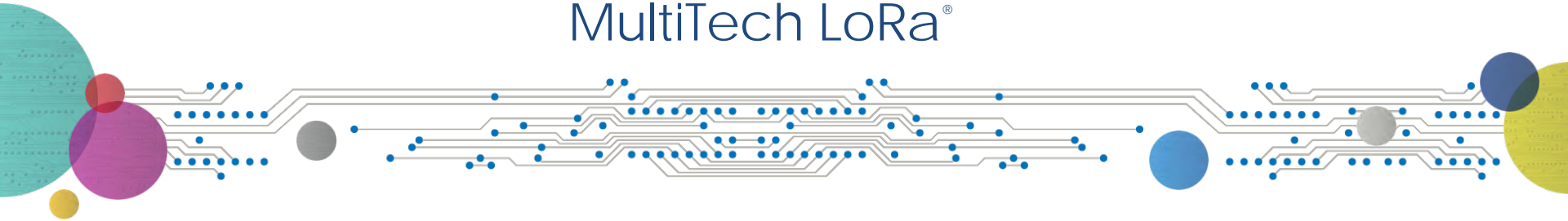




Low-POWER 2016

NOVEMBER 3-4, LAS VEGAS NV

MultiTech LoRa[®]



Presenter



Michael Finegan

Director of IOT Business Development

Agenda

Review - What is LoRa®?

Constrained device

Review conduit and mDot™ & xDot™

IoT Business Drivers for LPWA

Hybrid networks

LoRa Server on the gateway or in the cloud

DeviceHQ® Discussion

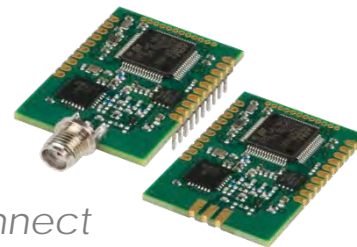
End-Node mbed™ scripts

Question:

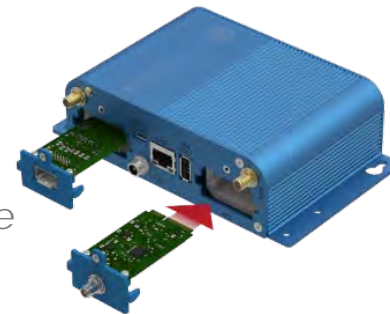
Create



Connect



Communicate



Different Markets: IoT vs. IIoT

Consumer Facing

- Low cost
- High volume
- One size fits all SW
- Frequent interaction with people
- Less harsh environments
- Short product lifecycle
- Data sharing w/ multiple different applications

- Strong security
- High reliability
- End device mgmt. & control
- Require little or no human intervention
- Operate in harsh environments
- Long product lifecycle
- Data aggregation into few enterprise systems

Industrial Facing

Low Power Wide-Area IoT Market

ENPHASE



ZOLL



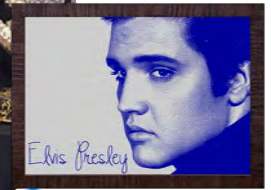
verizon



WaterBit



LORKTECH

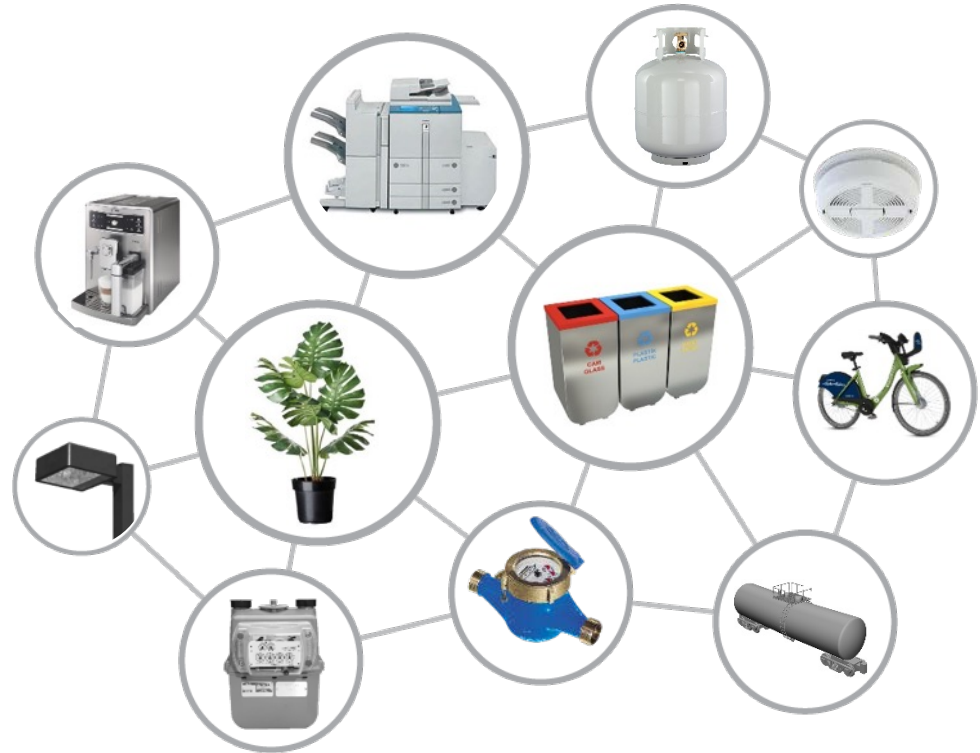


blu board

Connecting the Things to the Internet

Challenges at the Edge

- Long battery life (7+ years)
- Low cost communications
- Range & in-building penetration
- Decision making at the edge
- Ease of programming
- Time to Market
- Security & Scalability
- Ease of connectivity to the Cloud
- Remote Management
- Low touch - Easy to activate
- Highly fragmented connectivity



Connected Devices: Access

Source: Semtech

LAN

Short Range
Communicating Devices



Well established standards

Good for:

- Mobile
- In-home
- Short range

Not good for:

- Battery life
- Long range

Cellular

Long Range w/ Power
Traditional M2M



Well established standards

Good for:

- Long range
- High data-rate
- Coverage

Not good for:

