Greener and Smarter

A New World with ZigBee Technology

Marvell Semiconductor

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ZigBee Technology – Target Markets and Applications

ZigBee is a low power, low rate, low cost, secure and reliable wireless networking technology that enables applications in:

- Smart energy – home energy monitoring and saving
- Lighting control – home, building, parking structure, street
- Home automation – smart homes
- TV remote control (RF4CE) – smart remote
- Health care – health and fitness monitoring
- Telecom services – value added services
- Building automation – efficient commercial spacing
- Retail service – smart shopping and store management
- Input Devices – Easy to use touch pads, mice, keyboards, wands

Sensors are necessary to enable most of these applications

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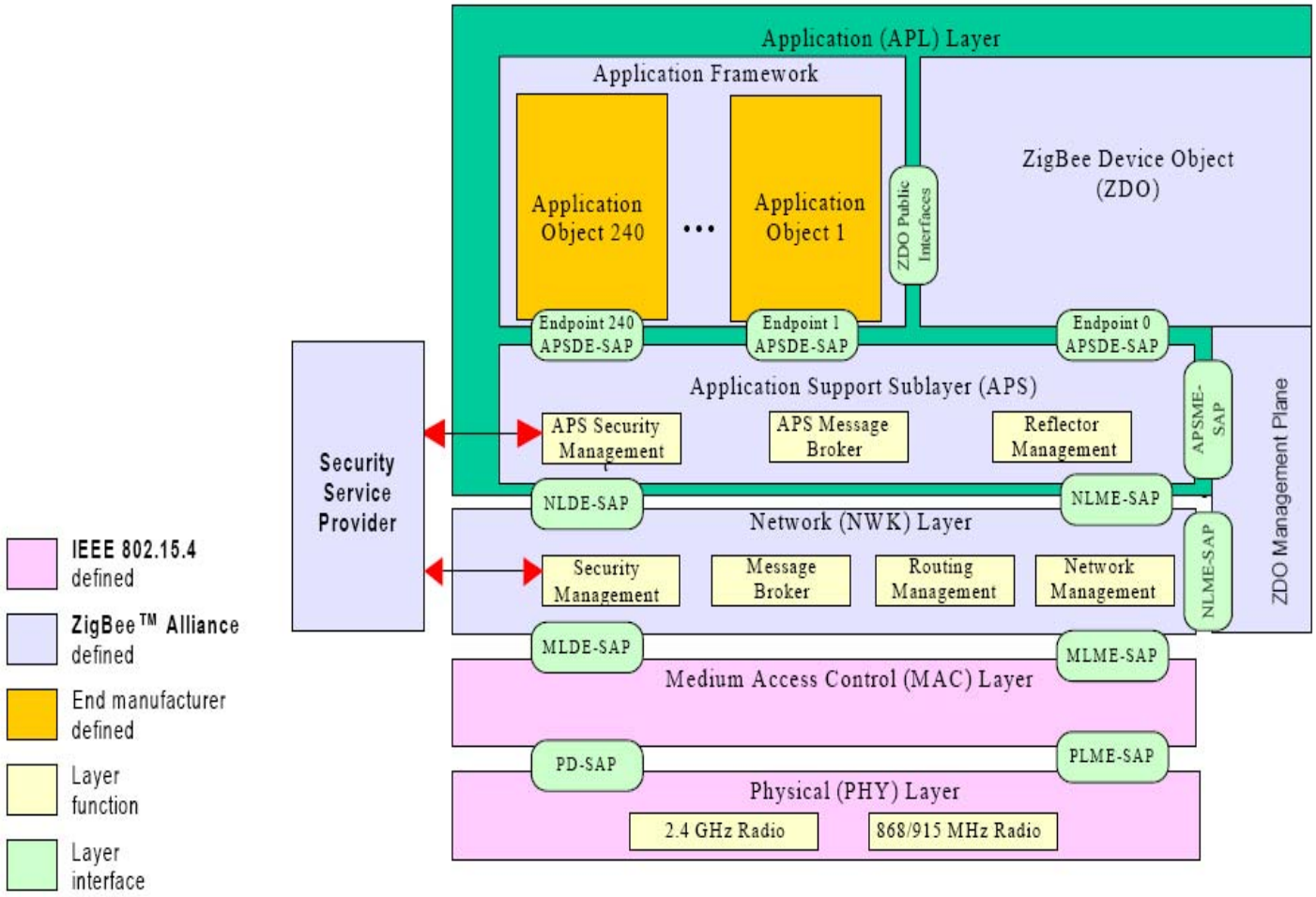
ZigBee Technology – Software Stack and APP Layer



