



WELCOME

Design with Z-Wave to Extend
Your Wireless Range 1 mile

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Z-Wave Long Range (LR)

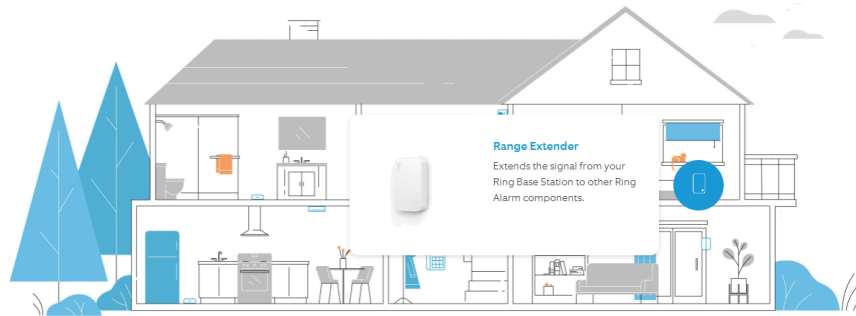
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Why Z-Wave LR

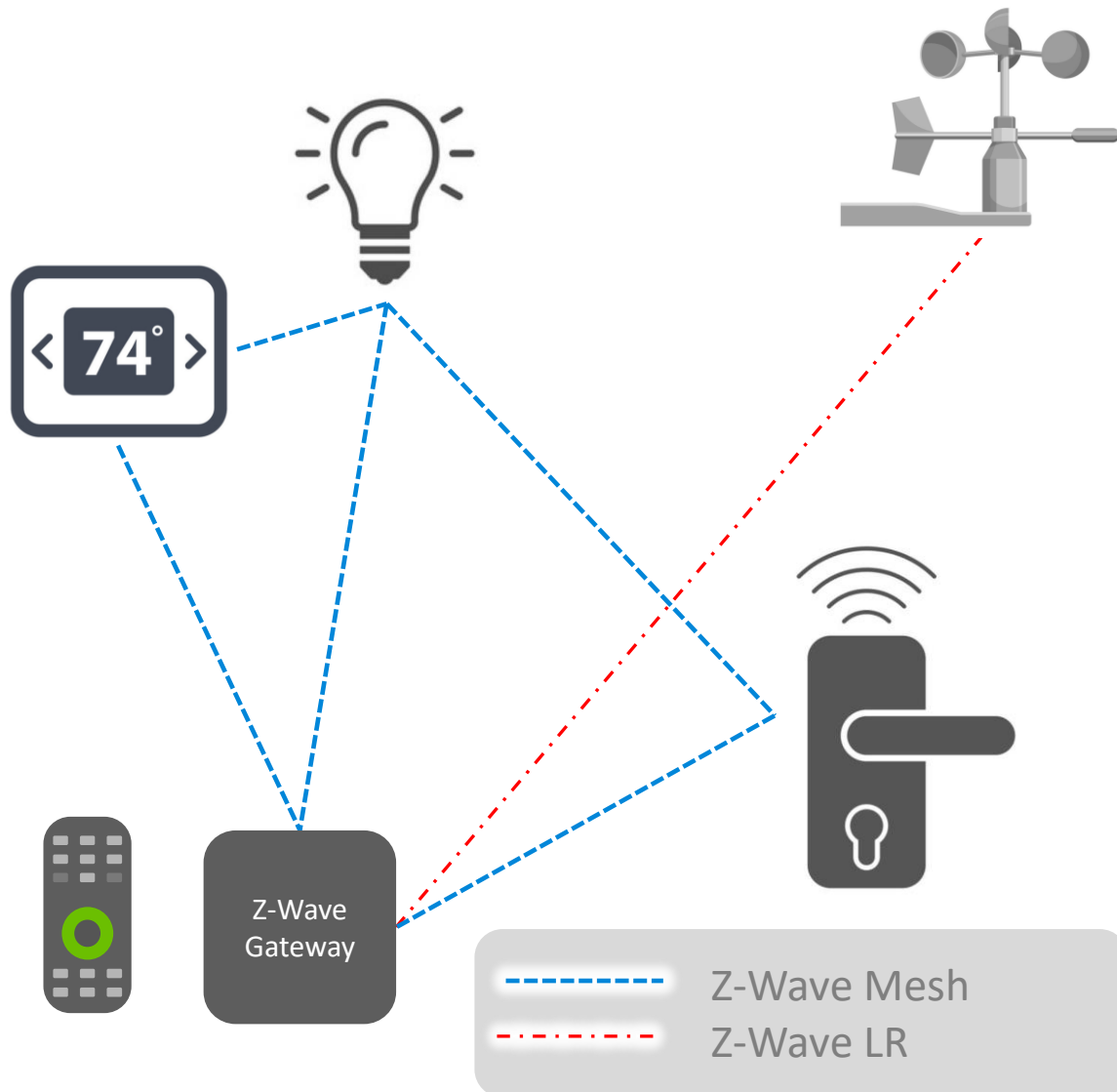
- Market Requirement
 - Full Home and yard Coverage; Reduced system cost; More node capacity
 - Today in USA Z-Wave max TX power is -1 dBm and customers end up shipping a range extender



