



Creating Infinite
Possibilities.

Using Profile Management To Operationalize The Roll-off Region In DOCSIS 3.1 HFC Networks

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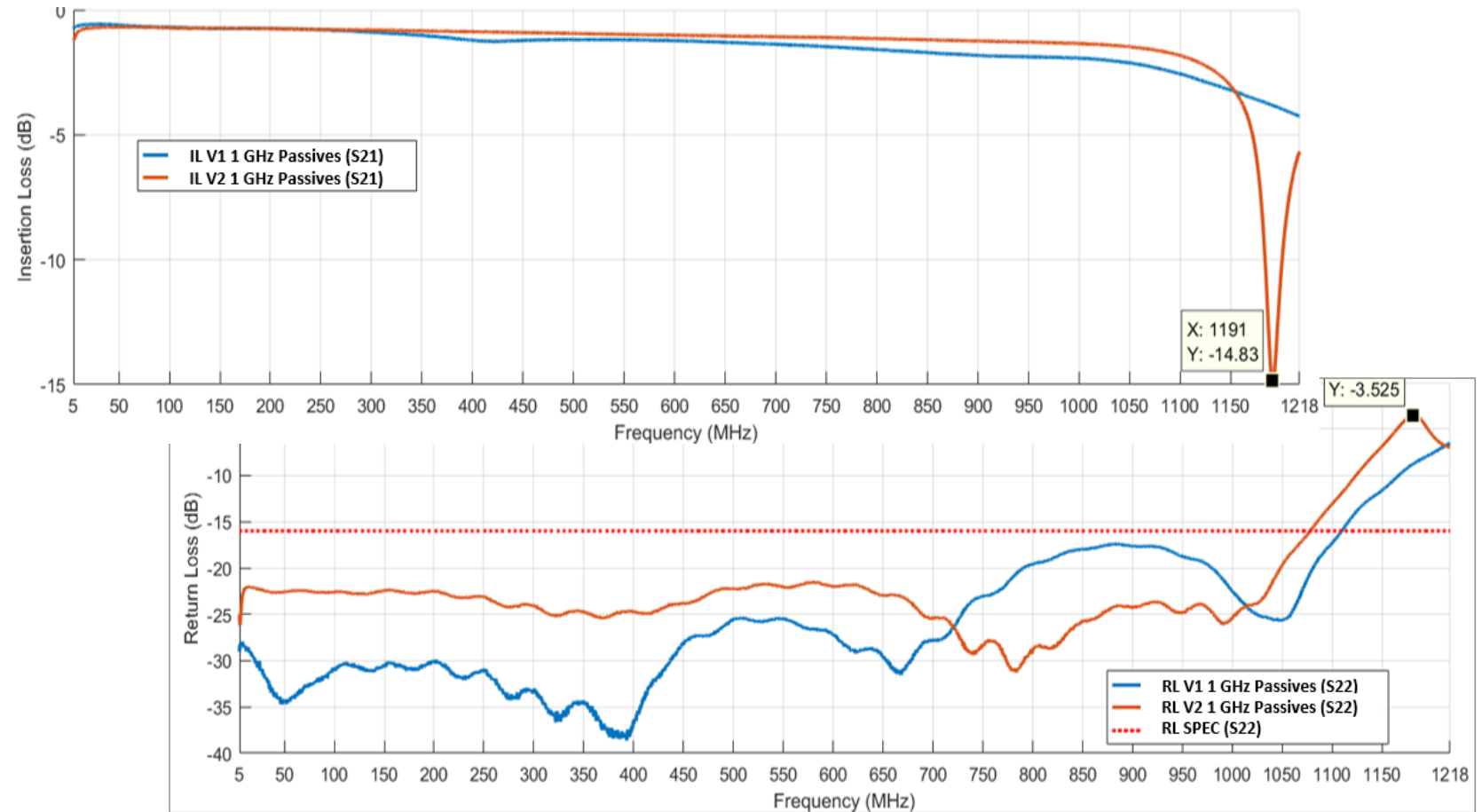
AGENDA:

