SCTE ISBE CABLE-TEC EXPO '16

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Optimizing the Home: MoCA and Wi-Fi

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SCTE

SCTE Society of Cable Telecommunications Engineers

ISBE International Society of Broadband Experts

#CableTecExpo

Essential Knowledge for Cable Professionals™

Optimizing the home: MoCA and WiFi

Overview

- Today's home network design is driven by increased coverage requirements and significantly higher capacity demands, which means:
  - customers are no longer satisfied with limited wireless connectivity throughout a home and less than satisfactory download speeds. .
- By infusing a Multi-Media over Coax Aliance(MoCA) backbone with 802.11ac Wi-Fi access points, Gigabit home services will soon be a widespread reality in residential broadband services.

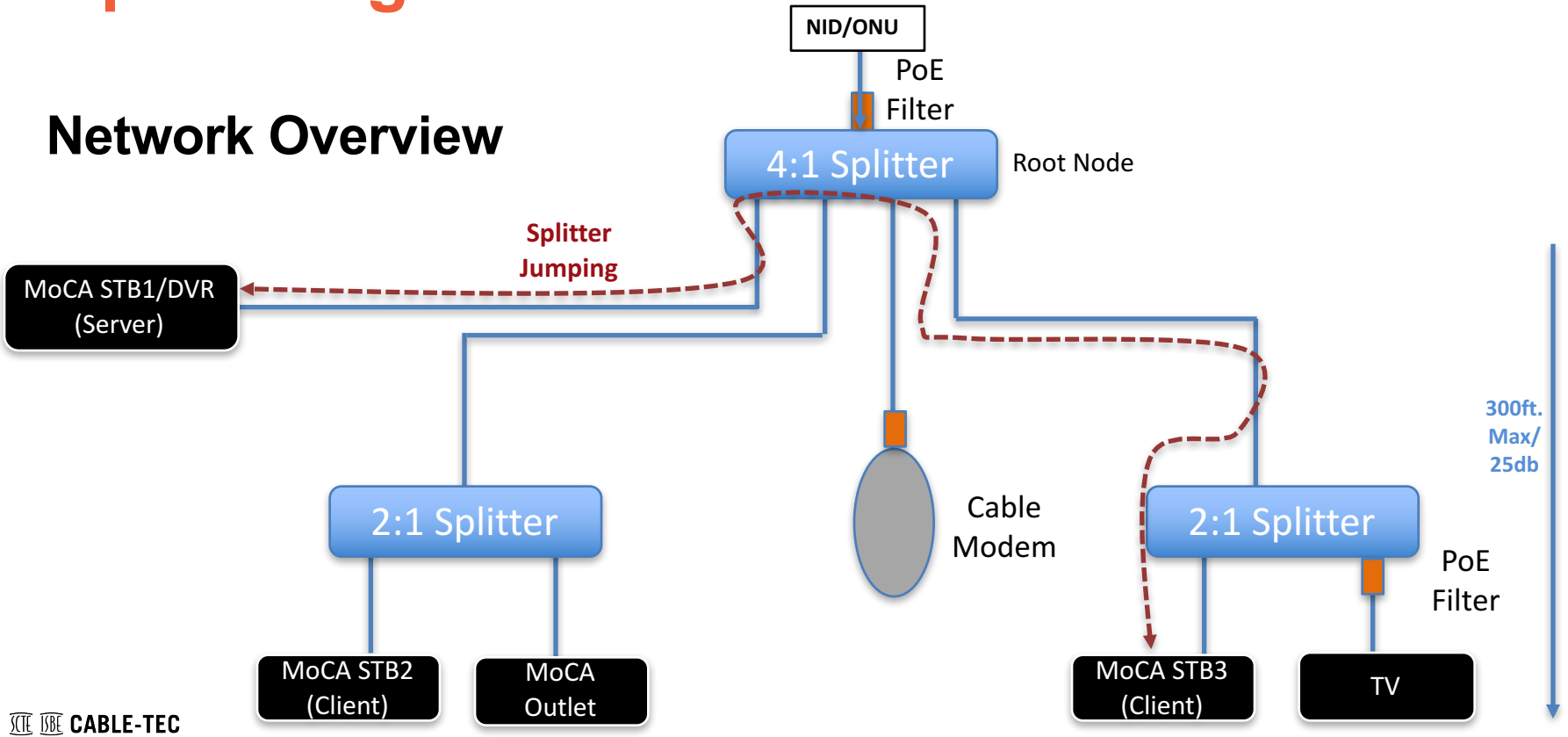
Optimizing the home: MoCA and WiFi

Overview

- Elevating broadband services to this level is absolutely necessary since customers are prone to targeting the service provider for problems with their broadband experience.
  - When in reality, it's quite probable that the customer's home network is what is contributing to the problem