- Market expansion into Sensor market with UL certification for security systems
 - Without battery powered mesh nodes
- Strategic Rational
 - Z-Wave strategy to strengthen Smart Home market & Expand to adjacent markets

Z-Wave Long Range strengthens Z-Waves position in the smarthome and expand into adjacent markets

Z-Wave LR In A Nutshell



New LR channel in Z-Wave
DSSS-OQPSK PHY ; 100 kbps data rate
Up to +30 dBm TX power [FCC 15.247]

Highly scalable to over 2000 nodes
12-bit address space
STAR network topology

Optimized for longer battery life
Dynamic power control to optimize battery life
Coin cell operation

New Z-Wave LR Certification
Mandatory requirement for future GWs
Incremental to current Z-Wave Plus v2

Z-Wave LR – Key Benefits

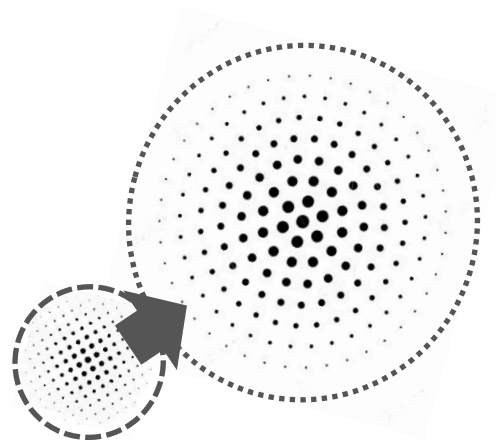
Coverage



1+mi Range

- Up to 1 Mile Outdoor Line Of Sight @ +14 dBm

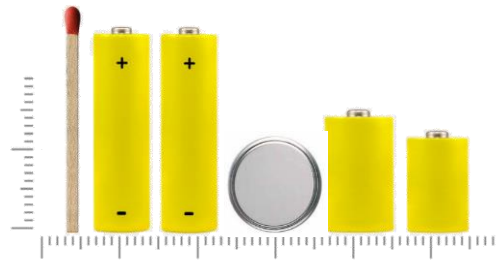
Scalability



1000s of Nodes

- Over 2,000 nodes enabling use cases in MDU and Hospitality

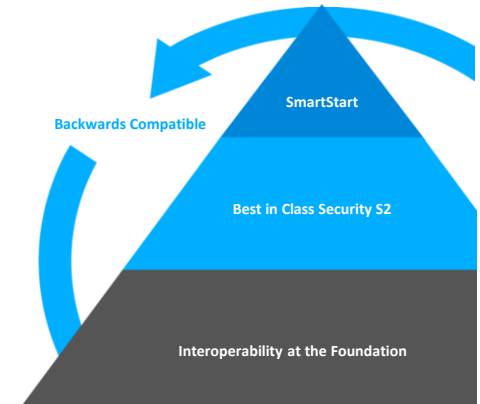
Coin Cell Operation



10 Years

- Up to 10 years for typical sensor use cases on a coin cell battery

Simple, Secure & Interoperable



Backward Compatible

- S2 Security, SmartStart & OTA

Z-Wave LR – Target Markets and Use Cases

Smart Home



Multi Dwelling Units



Hospitality



Z-Wave LR is available in the existing 700 series

Z-WAVE LR HARDWARE



- ZGM130s
- EFR32ZG14
- Updated Radio Boards

Z-WAVE LR SOFTWARE & TOOLS



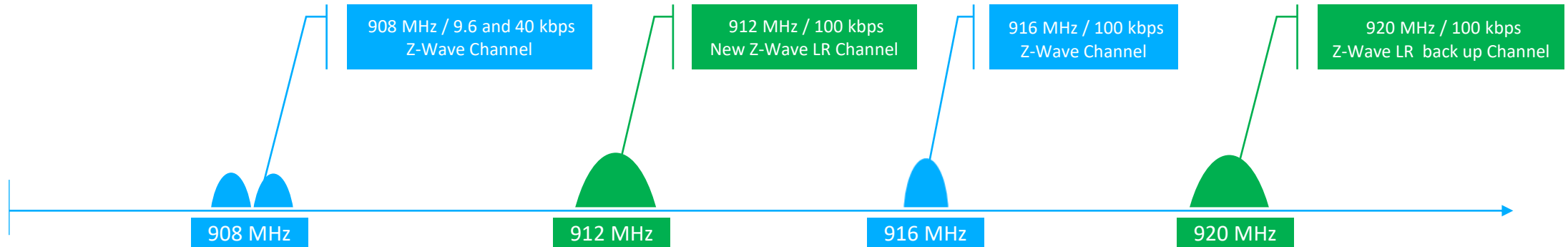
- PC Controller
- Z-Wave Ziffer, Network Analyzer
- RAIL Test

Z-WAVE LR CERTIFICATION



- New Z-Wave LR certification
- Incremental to Z-Wave Plus V2
- App level certification unchanged