- ✓ 1.0 GHz Tap signature (Roll-off overview)
- ✓ Overview of the HFC Test Network
- ✓ Roll-Off characterization using flat modulation profiles
- ✓ Overview of the CM operation in the roll-off region
- ✓ Optimization of OFDM Performance for roll-off operation
- ✓ PMA implementation
- ✓ Conclusion

1.0 GHz Taps Signature

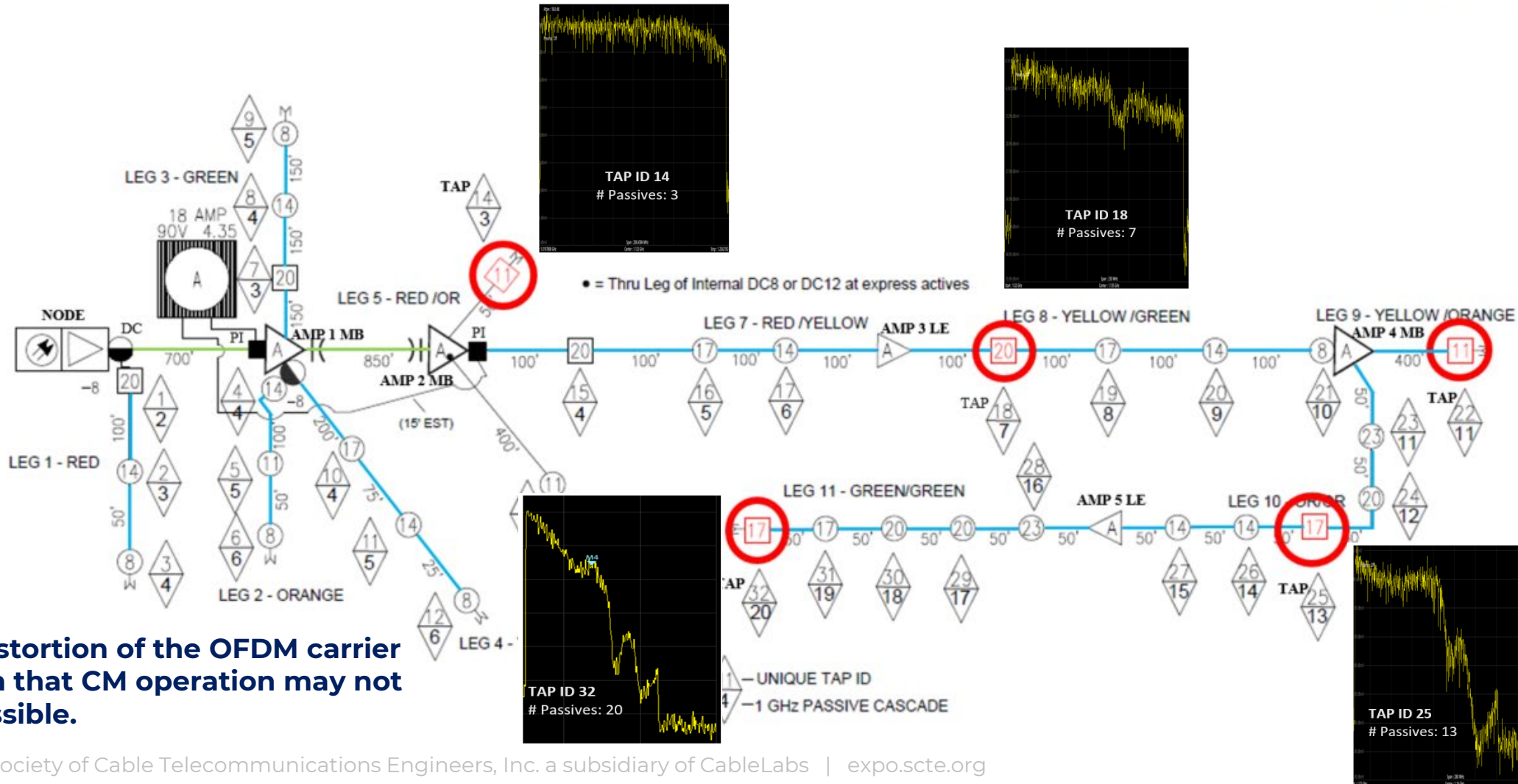
The combination of poor return loss and higher insertion loss creates a non-flat roll-off signature beyond 1 GHz

The severity of this signature (peaks and dips) varies by manufacturer, and worsens as the number of 1 GHz passives in a cascade increases.