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IEEE802.15.4 Physical Layer

Channelization

- 16 in 2.4 GHz ISM band (worldwide), 5MHz spacing
- 10 in 915 MHz ISM band (North America) (2 MHz channel spacing)
- 1 channel in 868 MHz band (Europe)

Table 1—Frequency bands and data rates

PHY (MHz)	Frequency band (MHz)	Spreading parameters		Data parameters		
		Chip rate (kchip/s)	Modulation	Bit rate (kb/s)	Symbol rate (ksymbol/s)	Symbols
868/915	868–868.6	300	BPSK	20	20	Binary
	902–928	600	BPSK	40	40	Binary
2450	2400–2483.5	2000	O-QPSK	250	62.5	16-ary Orthogonal

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IEEE802.15.4 Physical Layer

- General Packet Format

Octets: 4	1	1		variable
Preamble	SFD	Frame length (7 bits)	Reserved (1 bit)	PSDU
SHR		PHR		PHY payload

- Maximum PSDU size is 127 bytes

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IEEE802.15.4 Physical Layer

- **A comparison**

	802.15.4	Bluetooth	WiFi (11b)
Bit Rate (Mbps)	0.25	1 (GFSK)	1 (BPSK)
Sensitivity (dBm)	-105	-91	-100
TX Power (dBm)	10 (20 with FEM)	10	20
Link Budget	115 (125 with FEM)	101	120
RX power Active (mA)	20	25	80

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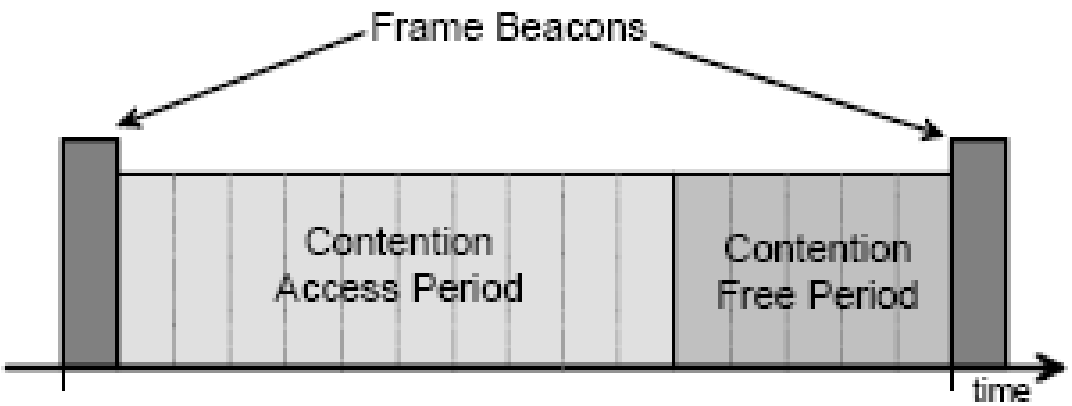
IEEE802.15.4 MAC Layer

- CSMA-CA
- Devices "poll" coordinator for data in "unslotted" mode
- Superframe



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IEEE802.15.4 MAC Layer

- **A comparison**

	802.15.4	Bluetooth	WiFi
Media Access	CSMA-CA	Master-Slave (TDMA)	CSMA-CA
Topology	Peer-to-peer Star, Cluster	Up to 7 slaves	Star Peer-to-peer