Z-Wave LR PHY and Channel details

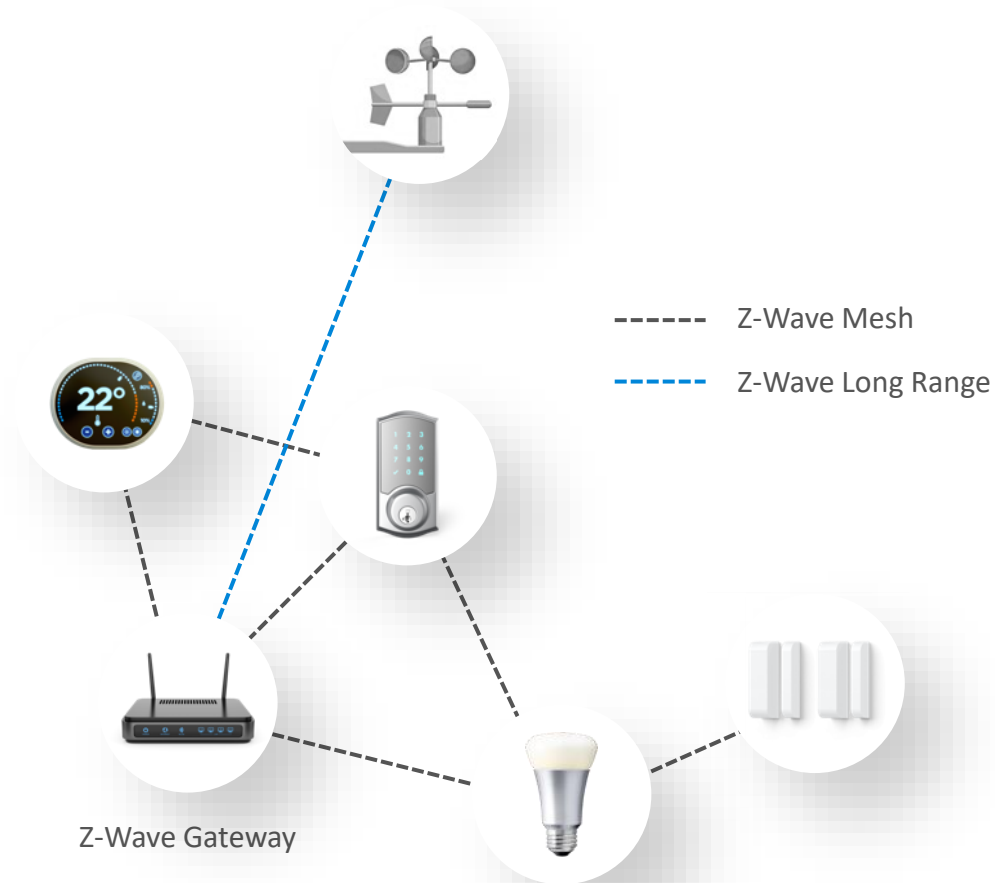


PHY Details

Comment

Modulation	DSSS-OQPSK	Higher output power and better interference immunity
Frequency	912 MHz or 920 MHz	Channel Agility, Better network and blocker performance
Maximum Data Rate	100 kbps	
Maximum output power	+14 dBm	700 series support 14dBm Specification will allow up to +30 dBm (FCC limit)
DSSS-OQPSK Sensitivity Gain	2 dB	For 700 series
Total Link Budget Improvement	17 dB	2 + 15 [-1 dBm to +14 dBm]

Z-Wave Long Range Comparison



Mesh Network
Topology

100 kbps
data rate

+0/14 dBm TX power

400m
Range (4 hops)

Coverage for the smart home
and end of yard

200+ nodes
scalable

8-bit address space



Star Network
Topology

100 kbps
data rate

Up to +30 dBm TX power

~1-Mile
Range

Coverage for the whole
home, yard and beyond
without a repeater

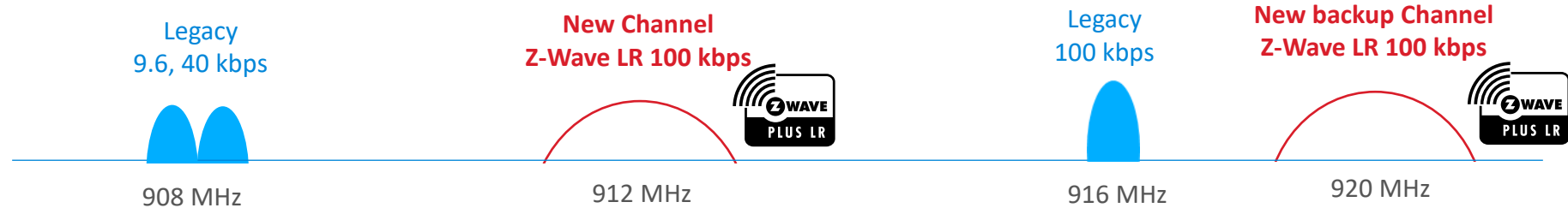
4000 nodes
highly scalable

12-bit address space

Comparing Z-Wave MESH and Z-Wave LR