PMA LAB TEST NETWORK - 1218/258/204 MHz

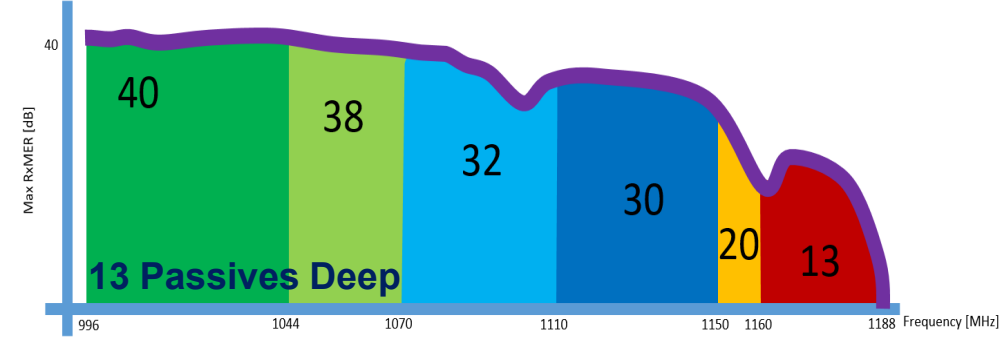
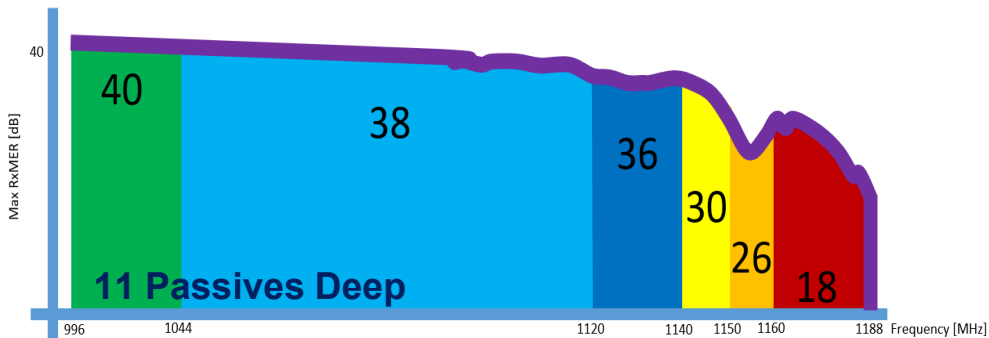
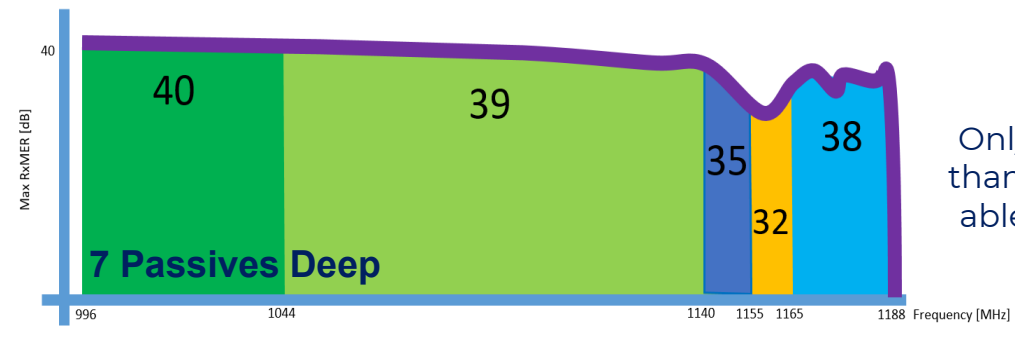
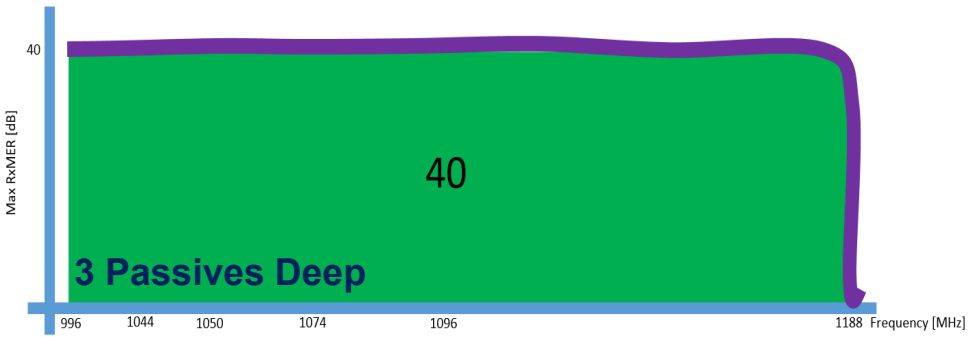
DESIGN REV: 07/25/22
VERSION: V12