- Battery life

Low Power WAN

Long Range w/ Battery
Internet of Objects



Emerging PHY standards

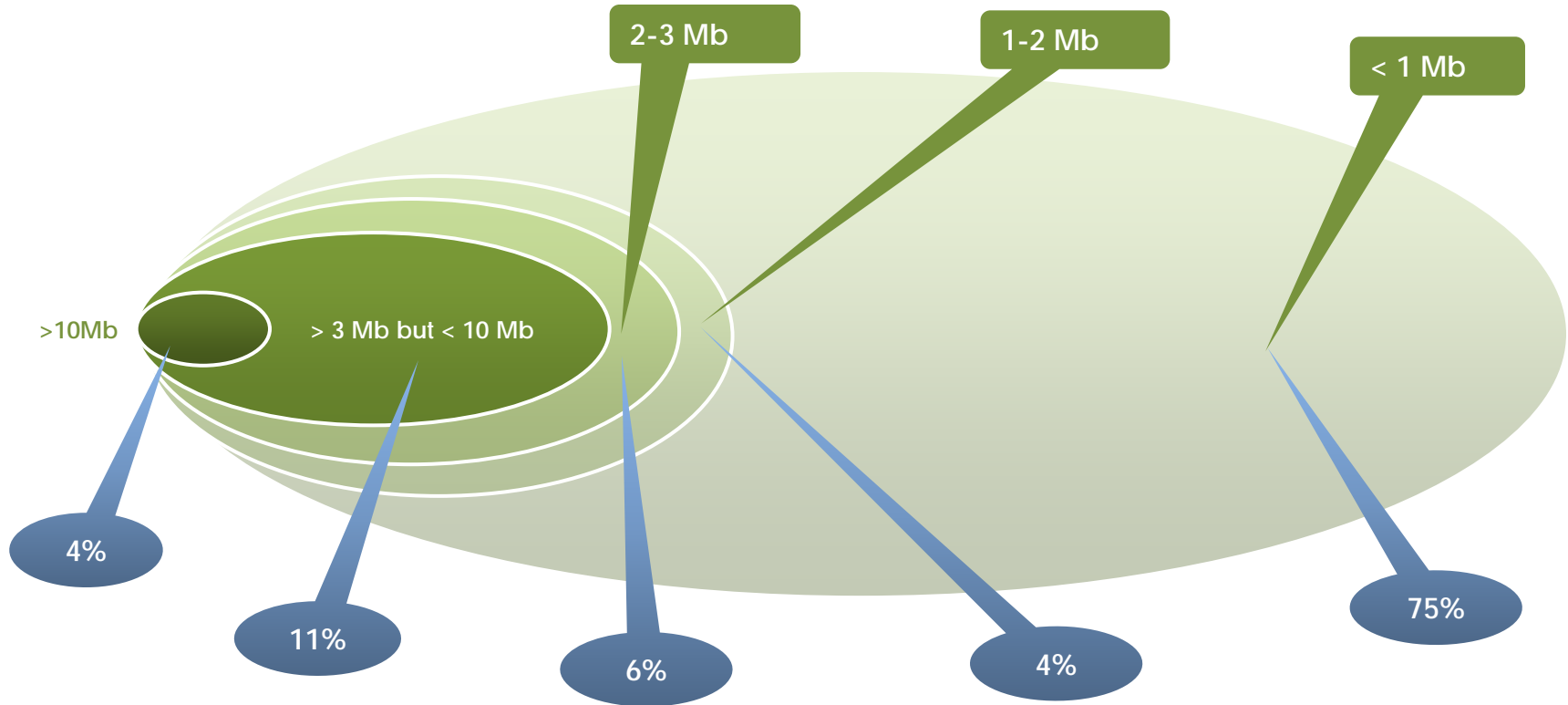
Good for:

- Long range
- Long battery
- Low cost

Not good for:

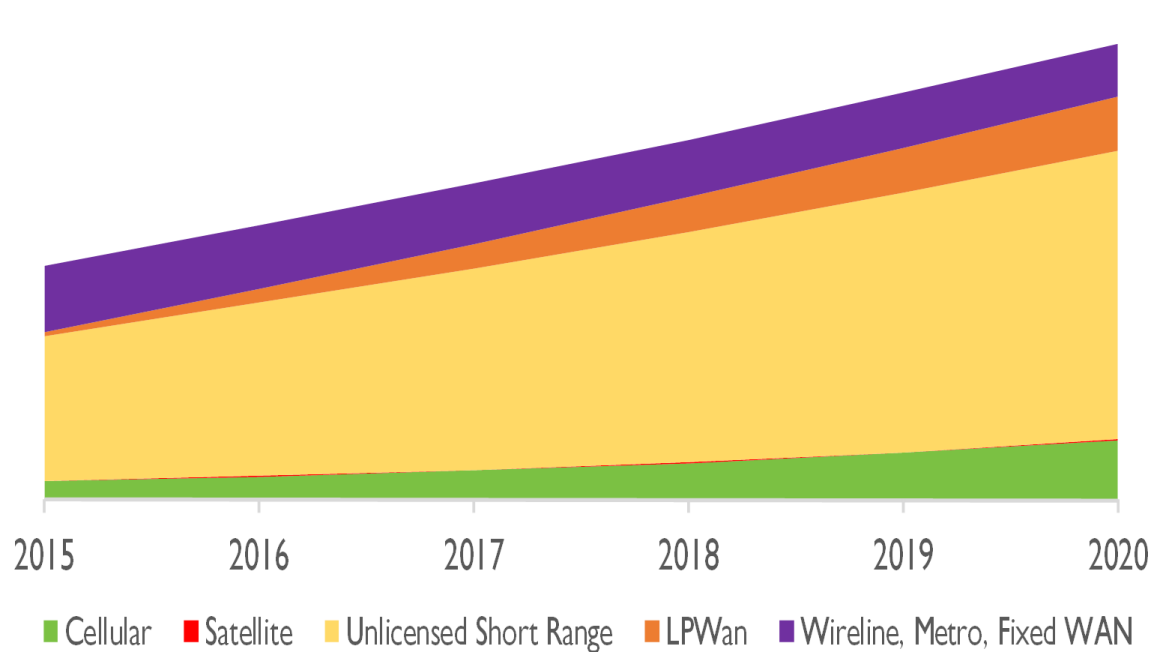
- High data-rate

IoT device average data consumption (estimated)