	Z-Wave	Z-Wave LR
PHY Modulation	FSK/GFSK	DSSS OQPSK
PHY Speed	9.6/40/100kbps	100 kbps
PHY Frequency in US	908.42/916MHz	912/920MHz
PHY max output power [FCC Limit]	-1 dBm	Spec will allow up to +30 dBm
PHY output power control	No	Yes
MAC LBT	Yes	Same as Z-Wave
MAC random back off	Yes	Same as Z-Wave
MAC frames	Single, multi, broadcast, beams (1000ms)	Single, multi, broadcast, beams (100ms fragmented)
Mac address space	32-bit Home Id, 8-bit Node Id	32-bit Home Id, 12-bit Node Id
NWK	Mesh	Star
Routing	Supported	Not supported
Inclusion	NWI and Inclusion controller support	Direct inclusion only
SmartStart	QR code	Same as Z-Wave
Security	S0, S2 non-Auth, S2 auth, S2 Access	S2 auth, S2 Access
Application framework	Supported	Same as Z-Wave
Sample Apps	Supported	Same as Z-Wave
IMA	Supported	Same as Z-Wave
EM4 Sensor power consumption		Same as Z-Wave for -1dBm output
EM2 FLIRS node power consumption		Same as Z-Wave for -1dBm output
End device code size		32Kbyte