The distortion of the OFDM carrier is such that CM operation may not be possible.

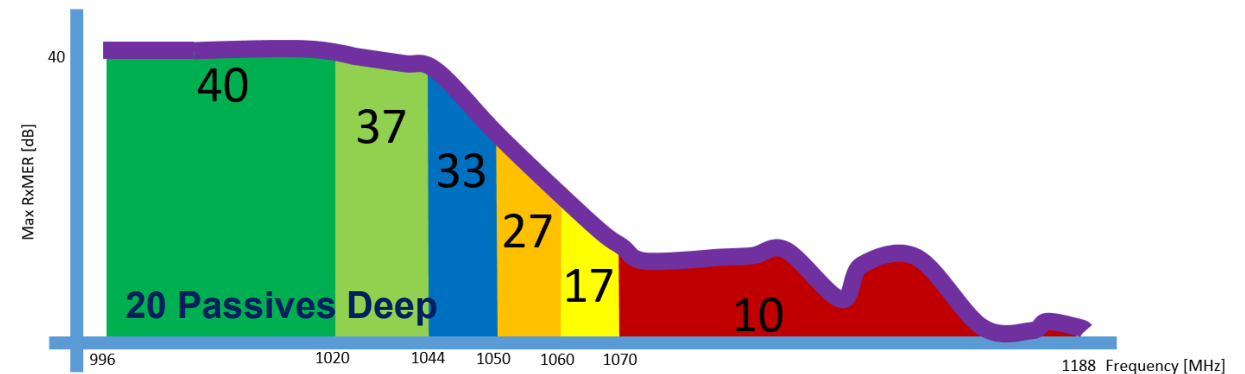
Roll-off characterization using flat profiles

Only CMs closer to the node (\leq than seven passives deep) were able to operate using a full 192 MHz OFDM channel.