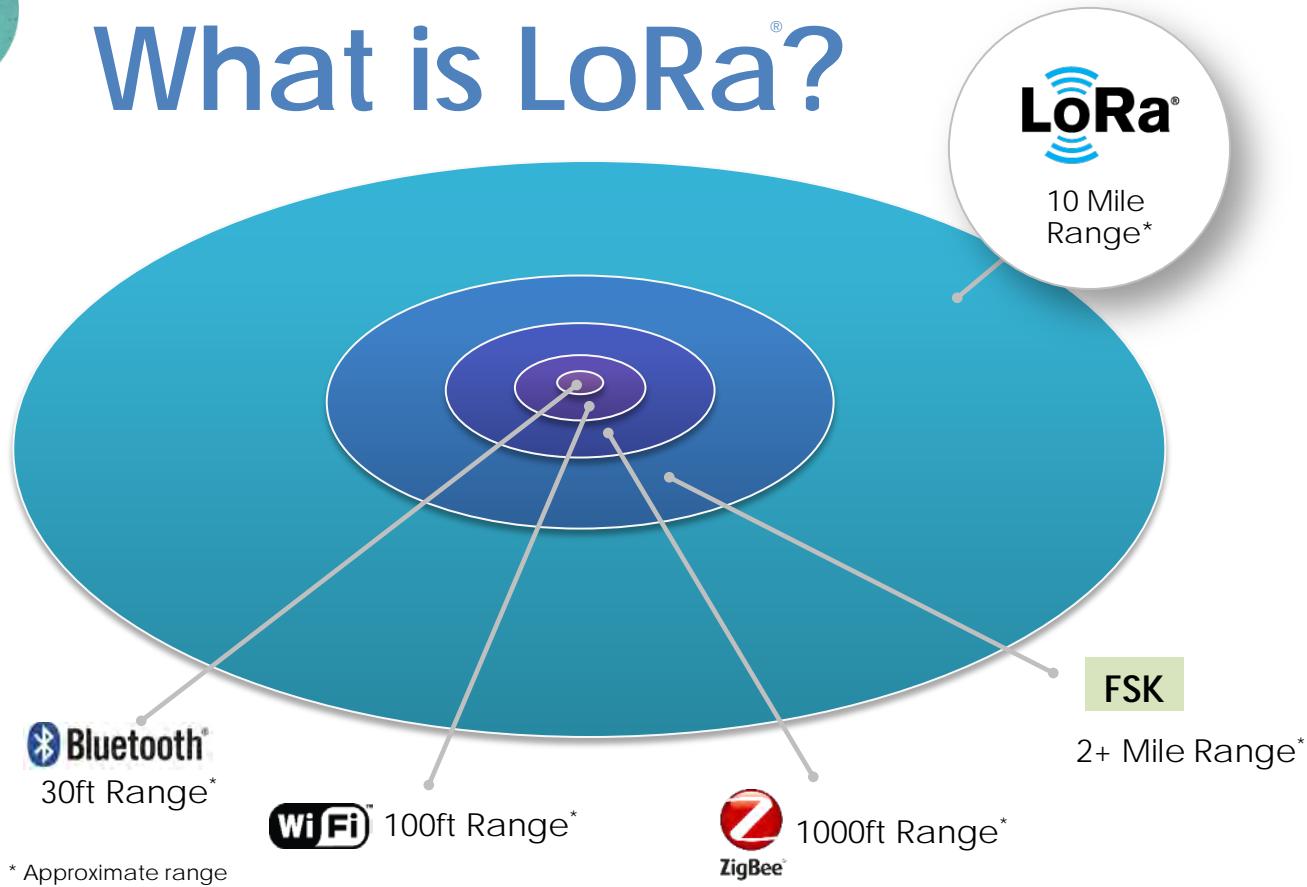
Source: James Brehm & Associates

Industrial IoT Forecast Through 2020



Source: James Brehm & Associates

What is LoRa?



Long range and low power

At +14dbm output power, 868MHz

- In Sub-GHz >5km dense urban >13km suburban > 80VLOS

Robust communication

- Not susceptible to interference from Wi-Fi, Bluetooth, GSM, LTE, etc

High accuracy localization and ranging

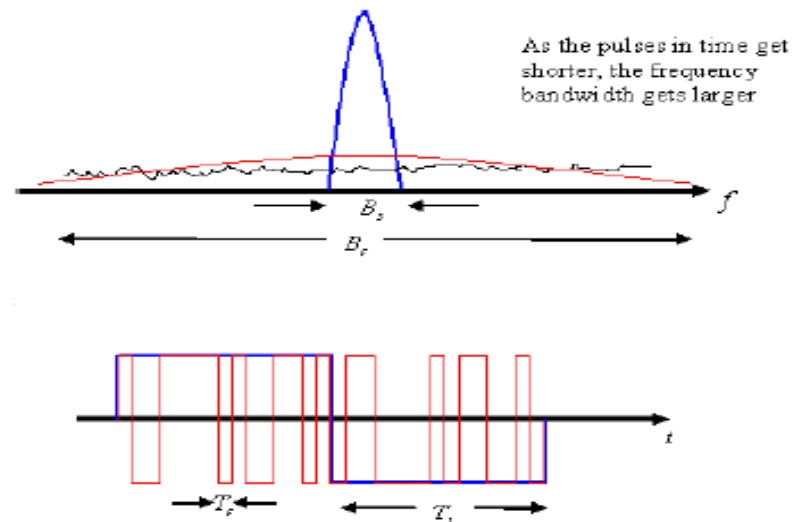
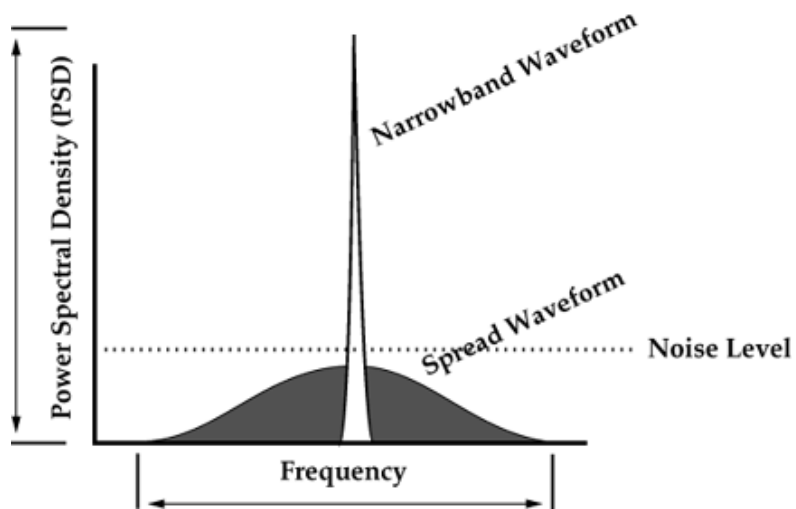
- Modulation format permits high accuracy localization
- Not RSSI based and accounts for multi-path and fading
- Permits high volume additional features