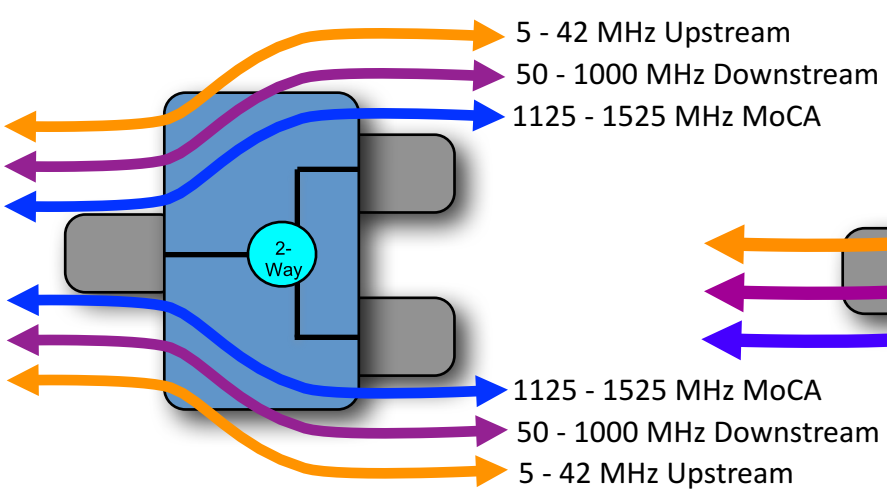
Optimizing the home: MoCA and WiFi

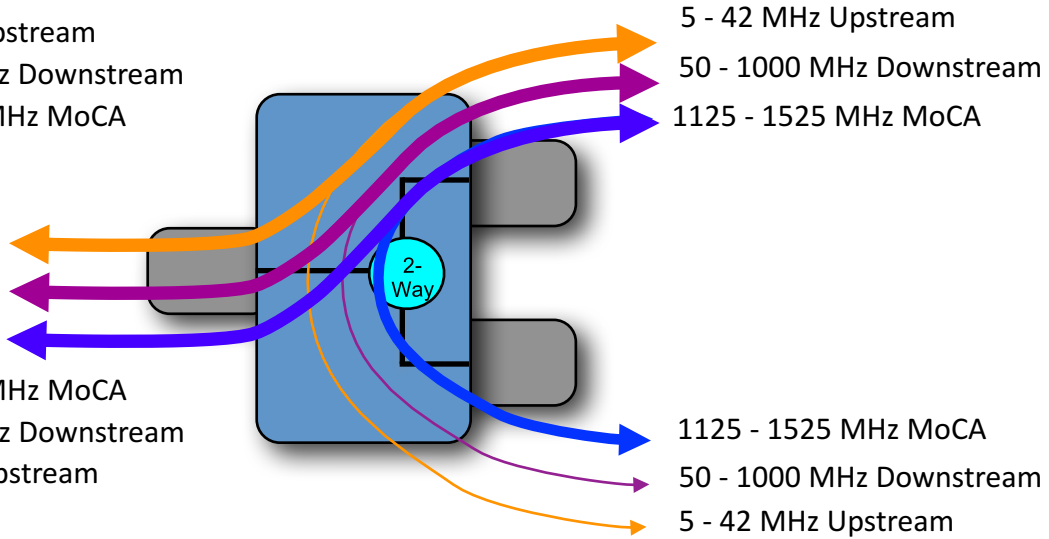
Network Overview



Optimizing the home: MoCA and WiFi

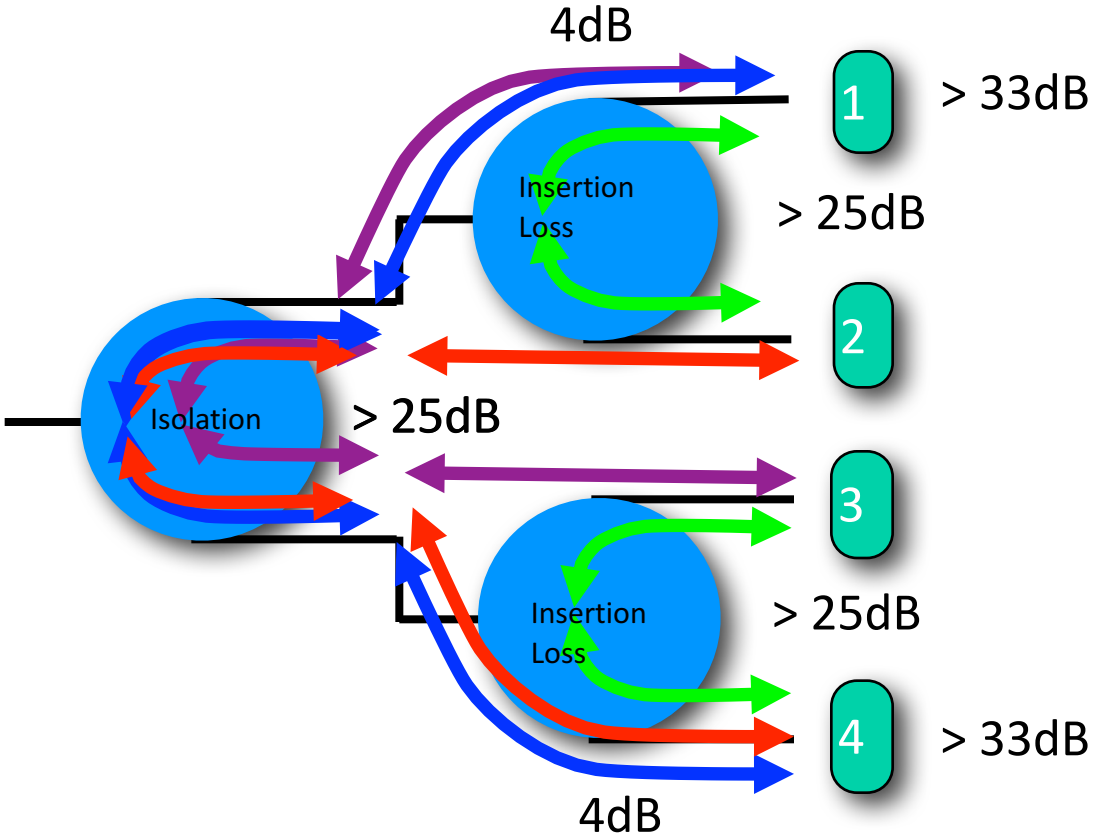
- Insertion Loss at MoCA frequencies may be 1-4dB or higher per 2 way splitter
- Splitter Isolation will be the area where the largest splitter signal loss is to MoCA signals





Optimizing the home: MoCA and WiFi

- Let's look at a 4 way splitter which has additional isolation paths.
  - From port 1 to 2 and from port 3 to 4: the signal flows through the isolation path of the internal splitters
  - Another path is from port 1 to port 4: the signal flows through the first internal splitters, through the isolation path of the next internal 2 way and through the insertion loss leg of the next internal 2 way splitter
- Since the signal flows through the isolation path of one internal splitter and the insertion loss of the other 2 internal splitters, the total isolation loss of this path is greater by 8dB than from port 1-2 or port 3-4, for a total loss of greater than 33dB



Optimizing the home: MoCA and WiFi

Overview

Here are two of the main advantages MoCA brings:

- **Multi-room content sharing** – share licensed content, pictures, music and videos.
- **Ethernet connectivity** – coax can now support Ethernet without running new wires. This also includes adding Wi-Fi access points to improve wireless coverage, or gaming.

Optimizing the home: MoCA and WiFi

MoCA 2.0

- Enhanced mode:
  - 800 Mbps MAC throughput
  - 1.4 Gbps PHY rate
  - Bonded single 100 MHz channels yielding 225 MHz channels
  - Packet error rate of 1 in 100,000,000
  - 3.6 millisecond latency, wide spectral function from as low as 500 MHz up to 1650 MHz
- Turbo mode (point-to-point):
  - 500 Mbps MAC throughput