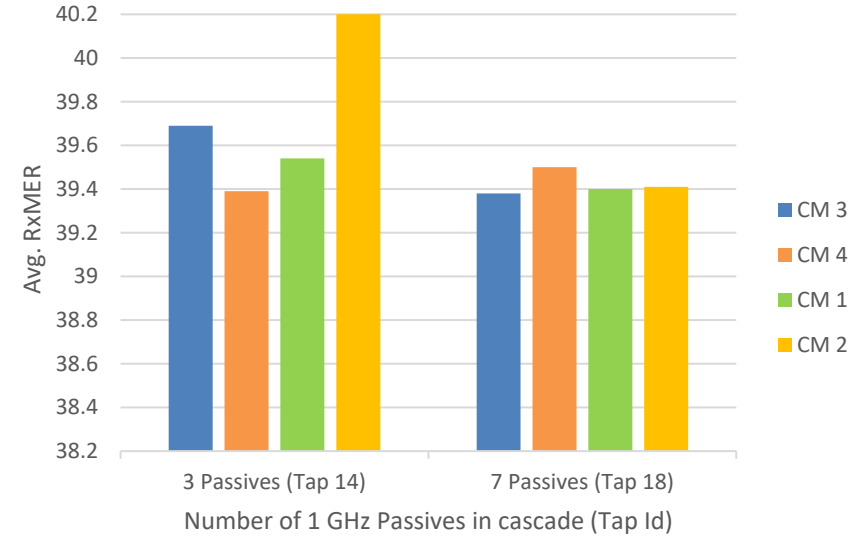
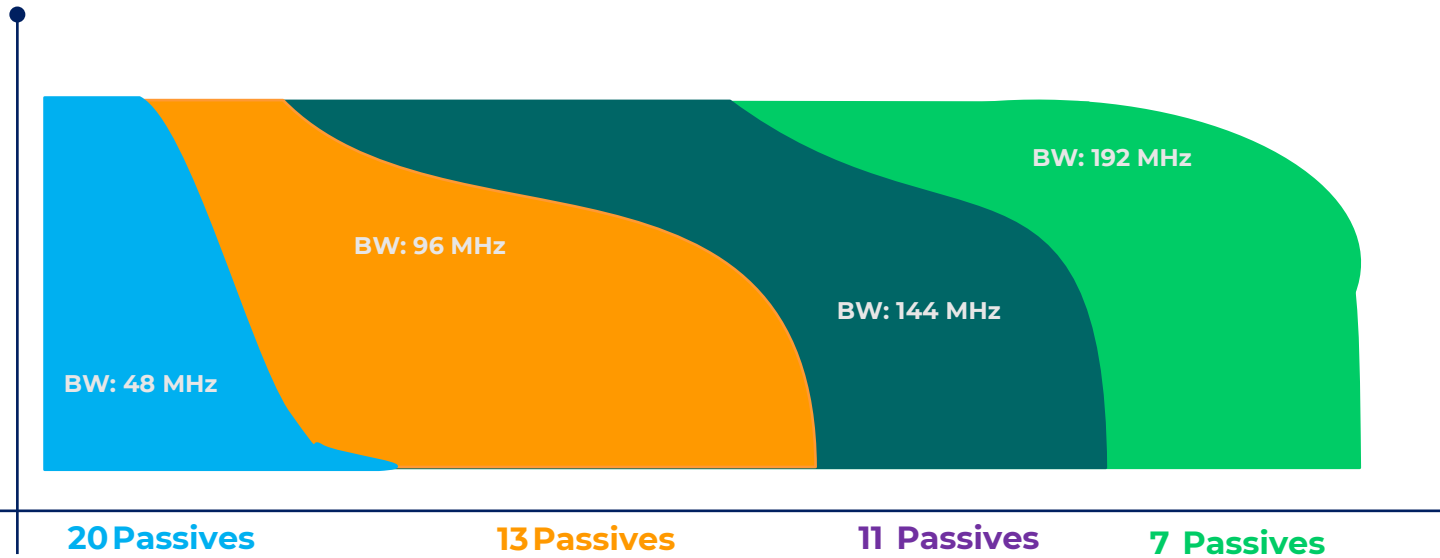


This distribution of MER values across frequency blocks within a 192 MHz OFDM channel across different tap locations begins to uncover the value of a PMA approach.

Without PMA, only flat modulation profiles are possible across the RF spectrum.