Improved network capacity

- Connect more nodes
- Additional capacity for features

* Approximate range

LoRa: spread spectrum-based modulation

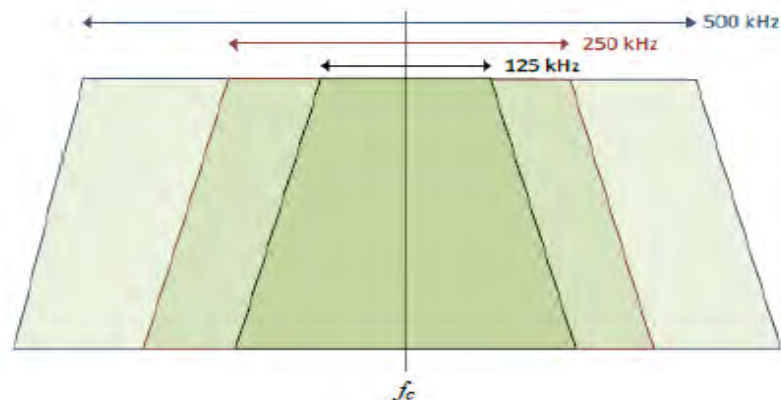
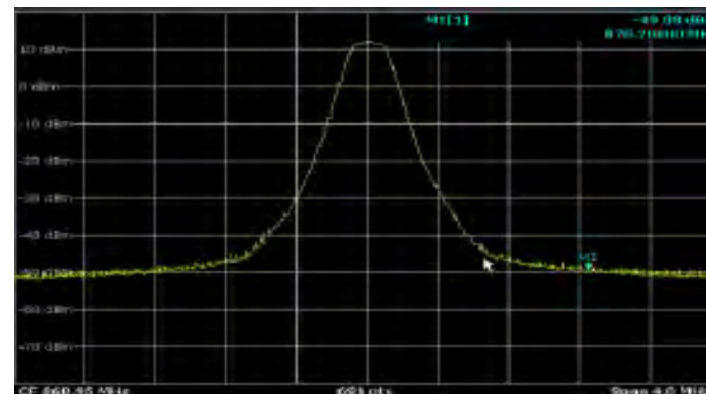


- Demodulate below noise floor
- Better sensitivity than FSK (better E_b/N_0)
- More robust to interference, noise and jamming
- Simultaneous occupation on a single channel if different data rate
- Tolerant to frequency offsets (unlike DSSS)