Scanning of 4 channels - for Gateways

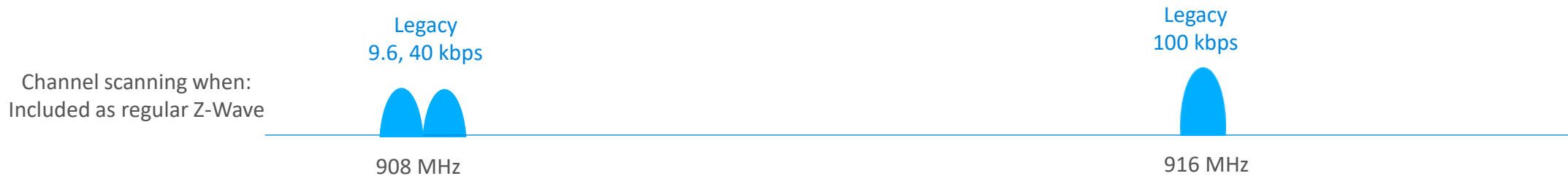


4 scans for 4 channels

9.6 kbps	Scan of 9.6 kbps channel
40 kbps	Scan of 40 kbps channel
100 kbps "legacy"	Scan of "legacy" 100 kbps channel
100 kbps LR	Scan of 100 kbps channels (Either 912MHz or 920MHz – dictated by the Application)

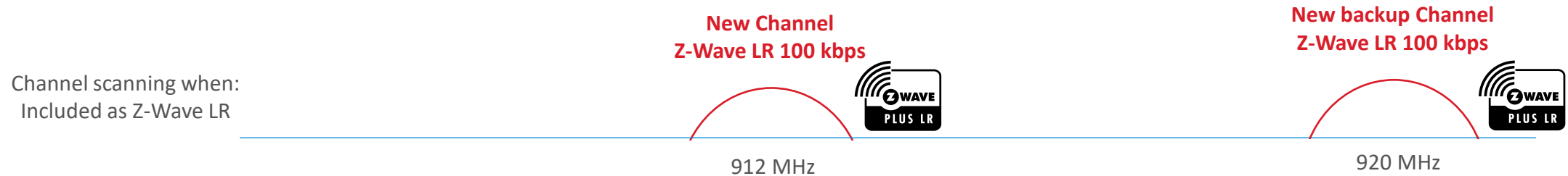
The same scanning pattern applies to non-included End Devices. After End device inclusion, the End device will use either the regular Z-Wave channels or the Z-Wave LR channels.

Handling of Z-Wave MESH vs LR – for End Devices



3 scans for 3 channels

9.6 kbps	Scanning of 9.6 kbps channel
40 kbps	Scanning of 40 kbps channel
100 kbps legacy	Scanning of 100 kbps channel



2 scans for 2 channels

100 kbps LR	Scanning of LR 100 kbps 912MHz channel
100 kbps LR	Scanning of LR 100 kbps 920MHz channel

Z-Wave LR frame

7	6	5	4	3	2	1	0
Home ID (MSB)							
Home ID							
Home ID							
Home ID (LSB)							
Source Node ID (11-4)							
Source Node ID (3-0)				Destination Node ID (11-8)			
Destination Node ID (7-0)							
Length							
Ack	Extended	Reserved			Header Type		
Sequence Number							
Noise Floor							
Tx Power							
<i>Extension 1 (Reserved)</i>			<i>Discard unknown</i>		<i>Extension Length</i>		
<i>Extension n (Reserved)</i>							
Data byte 0-x							
..							
..							
Checksum MSB							
Checksum LSB							

Home ID (32 bits)

The Home ID of the system where this frame should be received.

Source Node ID (12 bits)

The Node ID of the transmitting device.

Node ID	Purpose
000h	Un-initialized slave node
001h – 0E8	Regular Z-Wave node
100h – FA0h	Z-Wave LR Node ID
FA1h - FFEh	Reserved
FFFh	Illegal value

Destination Node ID (12 bits)

The Node ID of the transmitting device.

Node ID	Purpose
000h	Un-initialized slave node
001h – 0E8	Regular Z-Wave node
100h – FA0h	Z-Wave LR Node ID
FFFh	Broadcast

HeaderType (3 bits)

Type of frame (decides the contents of the rest of the frame)

