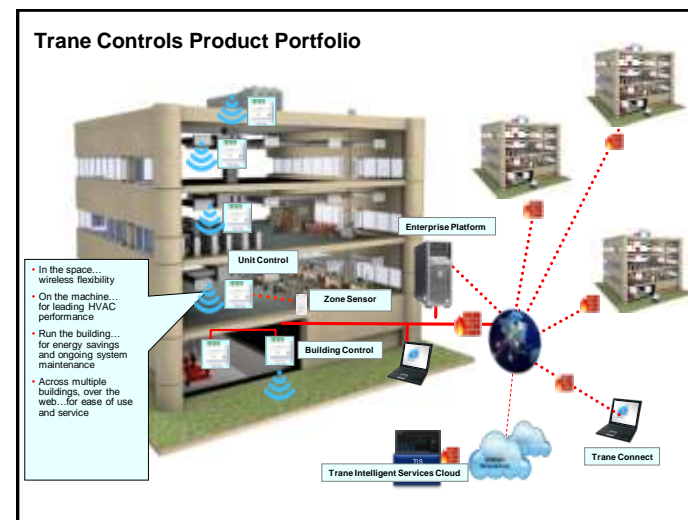
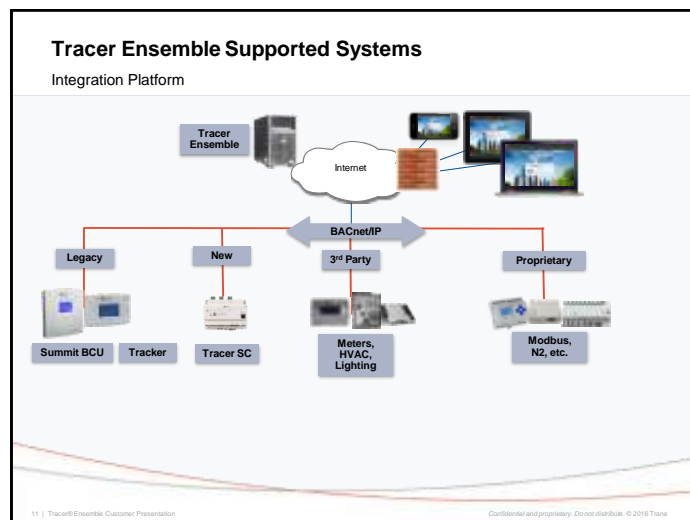
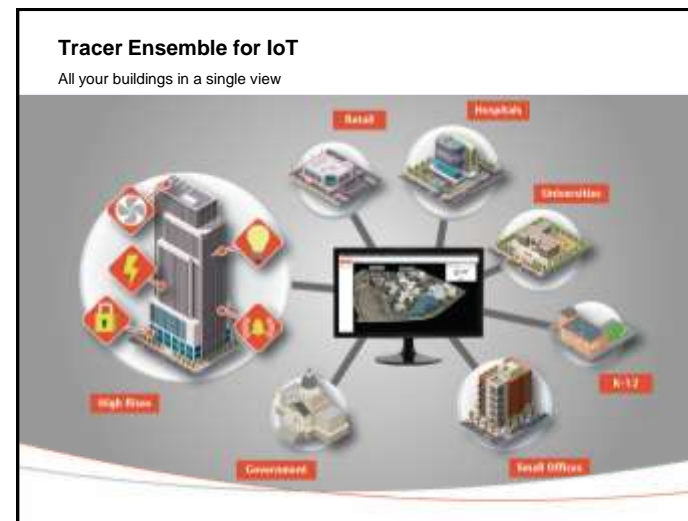
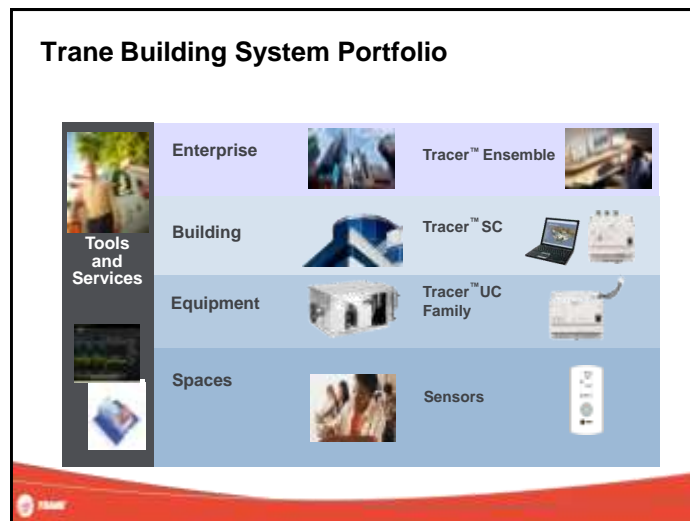
TRANE INTELLIGENT SERVICES