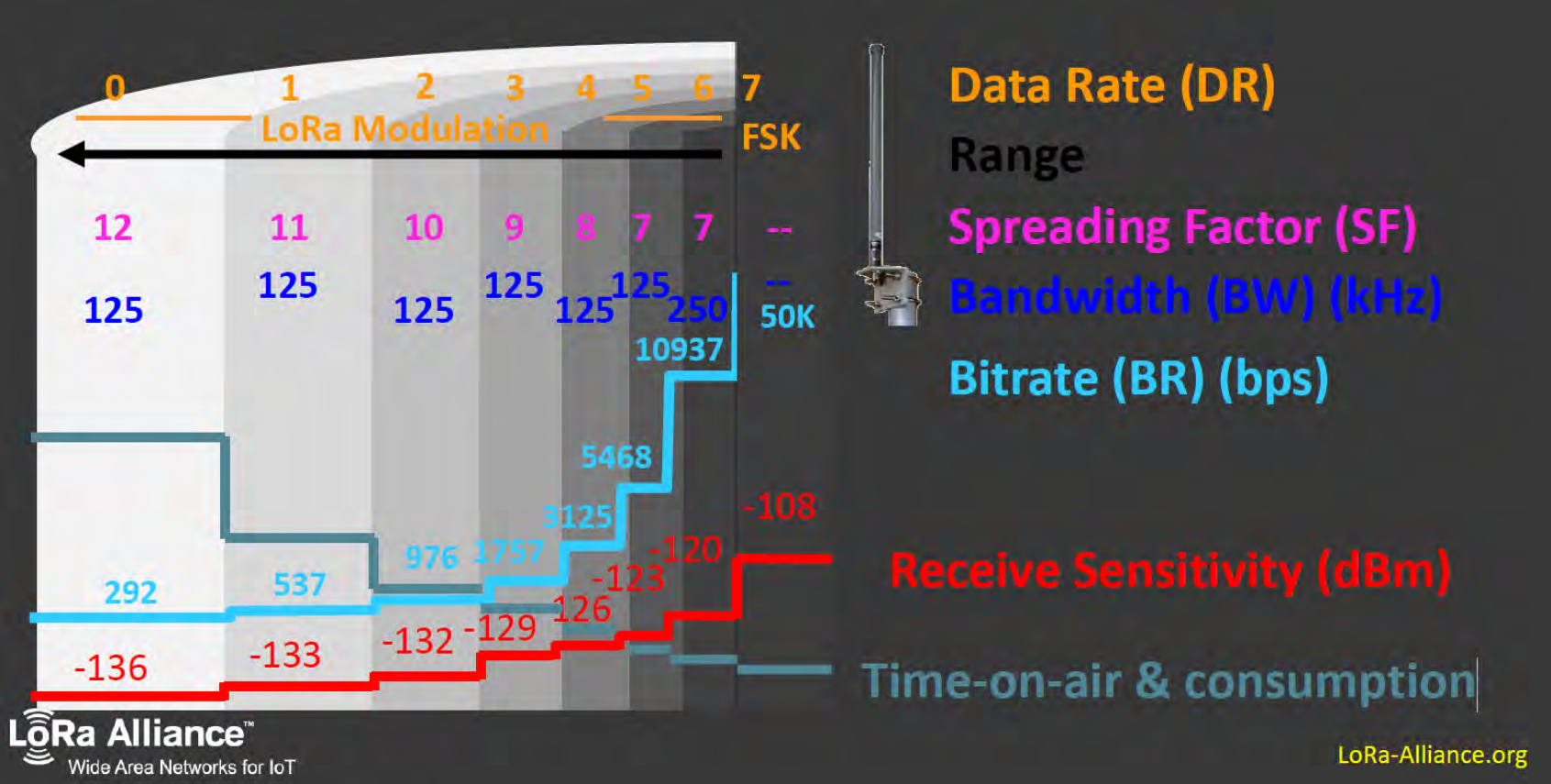
LoRa[®] bandwidths

SX1272 chip used in MultiTech's mDot Modules provides three bandwidths:

- 125kHz, 250kHz, 500kHz
- LoRaWAN uses all three
- LoRaWAN for North America uses 125 and 500kHz
- Each bandwidth has multiple data rates



LoRa bandwidth corresponds to the double sided transmit spectrum bandwidth.



LoRa-Alliance.org

Communication Technologies Compared

Feature	LoRaWAN Now	Sigfox Now	RPMA/ Ingenu	LTE Cat-1 2016 (Rel-8)	LTE Cat-M1 2017 (Rel13)	LTE Cat-M2 NB-IoT 2018 Rel13+
Frequency Band	433/480/780/ 868/915 MHz ISM	868/915 MHz ISM	2.4 GHz ISM	Licensed Spectrum (700 MHz-2.5 GHz+)	Licensed Spectrum (700 MHz-2.5 GHz+)	Licensed Spectrum (700 MHz-2.5 GHz+)
Modulation	DSS with Chirp	UNB / GFSK - BPSK	RPMA	OFDMA	OFDMA	OFDMA
Rx Bandwidth	125 - 500 KHz	100 Hz (EU) / 600 Hz (NAM)	1 MHz	20 MHz	1.4 MHz	200 KHz
Max Data Rate	293 - 50 Kbps	100 bps (EU) / 600 bps (NAM) 12 / 8 bytes Max	ACCESS POINT 624 Kbps DL 156 Kbps UL	10 Mbps	380 Kbps	~250 Kbps DL 22 kbps UL
Max. # Msgs/day	Unlimited (Some operators or service providers may have limits)	UL: 140 msg/day DL Broadcast: 4 msg/day	undisclosed	Unlimited (Single antenna restricted as low as 200KB/day)	unknown	unknown
Max Output Power	14-30 dBm	14-22 dBm	21 dBm	46 dBm	23 dBm	20 dBm
Link Budget	153-161 dB	149-161 dB	undisclosed	140 dB+	155 dB+ on DL	160 dB+
Communication Channel	Half Duplex	Limited Half Duplex	168-172 dB w/ diversity	Full Duplex	Half Duplex	Half Duplex
Power Efficiency	Very High	Very High	High	Low	Medium	High
Complexity	Very Low	Very Low	Medium	High	Medium	Low
Coexistence	Yes	No	undisclosed	Yes	Yes	Yes
Mobility	Yes	Yes	No	Yes	Yes	Limited to idle mode