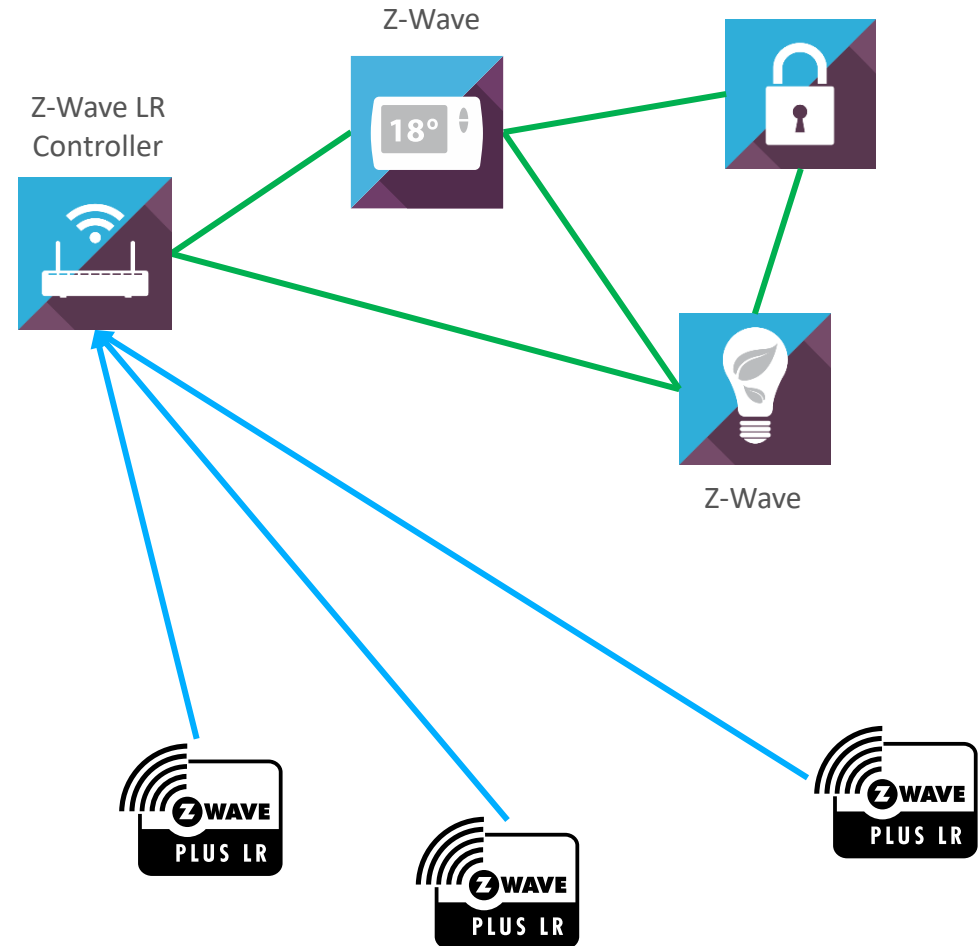
Currently defined header types are:

Header Type	Frame
1h	Singlecast frame
2h	Reserved
3h	Acknowledge
4h - 7h	Reserved

Backwards Compatibility (Network)

Network layer

- Z-Wave and Z-Wave LR nodes can co-exist in the same network
- Controller will choose to include End devices as either Z-Wave or Z-Wave LR at network inclusion time
- Z-Wave LR controller can communicate with both Z-Wave and Z-Wave LR nodes
- Z-Wave and Z-Wave LR nodes can only communicate via the central controller



Backwards Compatibility (Network)

OTA firmware update of existing 700 series based nodes is possible BUT

- Radio board filter must support LR - +14dbm often has harmonics
- Z-Wave nodes will not become LR nodes after OTA