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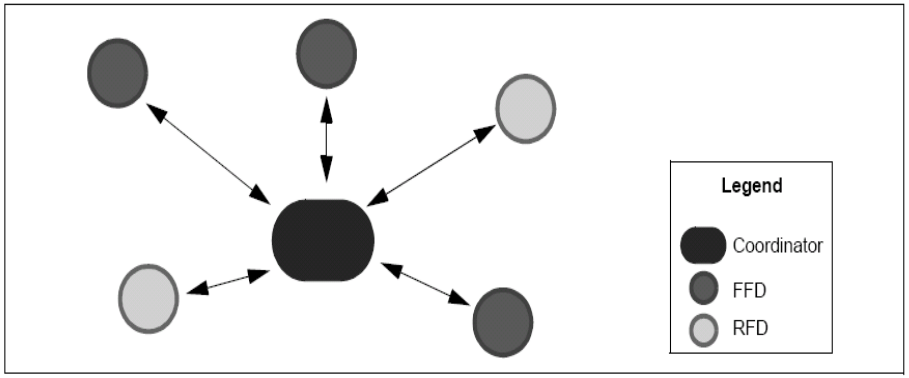
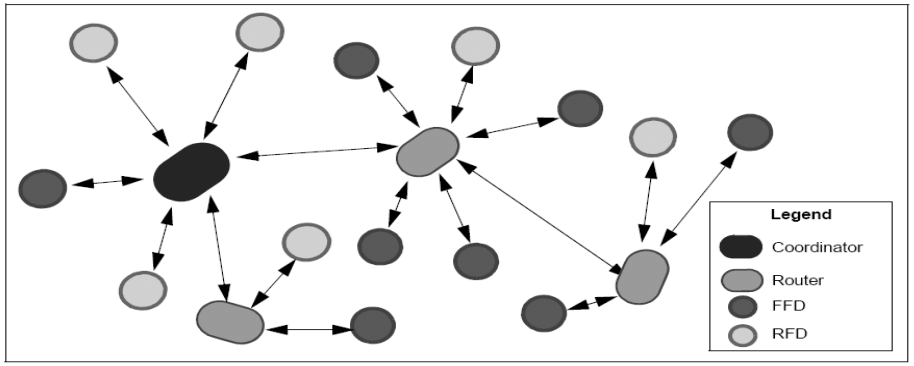
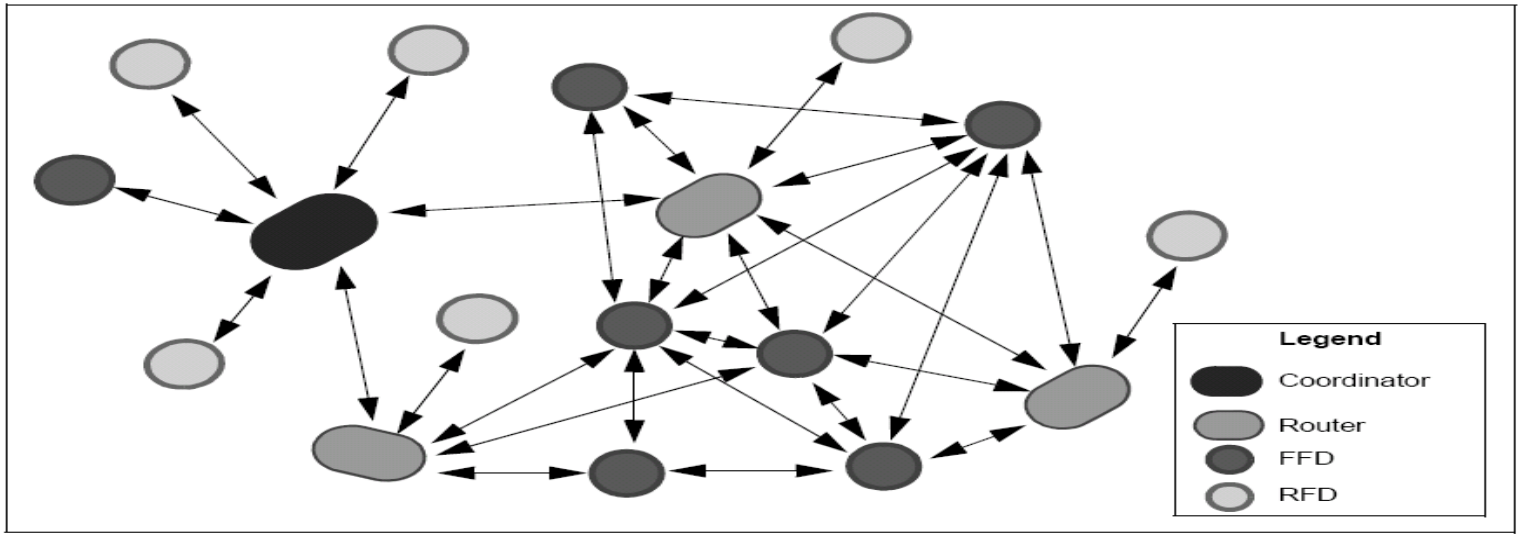
Zigbee Network Layer