Actionable Insights That Help You Achieve Your Business Outcomes

Intelligent Services Movie



Trane Connected Building Solutions




Fully Customizable Navigation

Standard pages and navigation out of the box

Tailored for your Enterprise

- Fully customizable Navigation Tree
- Hide/expand both tree & nodes
- Edit names and create groupings



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Standard Equipment-Centric Information

The right information just a "click" away




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Mobile Friendly

Does your current BAS work on your smart phone?

With Tracer Ensemble...

- Touch-friendly buttons for easy mobile access
- Full browser support, so you can use your favorite device
- Receive, view, and acknowledge alarms directly from your phone
- Quickly respond to comfort complaints regardless of your location




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Graphical Scheduling

Change a single schedule or across an entire enterprise

- Drag and drop quick editing and changes
- Weekly/daily views
- Only three "clicks" to change




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Alarm Management

Manage all your system alarms in one place

- **Filtering & grouping**
 - Manage your alarms like e-mail
 - Eliminates the noise caused by nuisance alarms




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Standard & Custom Reporting

Information for the entire organization

- **Built-in Web based report designer**
 - No third party software required
 - Measure and compare building and asset performance
 - Track and verify energy use and savings
- **Ability to schedule & email reports across the organization**
 - Compliance reporting
 - Secure auto archiving




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Custom Dashboards

View what's most important to you

- **Built-in web based dashboard designer**
 - No third party software required
- **Real-time and historical data**
 - Monitor system health and performance
 - Quick insight into potential problems and changes
- **Responsive screen sizing**
 - No need to design based on monitor size

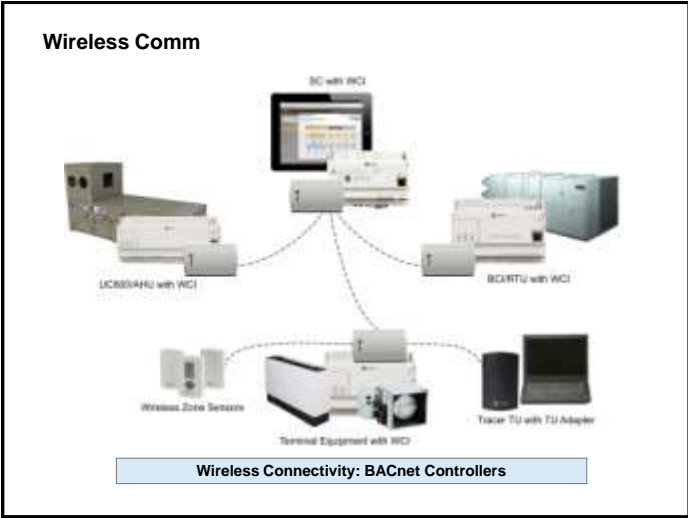
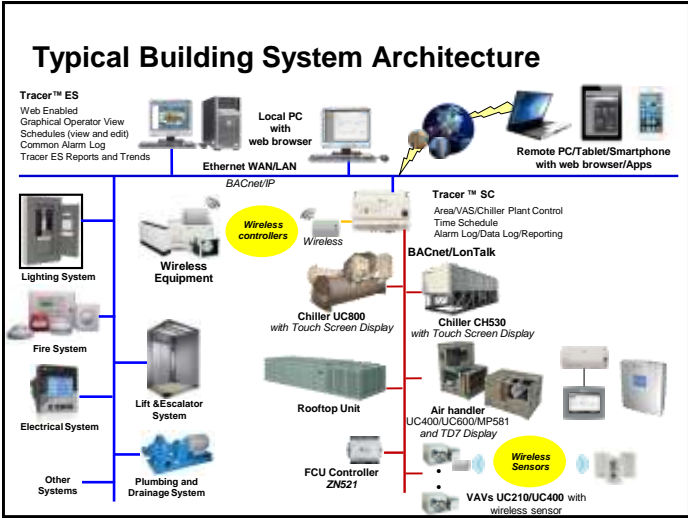