LPWA Applications

Smart City

- Metering and sub metering
- Parking
- Security and fire alarms

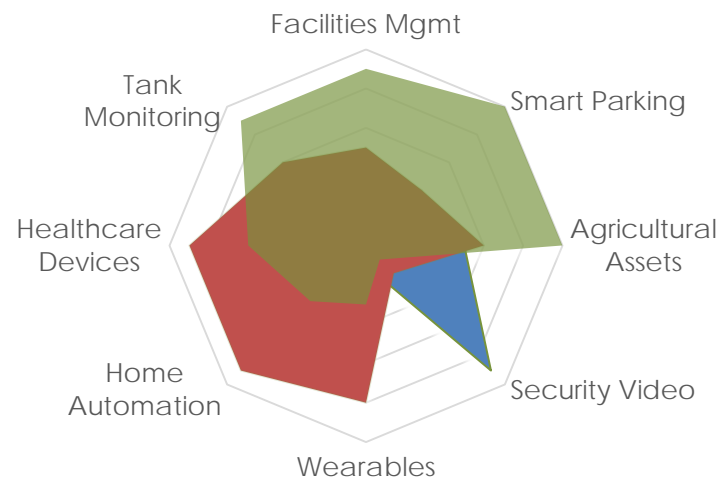
Smart Agriculture

- Environmental sensors

Building Management

IoT Use Cases

■ LTE ■ LTE Cat-M ■ LPWA



WaterBit: Unparalleled Performance



mDot



MultiTech
Conduit



Proprietary and Confidential

WaterBit: LoRa Enables Real Time Data



- Soil Moisture



- Flow



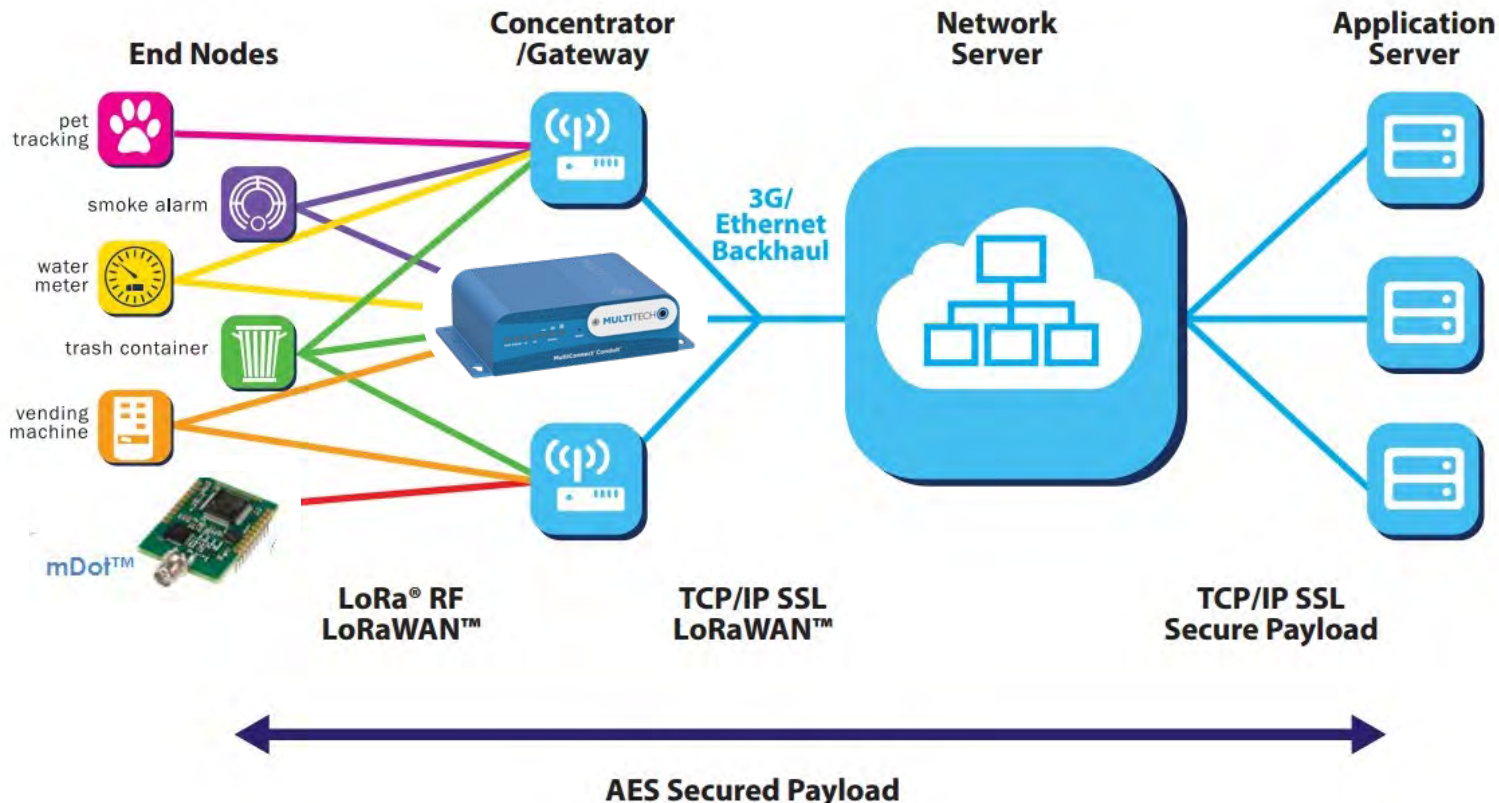
- EC



- Pressure

- Temp/Humidity

LoRaWAN™ Architecture



Types of LPWAN Networks

Public

Subscription Based
Just like a cell phone

Well established providers

Good for:

- Low CapEX
- Mobility
- Speed of deployment

Not good for:

- Low OpEx
- Network Management

Enterprise

Owner Operated
Mission Critical System

Well established companies

Good for:

- Low OpEx
- Data Protection
- Network Management

Not good for:

- Low CapEx
- Speed of deployment

Private

Simple Implementation
Easy to Deploy

Targeted data needs

Good for:

- Low OpEx
- Data Protection
- Speed of deployment

Not good for:

- Low CapEx
- Network Management

MultiConnect[®] mDot[™] & xDot[™]

LoRaWAN[™] 868MHz & 915MHz Certified Modules



mDot[™]

High Performance LoRaWAN SOM

- Cortex-M4 *STM32F411*
- 100MHz, 512K Flash, 128K RAM
- ARM mbed classic or OS v5.1 or AT Cmds
- XBee compatible
- Onboard SPI Flash

ARM mbed[™]



xDot[™]

Optimized for battery performance & cost

- Cortex-M3 *STM32L151*
- 32MHz, 256K Flash, 32K RAM
- ARM mbed OS v5.1 or AT Command driven
- Sub 2uAmp in deep sleep
- LGA Package 23.6x23.6mm
- Optional Secure Element

gemalto
security to be free

LoRa Alliance

MultiConnect[®] mDot[™] & xDot[™]

LoRaWAN[™] 868MHz & 915MHz Certified Modules

Product	Deep Sleep/Standby Mode	Sleep/Stop Mode	Average Current at Max Power
MultiConnect [®] xDot [™]	1.9uA	2.2uA	18mA
MultiConnect [®] mDot [™]	N/A	37uA	31mA



MultiConnect[®] Conduit[™]

LoRaWAN[™] Certified Modules



Industrial

- Improved coverage in buildings & production facilities
- Connect multiple assets LoRa and ...



External IP67 Rated

- Maximum range
- Designed for challenging external environments
- Lightning Arrestor

Programmable IoT Gateway + LoRa Gateway

- Azure, AWS, Exocite Murano, IBM Watson, HPE, OSI Soft Pi Systems, Telit deviceWise ...
- Actility, Lorient, Orbiwise, Senet, Stream, TheThingsNetwork ...