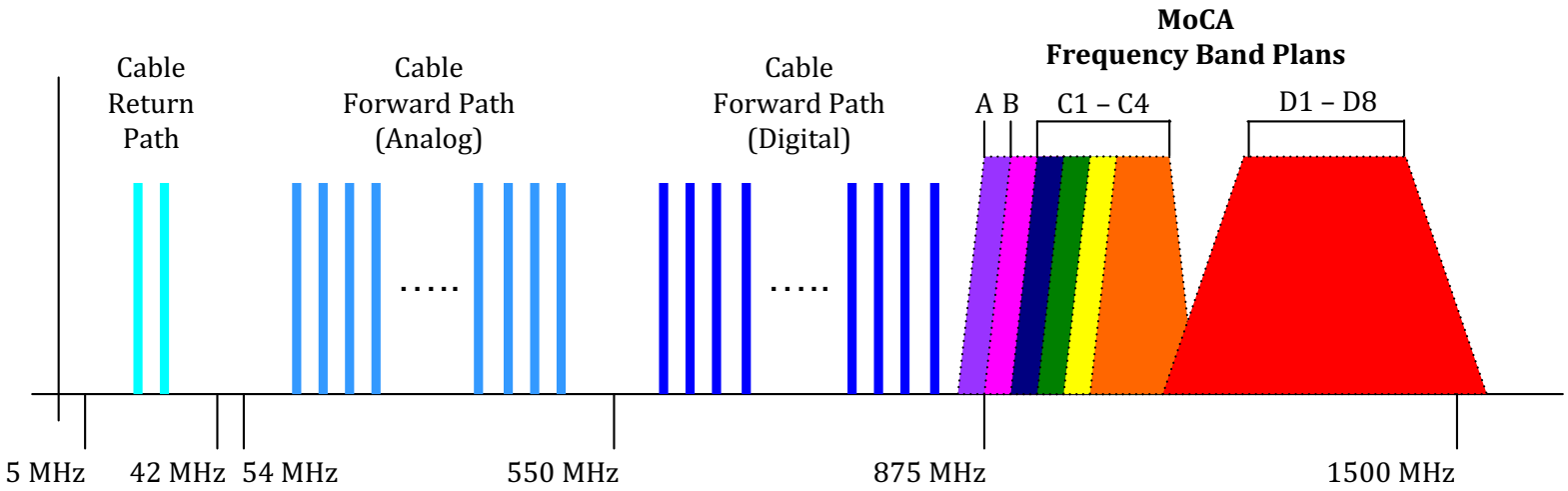
Optimizing the home: MoCA and WiFi

MoCA 2.5

- 2.5 Gbps actual data rates
- Interoperable with MoCA 2.0 and MoCA 1.1.
- MoCA protected setup (MPS): Easier setup with password sharing via push-button
- Enhanced Privacy: Secure data communications with additional longer password and using different keys between MoCA 2.5 nodes
- Multiple data rates available
  - Profile B: 400 Mb/s net data rate up to 16 nodes, and 500 Mbps in turbo mode (two nodes only).
  - Profile C: 800 Mb/s net data rate with channel bonding up to 16 nodes, and 1 Gbps in turbo mode (two nodes only).
  - Profile D: 1.5 Gbps, 2 Gbps and 2.5 Gbps net data rates up to 16 nodes.

Optimizing the home: MoCA and WiFi

MoCA Spectrum



Optimizing the home: MoCA and WiFi

MoCA Channel Plan

- **Extended band D** occupies between 1125 MHz and 1675 MHz.
  - Sub-band D-Low (DL): 1125 to 1225 MHz edge to edge (100 MHz wide)
  - Sub-band D-High (DH): 1350 to 1675 MHz edge to edge (325 MHz wide)
  - Guard-band between sub-bands: 1225 to 1350 MHz (125 MHz wide)
- This spectrum allows:
  - Single channel or bonded-pair channels operation in extended band D
  - Two independent networks on shared coaxial medium
    - Network 1: Single, non-bonded-pair, channels operating in sub-band D-Low
    - Network 2: Single channel or 2 bonded-pair channels in sub-band D-High
  - Mixed Mode operation anywhere within the extended band D
- **Band E** occupies frequencies between 400 MHz and 700 MHz.
- This spectrum allows:
  - MoCA 2.0 single channel or bonded-pair channels operation
  - Mixed-mode operation (MoCA 1/MoCA 2.0)
- **Band F** occupies frequencies between 650 MHz and 875 MHz.
  - This band is really two separate bands: Fsat (for satellite) and Fcbl (for cable)
- This spectrum allows:
  - MoCA 2.0 single channel or bonded-pair channels operation in Band F
  - Mixed-mode operation (MoCA 1/MoCA 2.0) in Band F

