

# **Bright House Networks, Hybrid Fiber Coax and EPON over Coax**

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# Agenda

- © Why EPoC ? And What “It” MUST Be
- © Hybrid Fiber Coax Deployment at BHN
- © Signal Amplification and Node+N
- © BHN Spectral Allocation
- © Spectral Allocation Flexibility
- © Residential / Commercial Service Coexistence
- © Access Network Segment Bandwidth Growth



# Why EPoC ? And What “it” MUST Be?

## © Why EPoC?

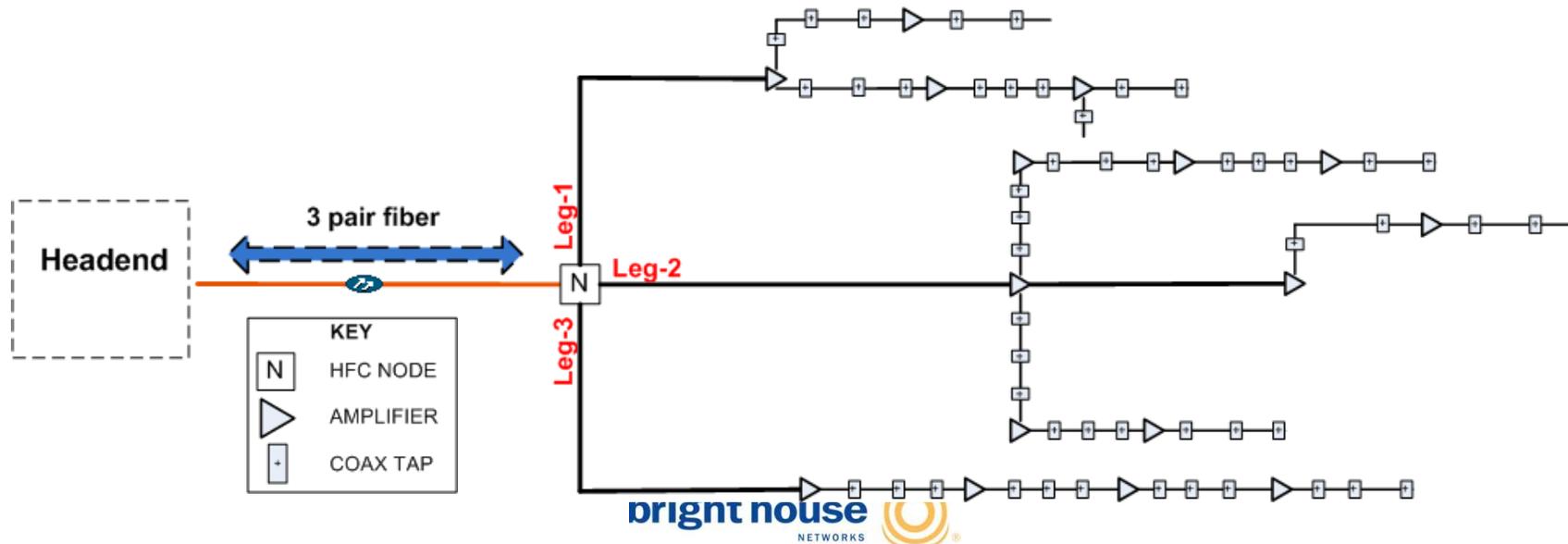
- Internal BHN studies indicate the construction cost to deploy EPoC on existing coax plant (at Node+0) is  $\sim 1/5^{\text{th}}$  the construction cost to build FTTH.
- These studies make assumptions based on “minimal” coaxial plant upgrades; amp upgrades/modifications is included in the “minimal” coaxial plant upgrades.

## © What “it” MUST Be?

- Much of the interest in EPoC stems from a theoretical ability to add EPoC into a system without a complete rebuild of the Coax system.
- Thus - EPoCs ability to operate through amps, utilize flexible spectral allocations, and support many concurrent services are all of paramount importance.