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Wireless Systems

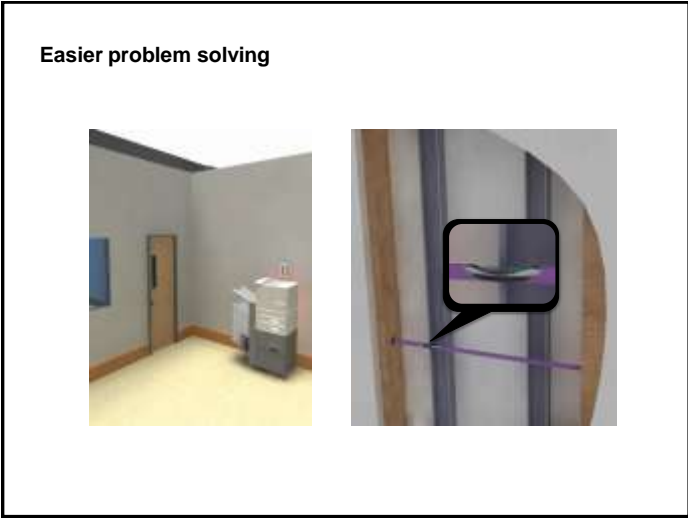
Why Wireless?



Benefits for Wireless

Trane Air-Fi Wireless is the best BAS Solution in the industry

- **On-time, On-budget Project Completion**
 - **Project simplification**— minimize the complexities and costs of wire, labor and sub-contractors
 - **Easy troubleshooting**— sensor relocation and tracing wiring or installation mistakes
 - **Standard factory installation, programming and addressing**
- **Lifecycle Savings**
 - **Flexibility**— Reconfigure, Upgrade and Expand your Spaces as your building needs evolve
 - **Reduced Maintenance**— Lifetime sensor batteries
 - **Open standard wireless BACnet solution**
- **Increased Reliability**
 - **Self-optimizing mesh network**
 - **Double the wireless range** for maximum redundancy
 - **Reduces** possible points of **communications failure**



Life-cycle savings

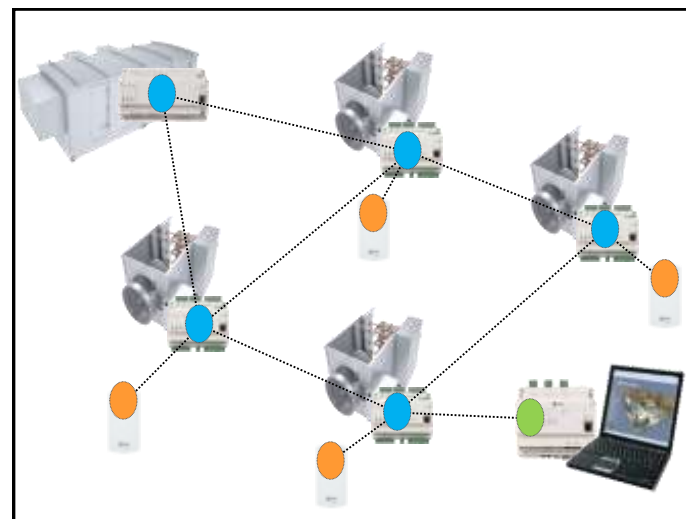
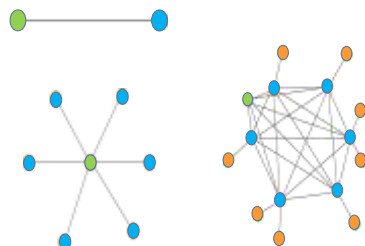