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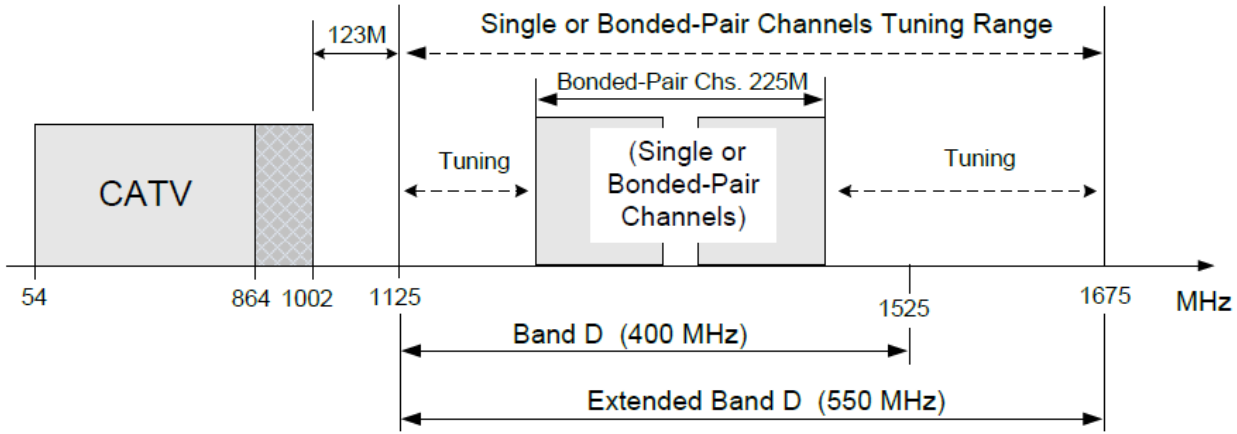
- MoCA Channel Plan



MoCA 2.0 Extended Band D Frequency Plan

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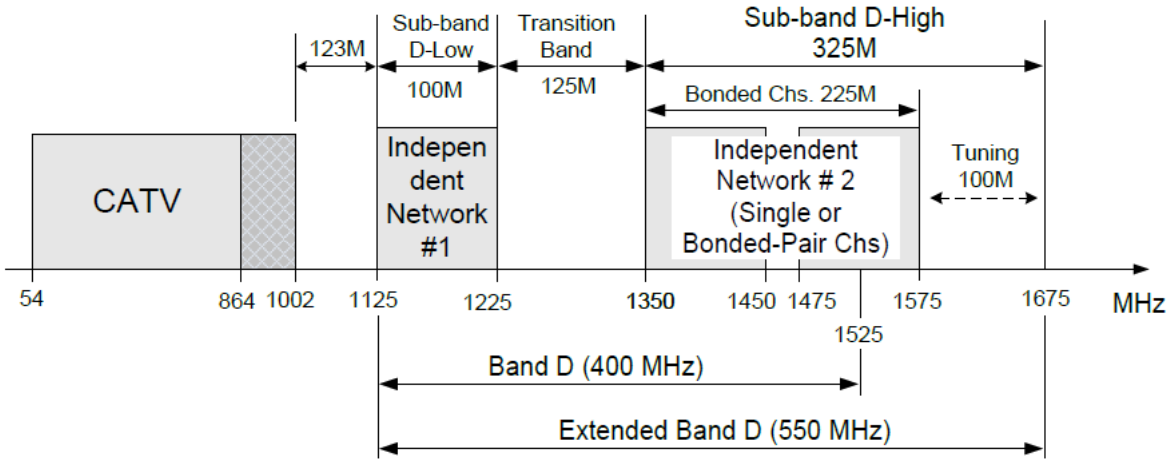
- MoCA Channel Plan



MoCA 2.0 Extended Band D Frequency Plan – Independent Networks

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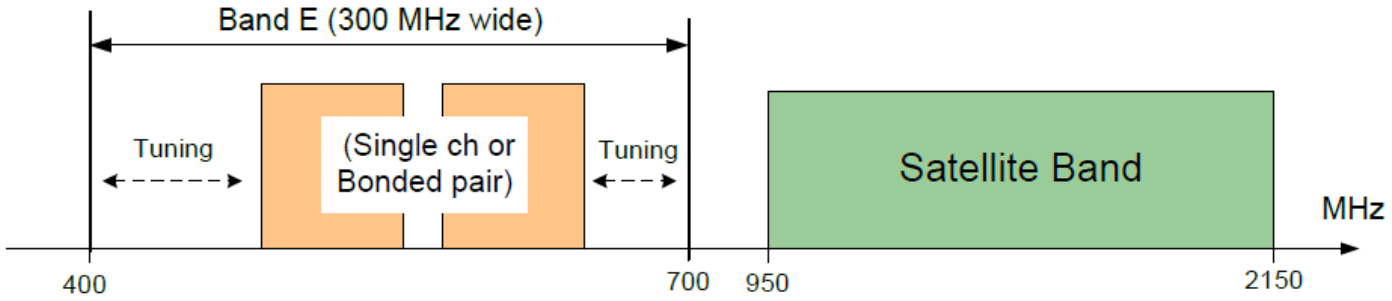
- MoCA Channel Plan