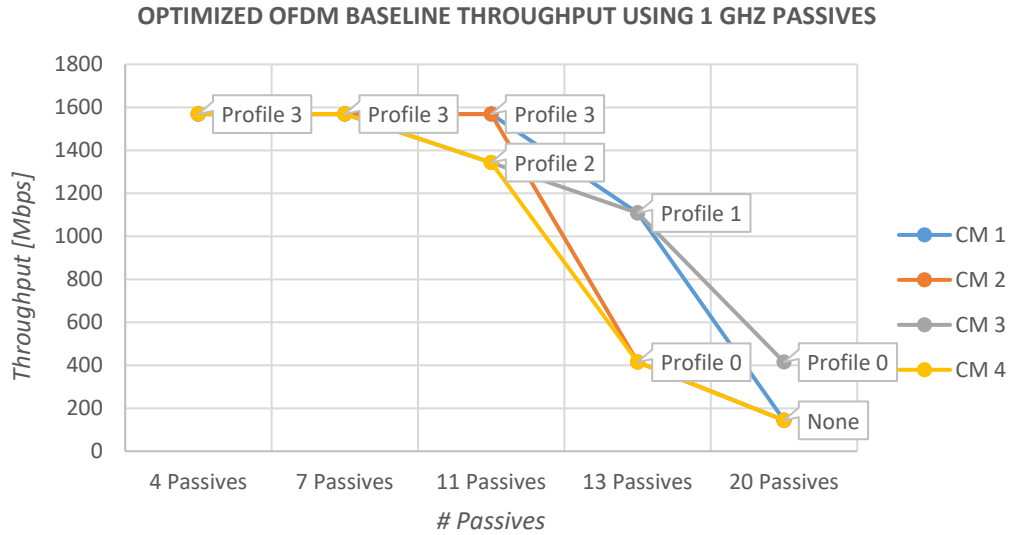
Understanding CM operation in the roll-off



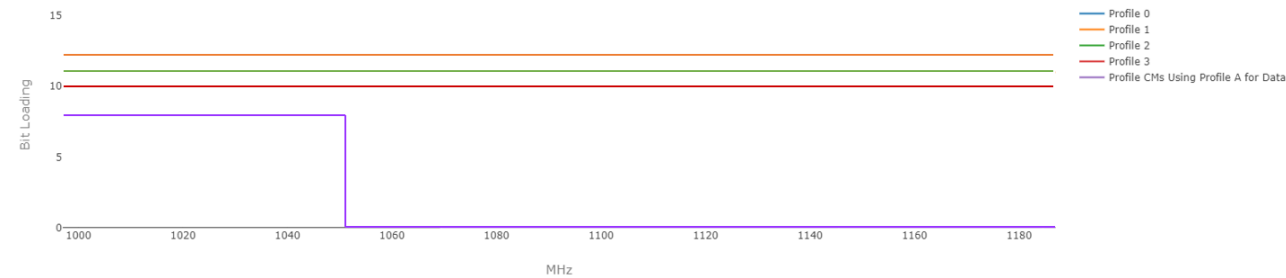
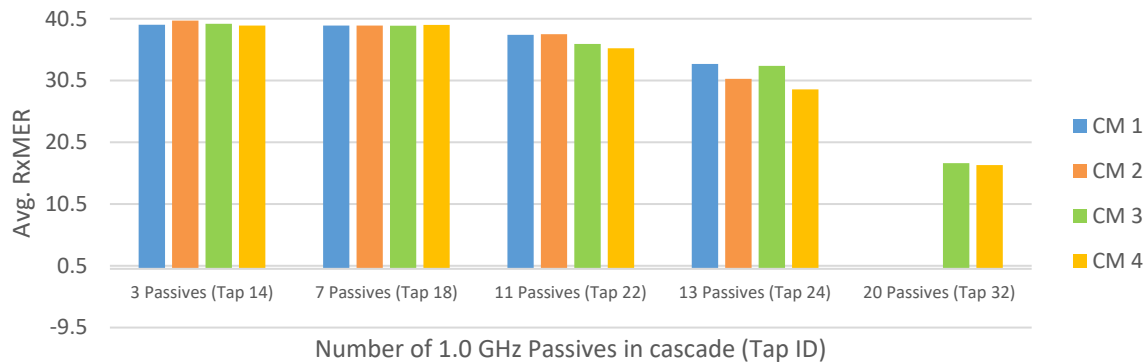
As the OFDM bandwidth increased, CMs at tap locations further from the node were not able to achieve stable operation on the reported profile.