Star



Cluster



Mesh

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Zigbee Application Layer – Application Profiles

- Attribute – a pre-defined unique identifier, to represent
  - switch state (on/off)
  - meter reading (10 Watts),etc
- Cluster – a group of attributes
- Application Profile – a single or a group of clusters
  - defines an application space
  - e.g. Home Automation

Devices are modeled as "application objects", communicating through exchange of attributes

- SW stack is simple
- Packet is short (127 bytes maximum)

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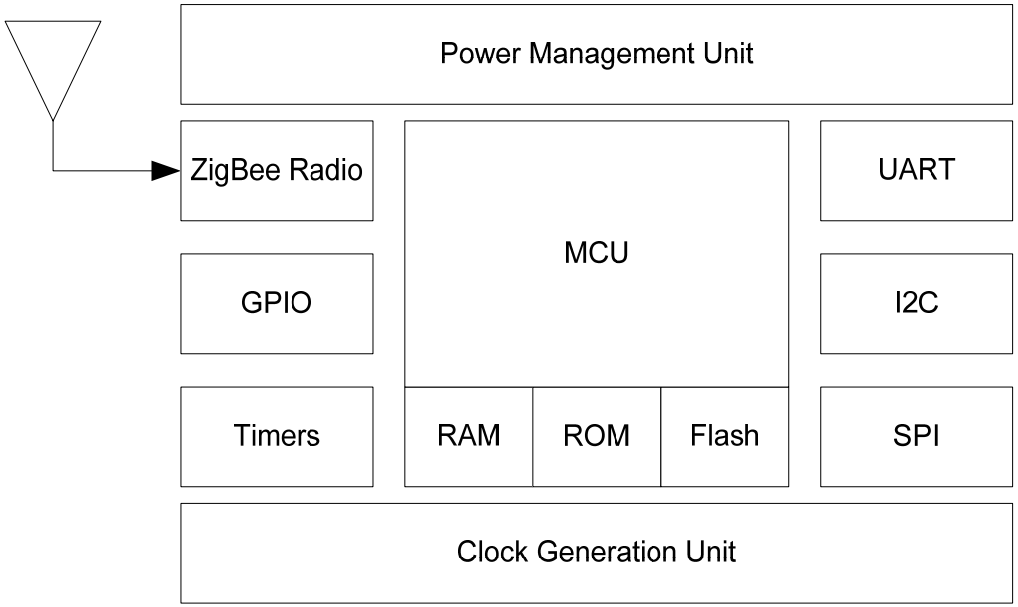
Zigbee System-on-Chip

- CPU
  - 8051, ARM Cortex M0/M3
- IEEE802.15.4 Transceiver
- Memory
  - ROM, RAM, Flash
- Peripherals
  - ADC, DAC, PWM
- I/O
  - UART, I2C, SPI, GPIOs
- Power management
  - Power islands
  - LDO, DC-DC
  - Power gating, clock gating



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Target Markets and Applications - Revisit

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Zigbee Technology – still evolving

- Zigbee IP stack (IPv6)
- SEP2.0 (based on IPv6)
- Zigbee Gateway
- Application Profiles

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Zigbee Technology – What's the Killer App?