MoCA 2.0 Band E Frequency Plan with Single or Bonded-Pair Channels Example

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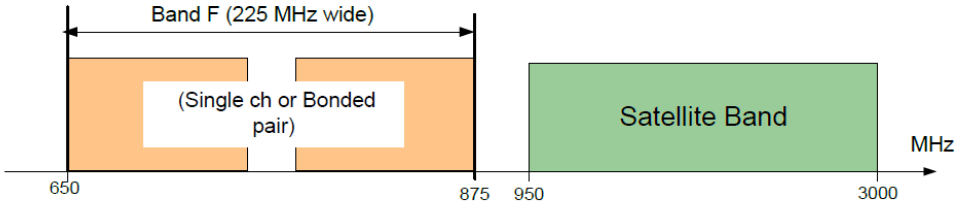
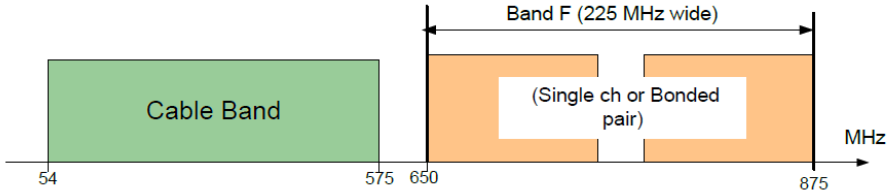
- MoCA Channel Plan



MoCA 2.0 Band F_{SAT} Frequency Plan with Bonded-Pair Channels Example



MoCA 2.0 Band F_{CBL} Frequency Plan with Bonded-Pair Channels Example

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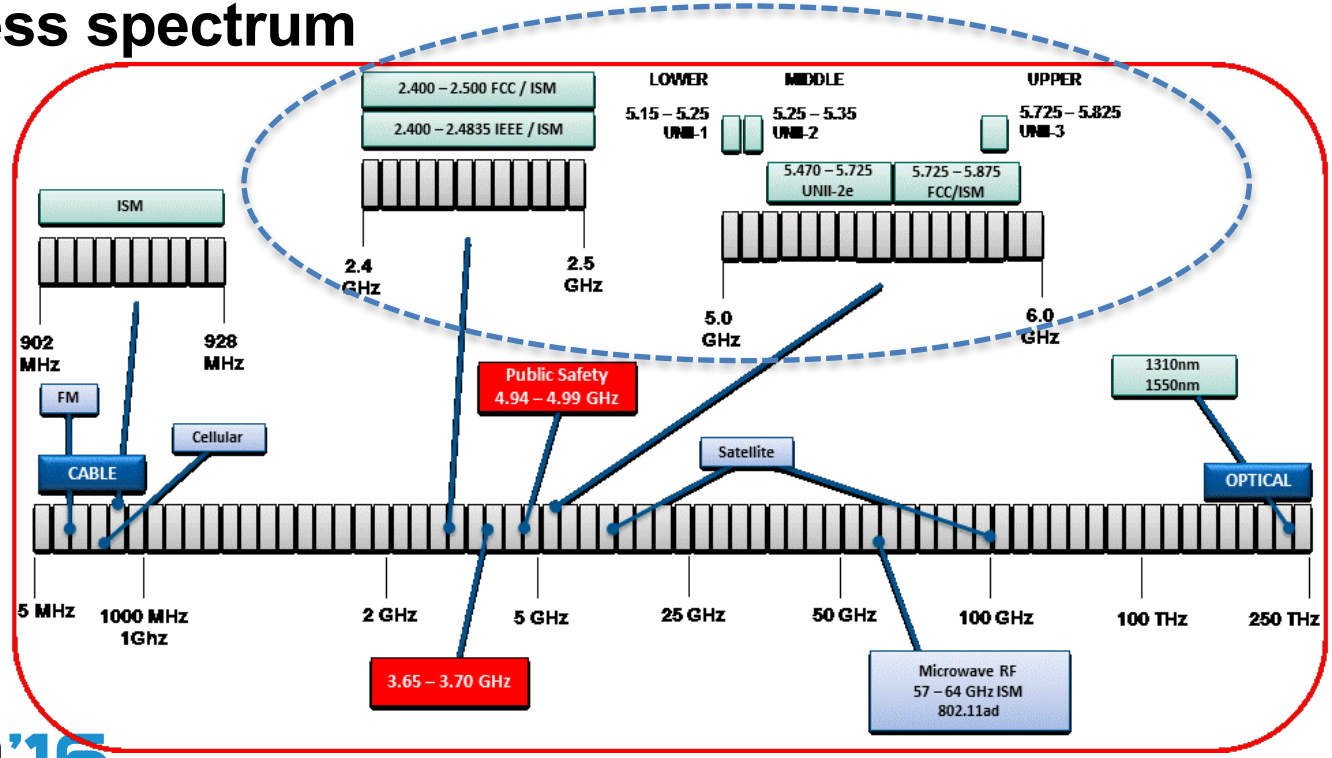
Wireless spectrum