This test reveals that it is crucial to revise certain OFDM configuration parameters before PMA implementation in the roll-off region to ensure stable operation

Optimizing OFDM Performance for Roll-off Operation



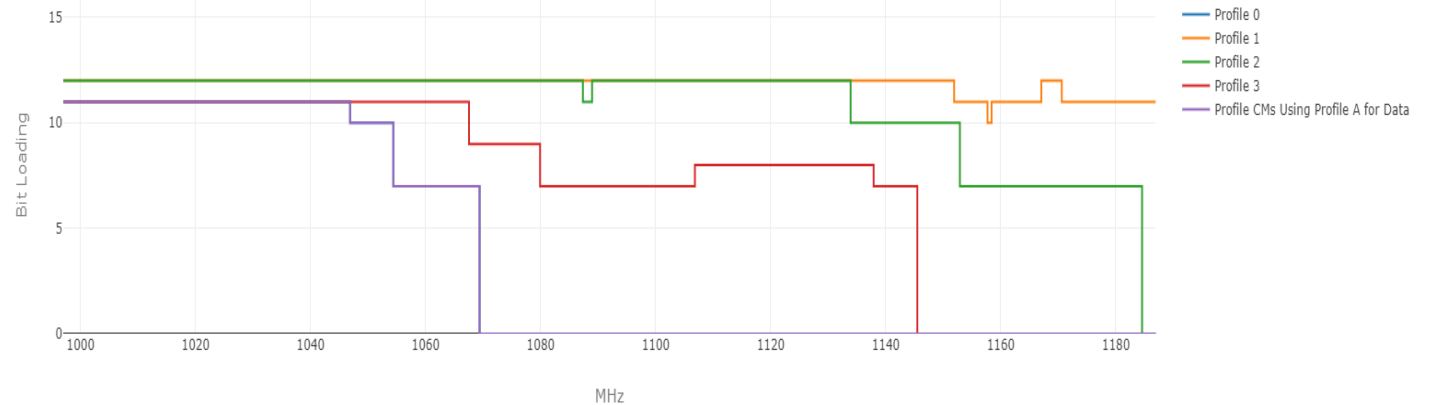
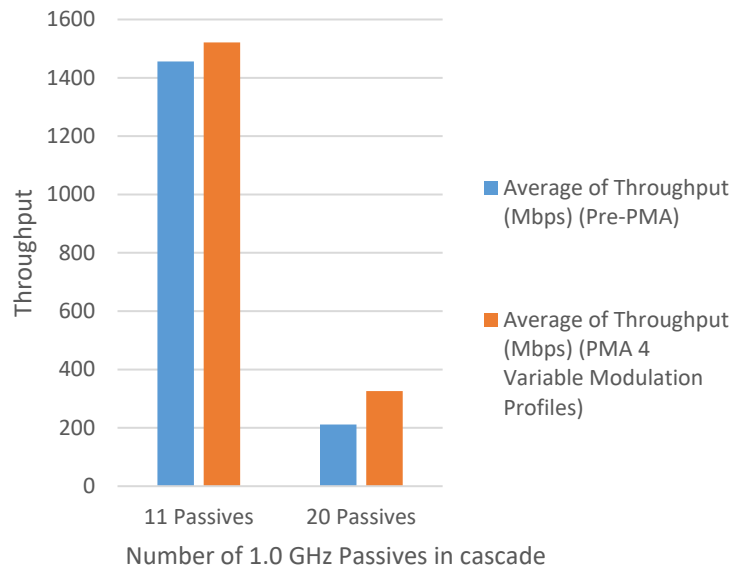
With optimized OFDM settings more CMs were able to operate with higher flat modulation profiles at the same tap location in the network compared to typical OFDM settings.