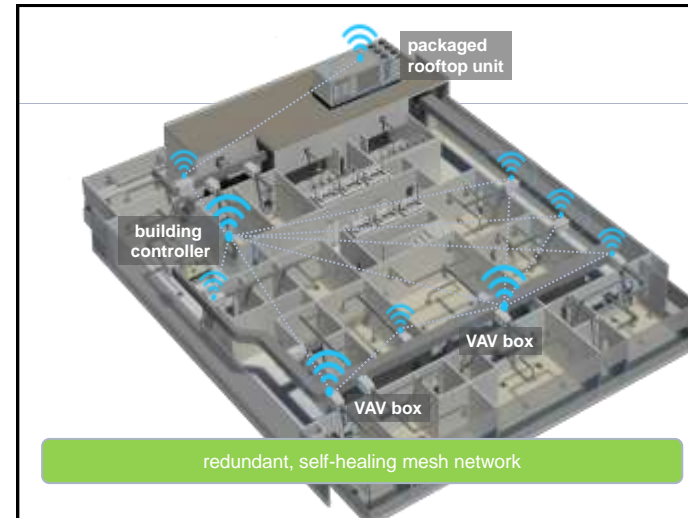
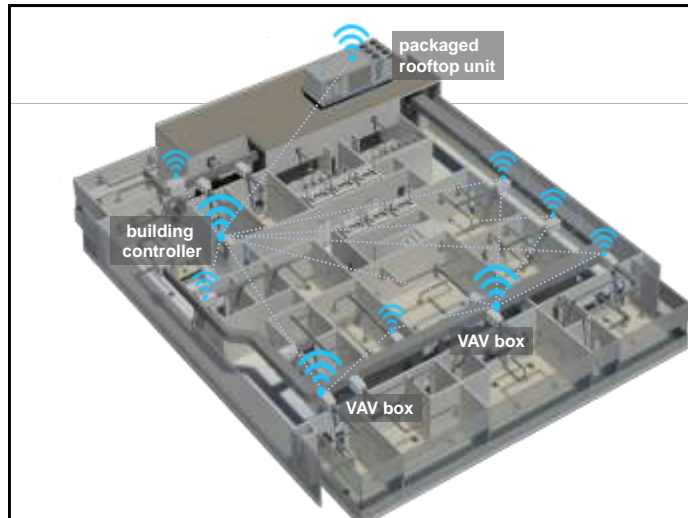
What's Wireless?



Common Wireless Topologies

- Point-to-point
- Star
- Mesh





Common Wireless Technologies

- Wi-Fi®
- Bluetooth®
- EnOcean®
- Z-Wave®
- Zigbee®



Wireless Technology	Typical Range (meters)	Data Rate	Topologies Supported	Power
Wi-Fi® IEEE 802.11 b/g/n	70	600 Mbps	Point-to-point Star	Battery (hours)
Bluetooth® IEEE 802.15.1	10	25 Mbps	Point-to-point	Battery (days)
EnOcean® ISO/IEC 14543-3-10	30	125 kbps	Point-to-point	Power harvesting Battery (years)
Z-Wave®	30	40 kbps	Mesh	Battery (years)
Zigbee® IEEE 802.15.4	70*	250 kbps	Point-to-point Star Mesh	Battery (years)

Controls System Components

	Power Source	Data Rate	Quantity
Sensors	Batteries (years) Power harvesting	Low	Many
Equipment controls	Line power	Moderate	Many
Buildings controls	Line power	High	Few
Tools	Batteries (hours)	High	Few