Optimizing the home: MoCA and WiFi

802.11ac

- Multi-User - Multiple Input, Multiple Output(*MU-MIMO*), which allows up four simultaneous forward path (“download”) transmission
- *Beamforming*, which allows for steering matrices to be established so transmission between an AP and Wi-Fi client are optimized.
- *More spatial streams*; 1300 Mbps (4) & 7000 Mbps (8)
- *Aggregate Frames* allow for multiple frame to be sent before acknowledgement is needed
- *Channel bonding* goes beyond the 40MHz found in 802.11n and is increased to **80 & 160 MHz** channels
- **256 QAM** is possible if a high enough SNR can be maintained

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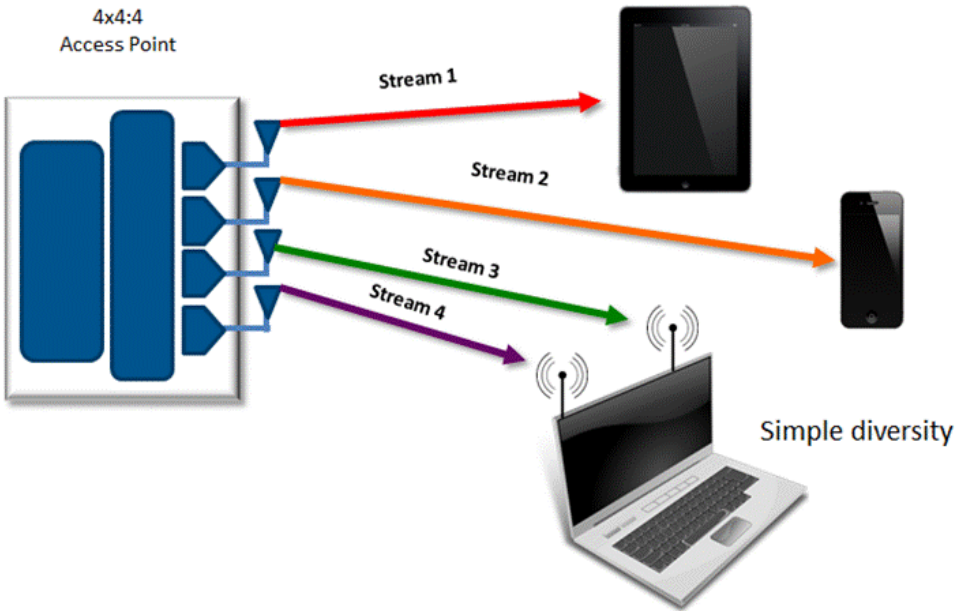
802.11ac MU-MIMO



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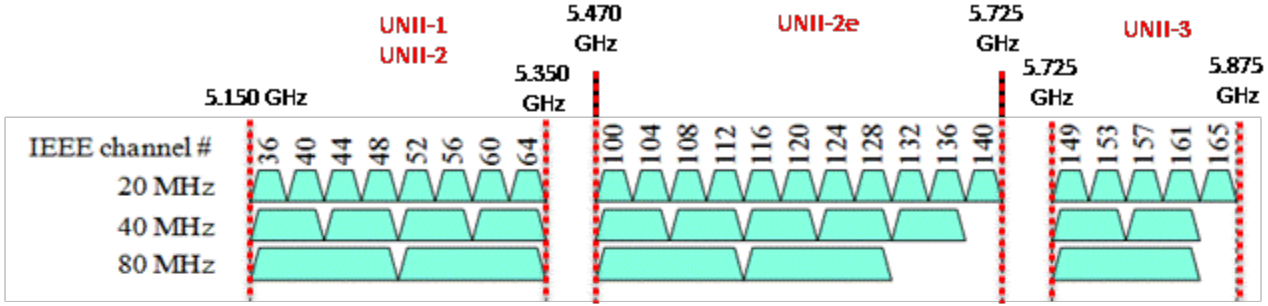
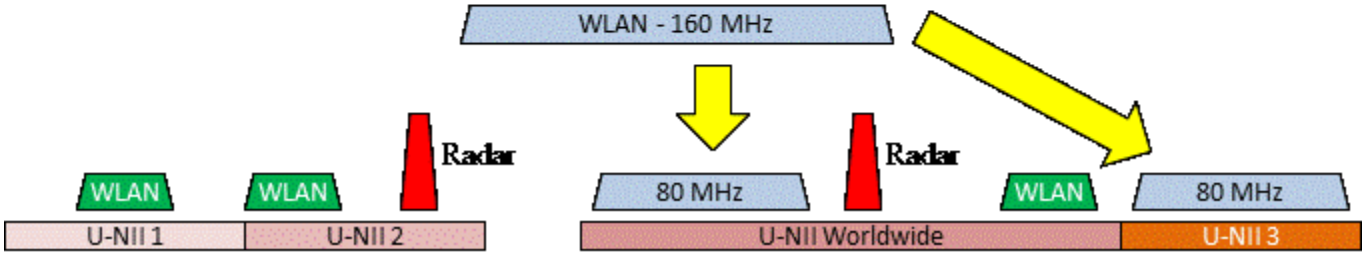
802.11ac: Wider Channels