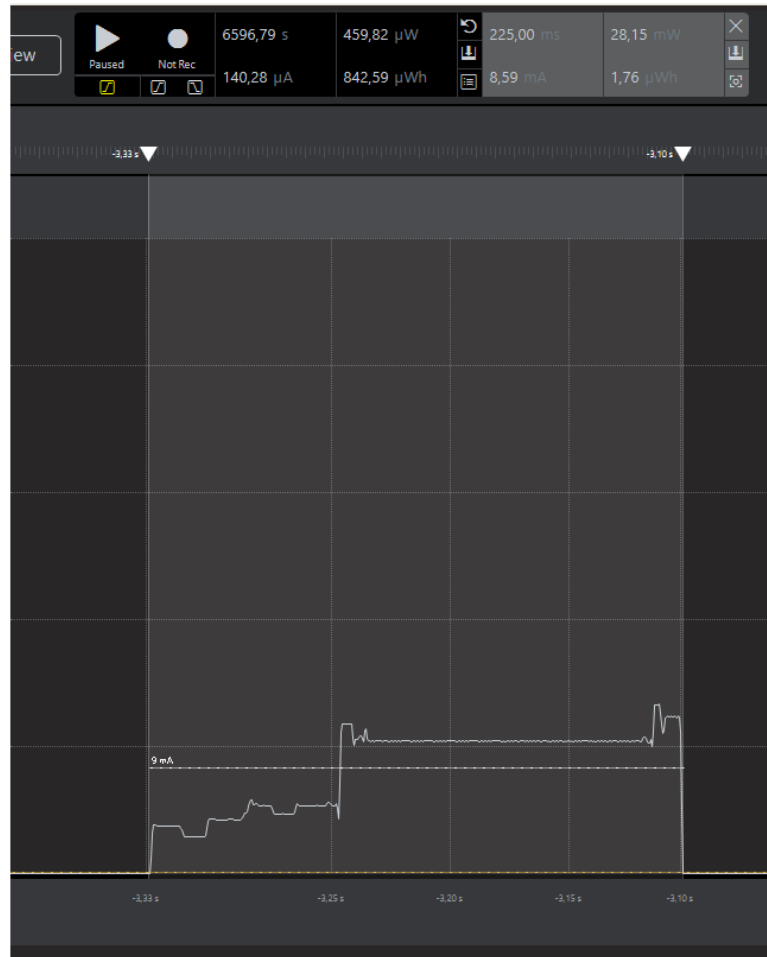
How to change a regular Z-Wave end device to a Long Range end device

1. Do an OTA update to a firmware version supporting LR
2. Exclude the node from the network
3. Include the node again (with smart start) as a Long Range node

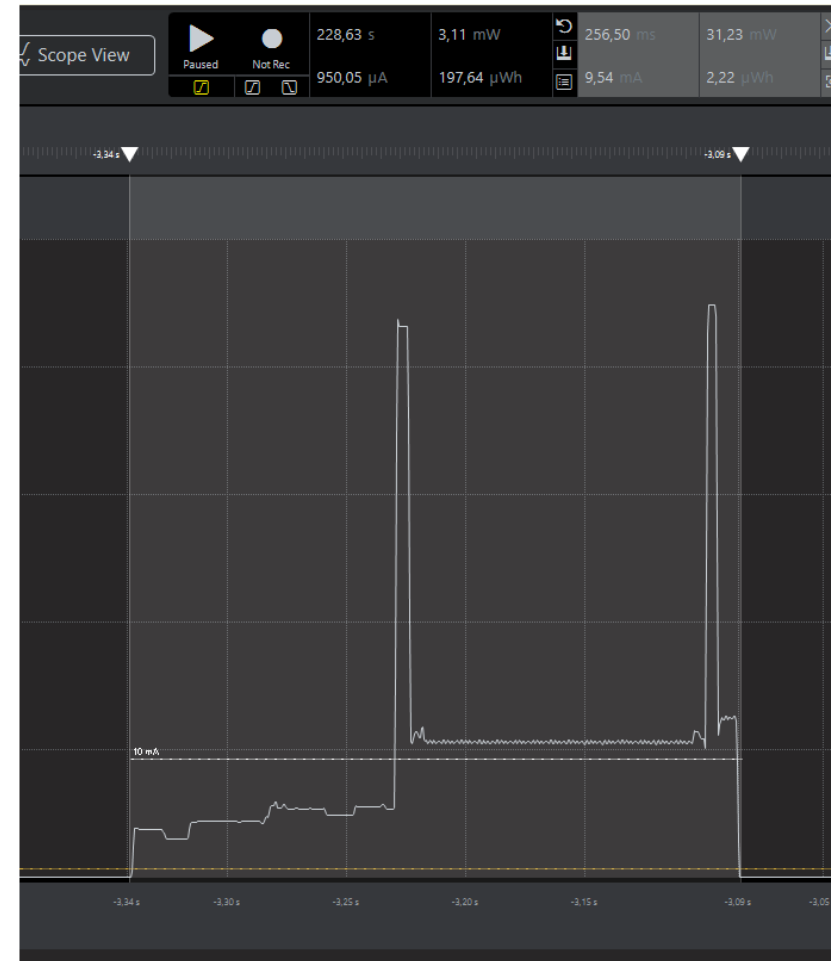
Hub decides to add the device as LR or regular Z-Wave

Z-Wave long range Power Consumption

Z-Wave (-1dBm)