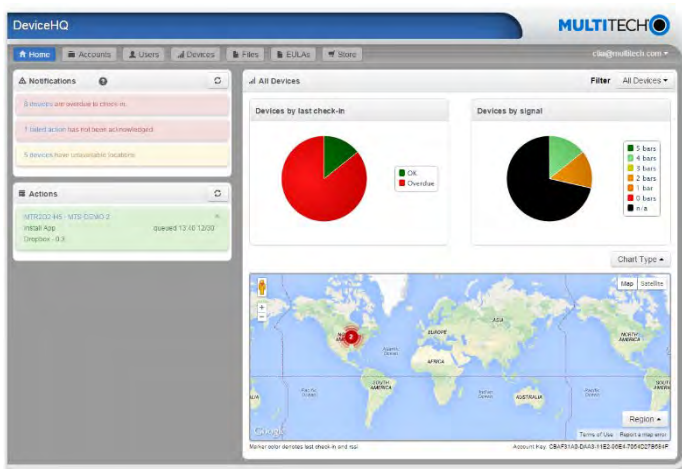
DeviceHQ[®]

What is DeviceHQ®?

DeviceHQ is a web based suite of tools to manage devices and custom applications for remotely deployed gateways.

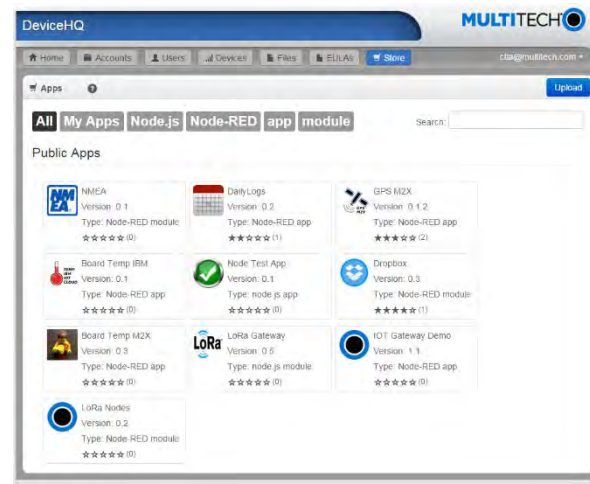
Device Management Tools

- Dashboards to quickly gauge health of devices
- Tools to remotely manage devices (custom configurations, firmware upgrades, etc.)
- Ability to provision new devices and simplify deployments



Application Store and Application Management

- Browse applications or build your own
- Deploy applications to remote devices
- Customize application settings for each device remotely



MultiTech DeviceHQ®

- New Features Coming soon

Remotely upgrade the firmware of a device

Remotely change the configuration/setup of a device

Monitor device status, statistics and notifications

- Act proactively - reduce downtime
- Aid in trouble shooting

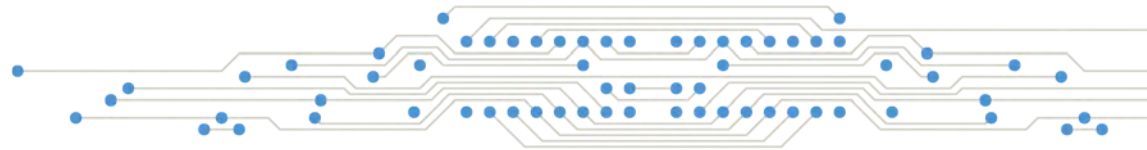
View location of GPS enabled devices

Lower total cost of ownership

- Reduced "truck rolls"