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802.11ac Frequency Bands

UNII Bands:

U-NII-1 5.15 GHz – 5.25 GHz

U-NII-2 5.25 GHZ – 5.35 GHz

**U-NII-2e 5.47 GHZ – 5.725 GHz*

U-NII-3 5.725 GHz – 5.85 GHz

*NOTE: requires Dynamic Frequency Selection (DFS) & Transmit Power Control (TPC)

UNII channels :

UNII-1 Lower (Channels 36 – 48)

UNII-2 Middle (Channels 52 – 64)

UNII-2e Extended (Channels 100 – 140)

UNII-3 Upper (Channels 149 – 161)

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802.11ac – In the future

Proposed UNII Bands:

U-NII-1 5.15 – 5.25 GHz 4 channels

U-NII-2A 5.25 – 5.35 GHz 5 channels

U-NII-2B 5.35 – 5.47 GHz 6 channels

U-NII-2C 5.47 – 5.725 GHz 13 channels

U-NII-3 5.725 – 5.85 GHz 5 channels

U-NII-4 5.85 – 5.925 GHz 4 channels

Optimizing the home: MoCA and WiFi

Things to know about when implementing MoCA

- **STEP-1:** *Assess the current inside cabling of the customer's home.* This is crucial because MoCA will demand more from the coaxial cabling than existing services.
- **STEP-2:** *Determine the splitter arrangement* since MoCA uses splitter jumping, which provides for 2-way transmission over the coax cabling within the home. Now, the distance from what will become the root splitter to MOcA device becomes very important
- **STEP-3:** *Replace suspect cabling and splitters*, as they need to be able to support the higher frequencies used in various MOCA channel plans and increased data throughput.
- **STEP-4:** *Install a Point of Entry (POE) filter* to prevent MoCA signals from leaving the customer location, which would otherwise be destined for the HFC plant.
- **STEP-5:** *Attach MoCA devices and test*. Ensure devices have power from the backbone or AC adapter, as might be the case for APs.

Optimizing the home: MoCA and WiFi

Things to know about when implementing Wi-Fi

- **STEP-6:** *Meet with the customer and discuss their wireless needs***.** Determine the number of devices and possibly which Wi-Fi standard these devices use.
- **STEP-7**; *Characterize the RF environment*; there are several options available from software based tools that provide Wi-Fi spectrum analyzers, which are loaded onto laptops or tablets. Also, use of handheld test equipment is highly recommended.
- **STEP-8**: *Assess antenna placement and RF coverage*. One of the most significant limiting factors cable operators have today, is the fact that most Wi-Fi deployments rely on embedded APs within the cable modem. Talk about limiting what an AP can do, on top of a big bowl of “RF soup”! *It is currently infeasible to place the functionality of newer multi-radio chain APs into the size of a standard cable modem chassis*.

Optimizing the home: MoCA and WiFi

Things to know about when implementing Wi-Fi

- More on **STEP-8:**
  - What needs to occur for single AP solutions, is having the ability to change out AP antennas. For most considerations, the goal of going to a higher gain antenna *is not to increase power output and extend the coverage are, but to increase APs receive sensitivity, or basically stated – received signal level from Wi-Fi clients*.
  - For multiple APs, it is much easier, as 802.11ac creates steering matrices for client devices and very little needs to be done with the AP. In fact, embedded antennas usually work just fine for “ac” APs
- **STEP-9:** *Meet with the customer and verify their wireless needs have been met.* This step is worth the time, without question. Deal with issues while the technician is there. Also, note, here is a good time for a conversation with the customer who has the desktop with a PCI Wi-Fi card, or the 5 year old “DVD” player.

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