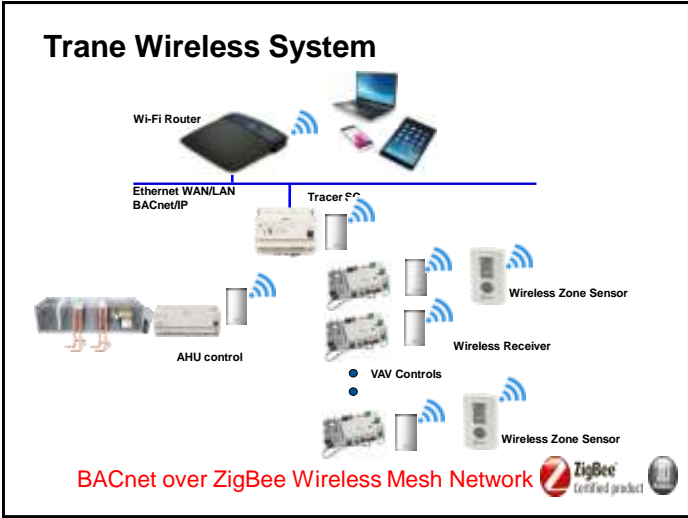
Wireless Technology	Typical Uses
Wi-Fi®	Replaces Ethernet cable (building controllers)
Bluetooth®	Short range, moderate data rate applications (service tools)
EnOcean®	Moderate range, low data rate applications (sensors, lighting)
Z-Wave®	Moderate range, low data rate applications (residential thermostats, lighting)
Zigbee®	Moderate range, moderate data rate applications (commercial buildings, sensors, equipment controls)

Communication Technology

Comm Technology	Protocol	Promoters	Strengths	Freq.	Power Draw	Bandwidth	Cost	Indoor Range	Issues	Best Applications	
Wired	BACnet™/IP	BACnet, Delta, Siemens, KMC	Bandwidth, Shared networks	---	---	100 Mbps	\$\$\$\$	230'	Dedicated Networks, IT issues, Security	High performance, remote buildings	
	BACnet™/MSTP	BACnet	All BAS mfgs. Low cost devices	---	---	76.8 Kbps	\$\$\$	200'	Dedicated Networks, Bandwidth	Controller Networks	
	LONTalk	LonTalk, Echelon, Others	Media options, highly standardized	---	---	78 Kbps	\$\$\$	200'	Somewhat proprietary, low usage today	Installed base, other non-building applications	
	Freedom	RTU, TCP	Meter & VFD mfgs.	Wide usage, simple	---	---	115 Kbps, 100 Mbps	\$\$	Dedicated Network, no security	Meters, Drives, local	
Wireless	Wi-Fi	BACnet, Proprietary	Tistats, Distech	Bandwidth, shared networks	2.45 GHz, 5GHz	High	20 Mbps	\$\$\$	230'	Dedicated Networks, IT issues, Security	High performance, remote buildings
	Zigbee	BACnet	Trane Air-Fi	ZBA Open standard, longer range, maintenance free	2.4 GHz	Low	250 Kbps	\$\$	200'	Still gaining market adoption	Sensor and controller networks
	Digilink Pro	Proprietary	Viconics, Others	Low cost	2.4 GHz	Low	250 Kbps	\$\$	100'	Minimal mfgs utilizing	Sensor and controller networks
	Digilink	Proprietary	JCI, others	Low cost	2.4 GHz	Low	250 Kbps	\$\$	100'	Old technology, not open	
	EnOcean	Proprietary	Multiple Mfgs.	Power harvesting	900 MHz	Low	125 Kbps	\$\$	30'	Bandwidth, range, sensor only	Sensors
	Bluetooth	Proprietary		Consumer Devices	2.4 GHz	Med	24 Mbps	\$	30'	Close Range only, one-to-one	Service Tools, Hand-helds
	EnOcean	Proprietary	Honeywell	Low cost	900 MHz	Low	100 kbps	\$	50'	Minimal range/bandwidth	Residential tstats



Trane Air-Fi Wireless Solution



Wireless Comm-Compatible Tracer™ BACnet Controllers

Trane Controls	Where Applied	Compatible
Tracer UC210	Trane VAV Controller	✓
Tracer UC400	Trane- and field-applied terminal equipment (VAV, WSHP, fan coil, blower coil, generic)	✓
BCI-I (IPAK)	Trane IntelliPak Rooftop equipment	✓
BCI-R (Reliabel)	Trane Voyager and Precedent Rooftops	✓
Tracer UC600	Trane- and field-applied air handling equipment, and ancillary systems (pumps, cooling towers, etc.)	✓
Tracer SC	Trane Building Control	✓