- Smart metering
  - More than 30 million installed in North America
  - How about going into home?
- LED lighting control
  - Dimming, color mixing need microcontroller
  - Control signals need send from dimmer switch to lights
- Remote control
  - RF4CE for TV remote control

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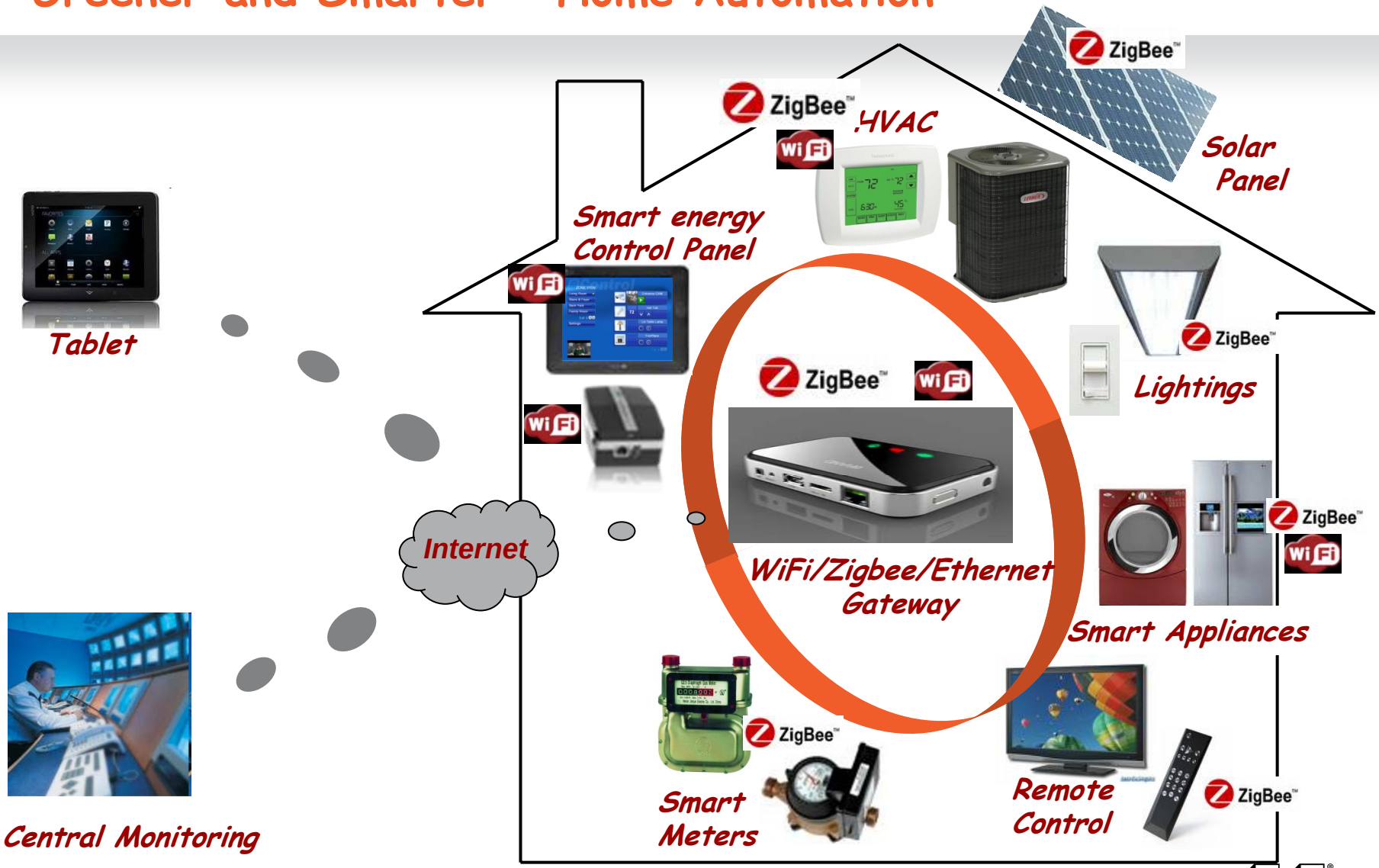
Greener and Smarter – Home Automation