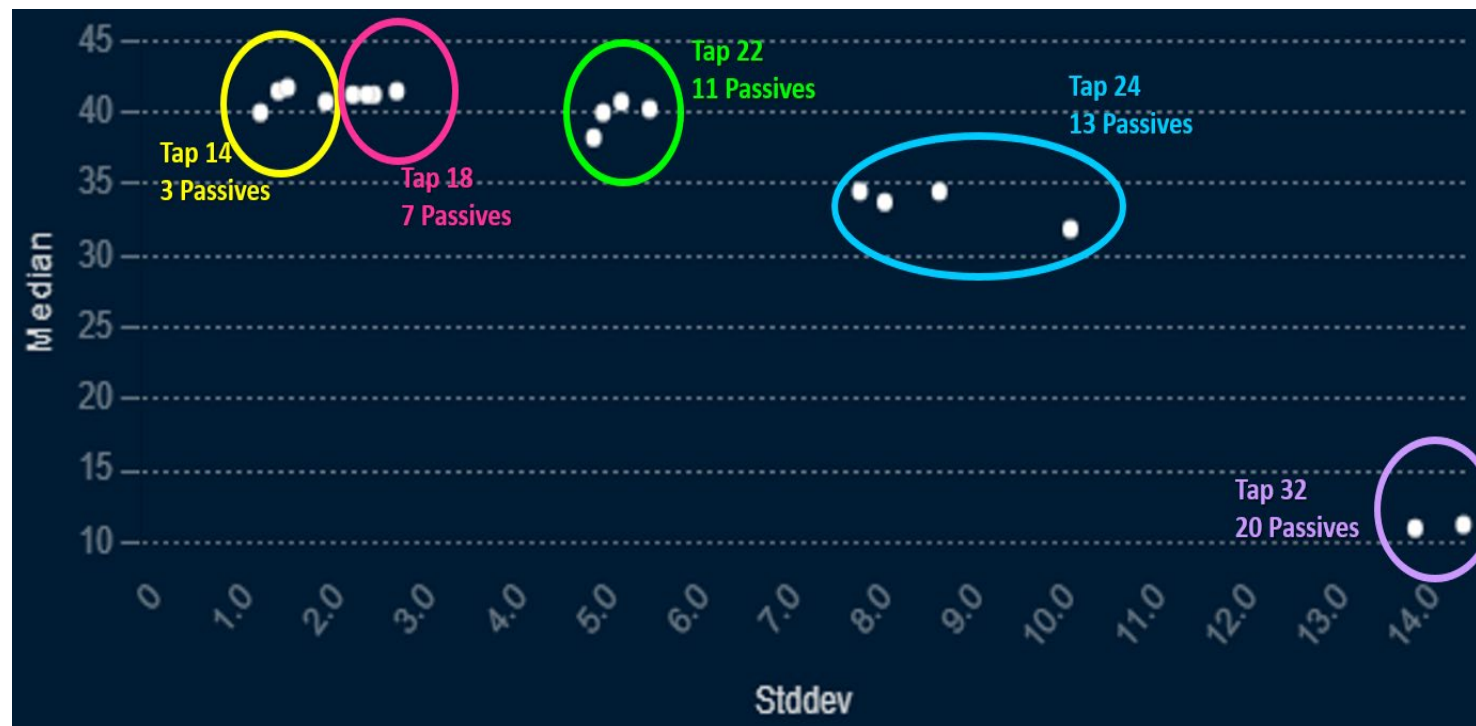
PMA alone does not allow operation in the roll-off region. We must use a combination of optimized OFDM settings to get as many CMs online as possible before PMA is implemented.

PMA allowed us to create custom-made profiles consisting of segments of different modulation orders based on plant conditions over the frequency range of the OFDM channel.

As a result most CMs were able to bond to a 192 MHz OFDM channel. At 11 passives there was a 4% increase in average throughput across four CMs. At 20 1.0 GHz passives, there was a 35% increase in average throughput.



As the cumulative effect of the non-flat frequency of the 1.0 GHz passives worsens, an increasing number of sub-carriers in the OFDM channel are affected the mean RxMER decreases creating five distinct clusters that correspond to the five selected tap locations in the HFC network



PMA provides operators the ability to implement proactive and adaptive network operations in a network with inevitable impairments such as roll-off. This minimizes trouble calls, maximizes throughput and allows scalable and progressive deployments.

However, should an operator decide to operate OFDM in roll-off regions, the OFDM carrier should be configured/optimized first to ensure the best possible performance prior to PMA implementation. Once optimal performance is achieved pre-PMA, higher and stable capacity gains can be obtained through the implementation of a fully automated PMA solution.

PMA implementation provides extra network capacity that can be used to alleviate traffic during peak hours. Further testing will be performed to continuously implement the benefits that PMA can provide.



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Questions??

Thank You!

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