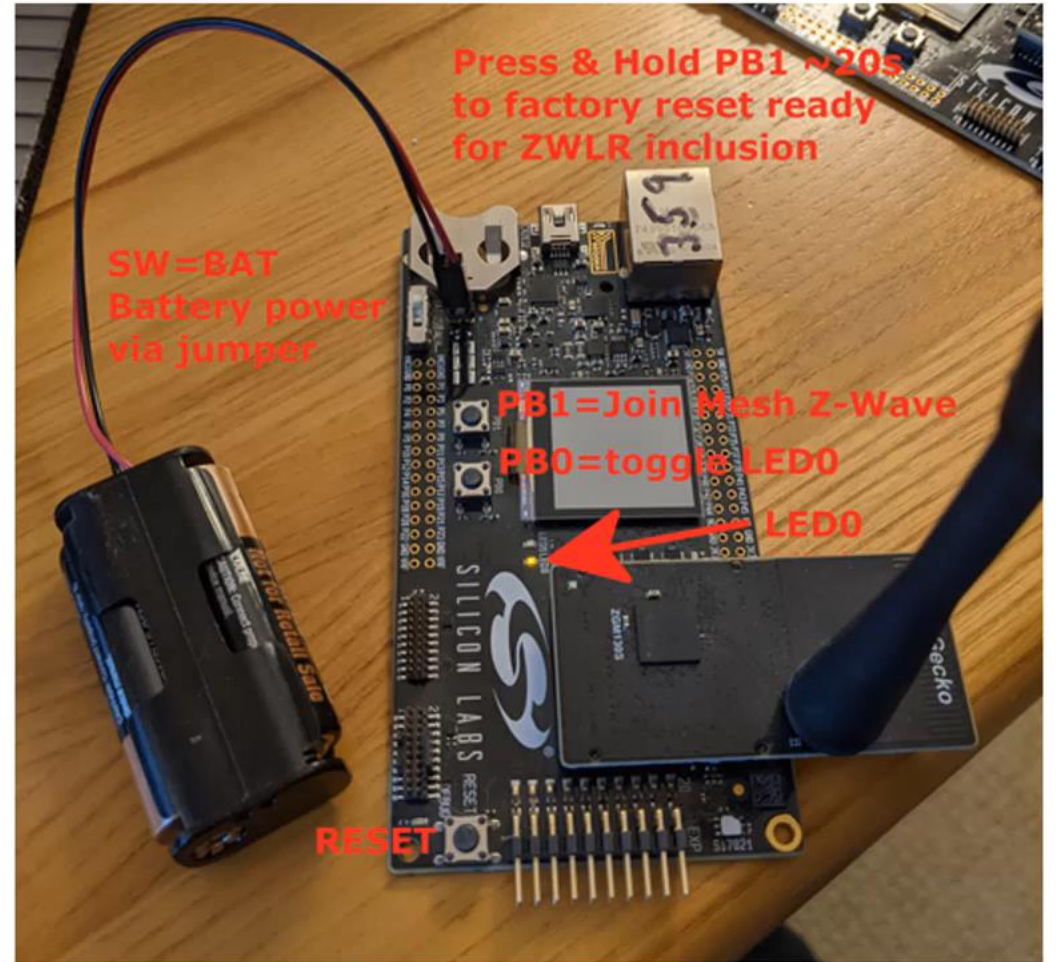


Z-Wave Long Range (+14dBm)



Z-Wave ERTT – RF Range test – Lets go outside!

- Click on Run Forever
- Check on Start
- Observe LED0 blink on/off
- Connect a battery to the WSTK
 - New Coin cell can work for a little while but 2AAs are better
- Switch power from AEM to BAT
- Walk outside and see how far you can go!
 - Stop when LED stops blinking
 - Try different orientations or walk a little further
 - Hold board by the enet connector, away from antenna
- Should reach your mailbox & down the street
 - Blinking requires 2-way secure connectivity
- Compare to Normal Z-Wave
 - uncheck Long Range when joining via SmartStart



What's Next?

- Visit resources on www.silabs.com/z-wave
- Evaluate with the [Z-Wave Long Range 700 Starter Kit](#) (SLWSTK6050B)
- Review Z-Wave Long Range Hands-on Lab
 - www.silabs.com/support/training/z-wave-long-range-intro-curriculum
- Attend the next Tech Talk
- Complete the survey at the conclusion of today's Tech Talk



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