Built on an open set of APIs



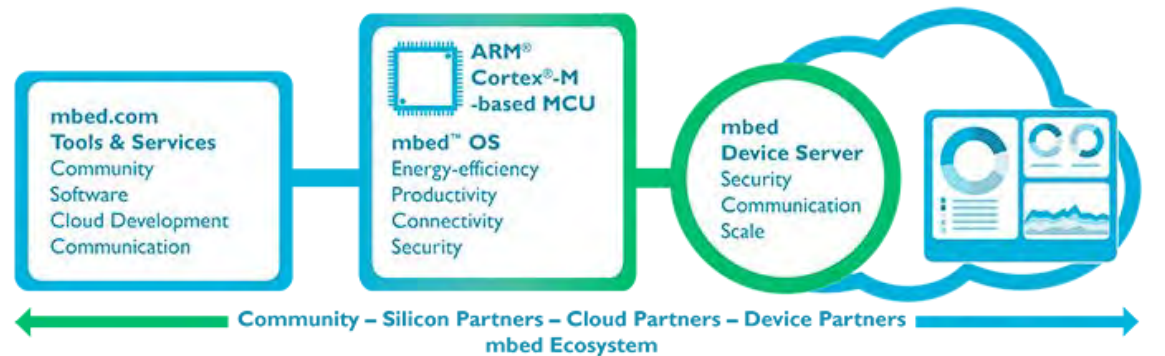


Distributed intelligence and development tools

TECHNOLOGY EVOLUTION

ARM[®] Announces “mbed” IoT Device Platform

Let's Connect Everything

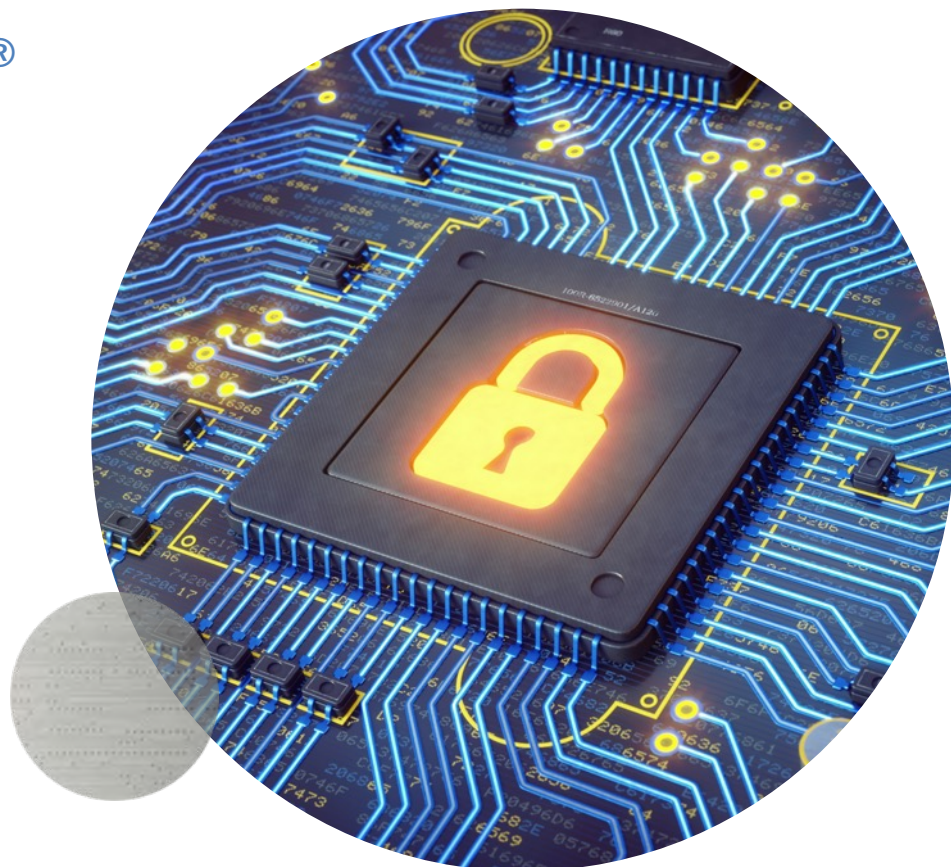


ARM[®] and its Partners share a disruptive vision where the creation and deployment of commercial, standards-based Internet of Things devices is possible at scale.

- MultiTech MultiConnect[®] mDot is the world's first mbed deployable product
- ARM[®] will be a co-marketing partner promoting our technology

Trusted IoT[®] Platform

- Asset Authentication
- Encrypted Data-in-Motion
- Tamper Resistant
- Software Updates
- Secure Boot
- Provisioning & Activation



MultiTech mbed Boards

Over 5,000 mbed compiles per week and growing

ARMmbed

Developer Resources

Partners

Hardware ▾

Documentation ▾

Code

Questions

Forum

Log In/Signup

Compiler

Boards

Showing 4 of 104 ([Show all](#))

 <p>MTS Dragonfly</p> <ul style="list-style-type: none"> • mbed deployable product • Cortex-M4 + Cellular Radio • FCC and Carrier Certified 	 <p>MultiTech mDot</p> <ul style="list-style-type: none"> • mbed deployable product • Cortex-M4 + LoRa Radio • FCC/CE certified, LoRaWAN r 	 <p>MultiTech mDot Box/EVB</p> <ul style="list-style-type: none"> • MTDOT LoRa module • Programming header • Monochrome LCD display 	 <p>MultiTech xDot</p> <ul style="list-style-type: none"> • LoRaWAN 1.0,1 Compliant • Cortex-M3 32MHz, 256kB fla • ZuA current draw in low pow
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- mbed OS 5.x pre-integrated
- MultiTech custom Library support
- Regulatory and Industry certified as end platforms
- Available & Mass Deployable today

MultiTech Key Vertical Markets



Agriculture

Agriculture

- Animal Husbandry
- Crop Production
- Water & Wastewater Management
- Remote Monitoring
- Security



Energy

Energy

- Energy Monitoring
- Smart Grid
- Renewables/Wind
- Car Charging Stations
- Utility Controls
- Environmental Monitoring



Healthcare

Healthcare

- Home & Mobile
- Tele-Monitoring
- Disease Management
- Assisted Living



Financial

Finance

- ATM
- POS
- Temporary Kiosks
- Vending Machines
- Cash Registers

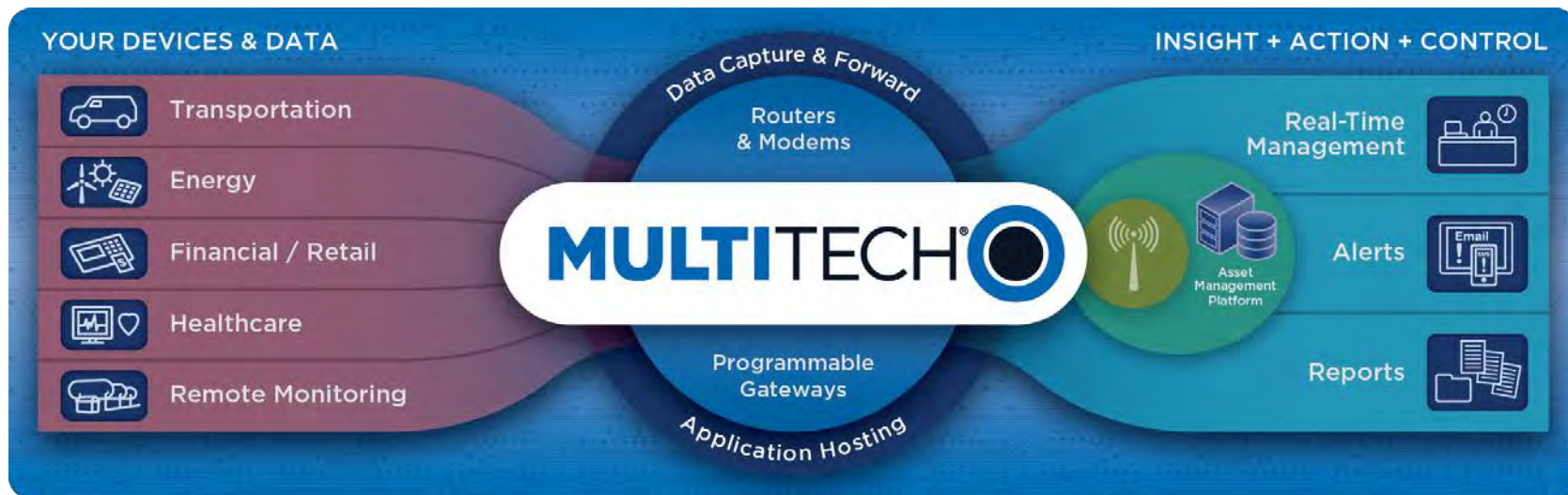


Monitoring

Monitoring

- Asset Monitoring
- Security & Surveillance
- Remote Service Alarming
- Smart Robotics
- Smart Metering

MultiTech designs, develops and manufactures communications equipment for the industrial Internet of Things – Connecting physical assets to business processes to deliver enhanced value



The Preferred Provider for Innovative Connected Technology Destined to Transform our World

Thank you!

Multi-Tech Systems, Inc.

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