Compatible with Trane BACnet unit controllers

Air-Fi™ Wireless Hardware

Wireless Communications Interface

- Multi-Purpose
- Compatible with Trane BACnet controllers

5 Sensor Options

- Temperature-only
- Temp and Display
- Temp and Occupancy
- Temp, Occupancy, and CO2
- Up to 6 sensors per controller
- 2% Field Installed RH Module

TU Adapter

- Wired or Wireless
- Access without disturbing occupants

VAV Example - Traditional

Above the ceiling

- Control comm wire
- Unit and system
- Low voltage peripherals
- Sensors, valves

Below the ceiling

- Zone Sensors

Opportunity: Eliminate all field-installed, low-voltage wire

VAV Example - Wireless

Above the Ceiling

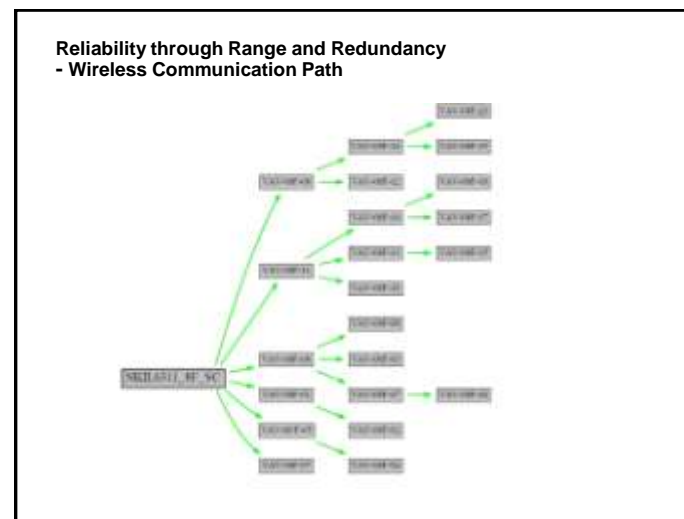
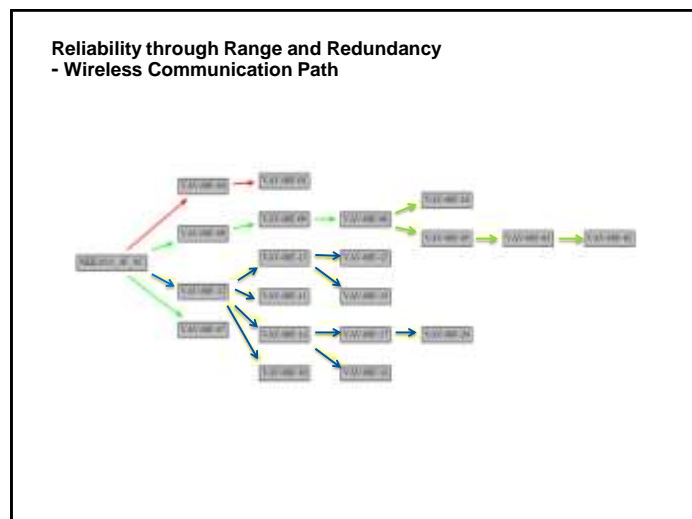
Factory Installed, Configured, and Commissioned VAV boxes
- Sensor options

- Replaces comm link and sensor wire for:
 - Reduced project time
 - Reduced project cost
 - Installation and problem-solving flexibility
- Increases system flexibility

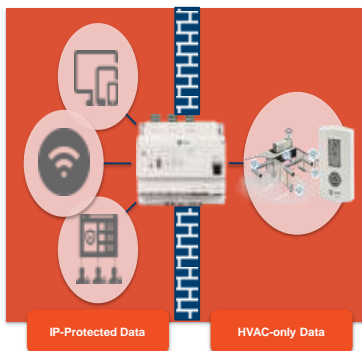
Below the Ceiling

Potential to eliminate all low voltage labor

Reliability through Range and Redundancy



Air-Fi Wireless Security



- Air-Fi Wireless is secure
 - 2 keys required to access the network
 - Isolated from high security systems

Air-Fi Wireless Coexistence

- Designed to IEEE standards for reliable coexistence
- Proven to reliably coexist in challenging environments
 - Hospitals
 - Stadiums
 - Distribution Warehouses

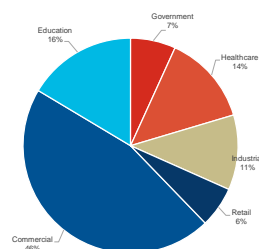


IEEE devices are designed to work and play well together

A Proven Solution

Air-Fi Wireless is the Trane Standard!