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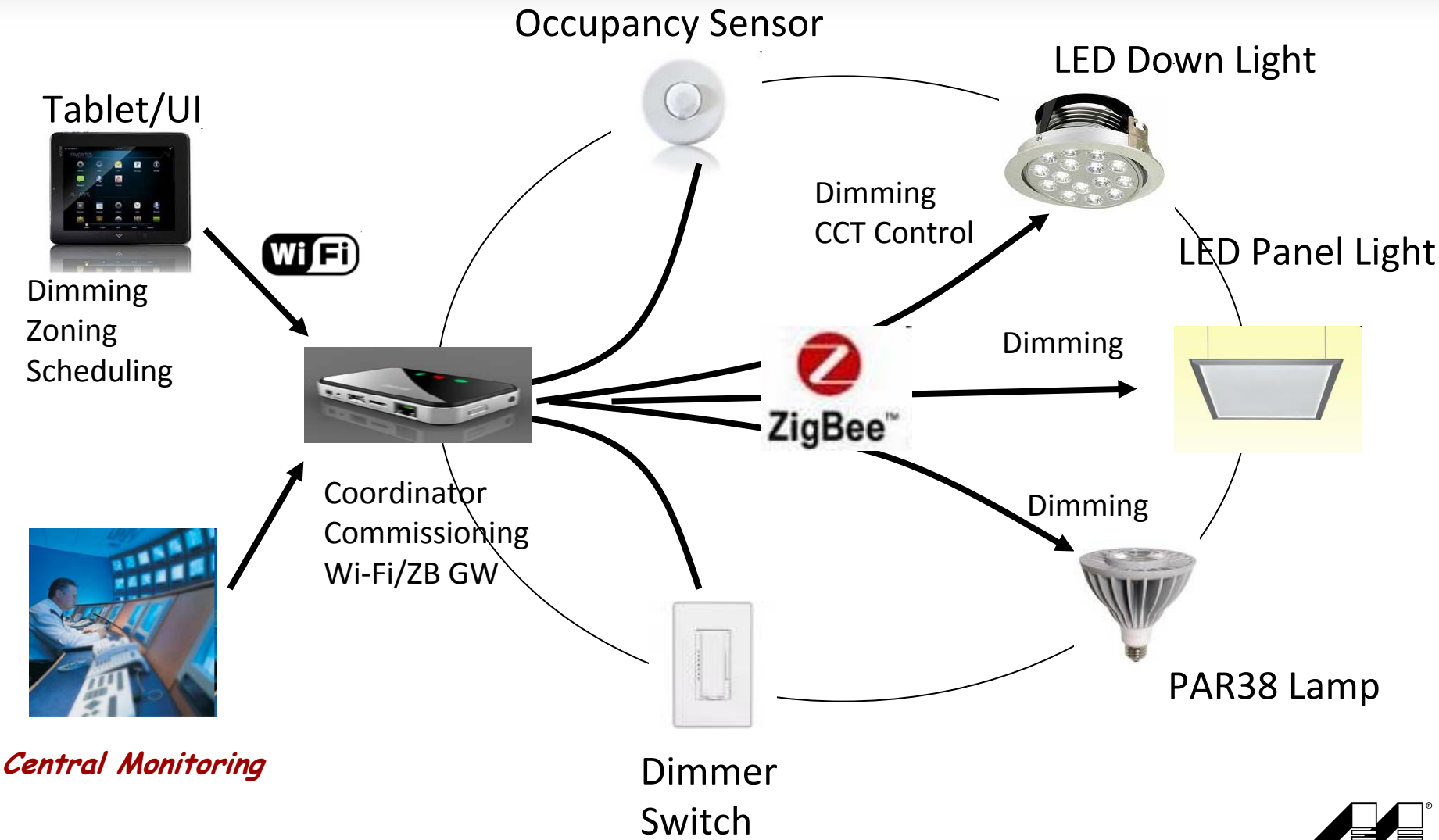
Greener and Smarter – LED Lighting Solution



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Thank You!

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