- Thousands projects installed
 - Offices
 - Hospitals/Acute Care Facilities
 - Stadiums/Theme Parks
 - Warehouses
 - Data Centers



Proven Success: Hospitals, Stadiums, Warehouses, Data Centers

Performing Arts Center

Situation

- Air handlers mounted around perimeter of theatre
- Separated by cinder-block walls for quiet operation
- Difficult to wire

Project

- Equipment and controls upgrades

Challenges

- Difficult to wire
- The show must go on

Solutions

- Wireless air handlers
- Wireless zone sensors and service tools

Outcomes

- On-time
- On-budget



Fire Station

Situation

- County-wide fire station headquarters
- Significant radio traffic

Project

- Upgrade the controls without down time

Challenges

- Difficult to wire
- No time for downtime
- Emergency radios get priority

Solutions

- Wireless rooftop unit (RTU)/variable air volume (VAV)
- Wireless zone sensors and service tools

Outcomes

- On-time
- On-budget
- No interference



School District

Situation

- Order not received until after school year
- Project planning was not completed

Project

- Controls upgrade – 20 buildings

Challenge

- Tight project schedule
- Availability of labor

Solution

- Wireless sensors

Outcomes

- On-time completion
- Wireless now standard



Airport Cargo Area

Challenges

- No conduit from between buildings
- Trenching too expensive
- Security restricted access

Solution

- Building automation systems integrated via wireless communications network

Outcomes

- Affordable solution allowed project to move forward
- Overcame security issues in restricted areas
- Building automation systems integrated in less than one week
- Operators no longer need to walk between buildings
- Response time to customer issues drastically reduced



Corporate Headquarters

Situation

- Large campus
- Four separate buildings

Project

- Renovation and employee relocation
- Integrate new equipment and controls for all buildings

Challenges

- Could not utilize company local area network (LAN) for HVAC communications
- Traditional wired systems cost prohibitive
- Concurrent renovation/employee relocation

Solution

- Building automation systems integrated via wireless communications network throughout campus

Results

- Wireless solution allowed project to move forward
- Network integration expense drastically reduced
- Eliminated security access issues
- Utilized wireless for commissioning
- Project completed on time
- Provided access to all HVAC equipment
- Minimized risk of lost communications during construction
- Easier future expansion projects and integration



Third-party bridge/access point with patch antenna

Moody County Courthouse

Situation

- 30 year old HVAC system
- Wanted a Building Automation System
- Couldn't compromise integrity of historic building

Solution

- RAUJ condensing unit with a remote evaporator
- Fan coils
- Tracer® SC
- Air-Fi Wireless

Results

- (Part-time) facility manager can manage building remotely
- Without wireless, they might not have been able to install a BAS



Hong Kong Office Building (Existing)

Situation

- Existing room temperature too low
- Air pressure unbalance
- Replace the AHU and VAV control at Floor 5/F, 7/F, 8/F, 10/F, 16/F, and 12/F

Solution

- AHU Control with Frequency Inverter
- VAV Control
- Tracer® SC
- Air-Fi Wireless

Results

- Improve the room temperature comfort
- Improve room pressure balance



Hong Kong Grade A Office Building in Kowloon Bay (New)

- A new 28-storey Grade A office building w/ Retail & Carpark
- BEAM Plus Platinum & LEED Gold certificate

Trane Control System

- Tracer Air-Fi system for 836 sets of wireless VAV controls
- Tracer Air-Fi system for 45 sets of wireless FCU & AHU controls
- Tracer Ensemble central control & monitoring system for 6 buildings

Benefits

- Flexible zoning controls & system re-balancing
- Minimize disturbing tenants operation while trouble-shooting
- Reduce future renovation cost and time