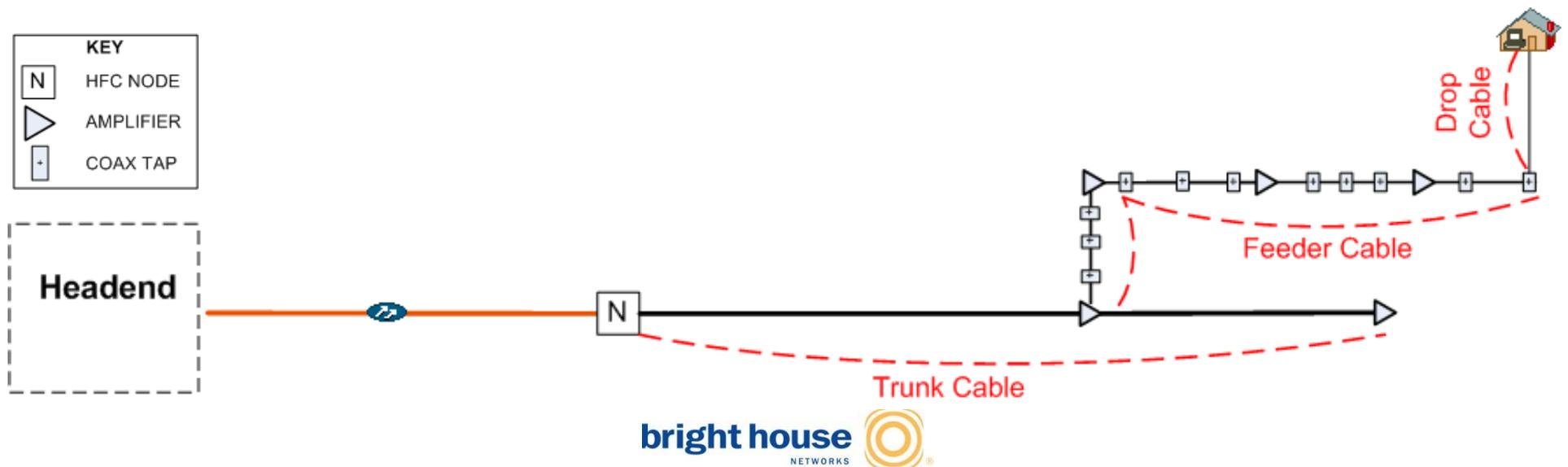
# BHN Hybrid Fiber Coax 1/2

- BHN's existing hybrid fiber-coax (HFC) plant typically has some "node" fiber – commonly 6 fibers or less pulled to the HFC Node though in more recent builds this number is much higher.
- All the analog and digital 6MHz channels are transported over a single fiber to the node where the node converts the optical carriers back to RF carriers and transmits them on coaxial cable.
- The coax plant distribution to service a group of subscribers is often segmented in terms of a number of "legs" off of a given HFC node.
- The number of legs is typically between two and four legs off of an HFC Node.



# BHN Hybrid Fiber Coax 2/2

- The diagram below depicts a single leg off of an HFC node.
- Trunk Cable extends from the HFC node and often has as many as four amplifiers (amps, line extenders, etc)
- Feeder cable connects to Trunk Cable and has taps positioned along the feeder cable which service homes (via Drop Cable).
- Typical feeder amplifiers support 16-32 homes via 2, 4, and 8-port taps.
- Typical feeder cable has 3 or fewer amplifiers from trunk cable to the end of the feeder cable.





# BHN HFC and Amplification

- **There are two profiles provided of BHN HFC plant deployments which cover a large number (80%+) of our deployments.**
- **A big difference is the gain provided by amplifiers - some actives have a higher output gain than others.**
- **BHN has some markets where earlier deployed, lower gain amps were implemented with lower output gain resulting in fewer homes passed per active.**

Profile 1: Low Gain Amp	
Homes Passed per Node	392
Actives per Node	31
Coax Miles per Node	4.6
HP per Mile	85
HP per Active	12.7

Profile 2: High Gain Amp	
Homes Passed per Node	380
Actives per Node	19
Coax Miles per Node	4.4
HP per Mile	89
HP per Active	20



## NODE + N

- © EPoC PHY MUST operate through actives.
- © Support of Node+3 is a MUST Requirement.
  - Node +0 (passive) is an assumed requirement.
  - Node +3 (or better) is necessary to be cost effective early in the deployment cycle.

**NOTE:**

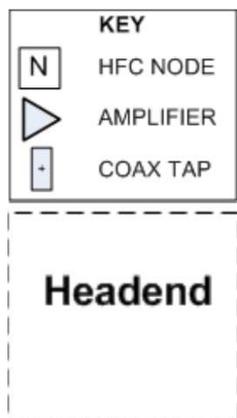
*It is NOT a requirement that the performance in Node+3 deployment be equivalent to the performance in Node+0 deployment.*

# NODE +0

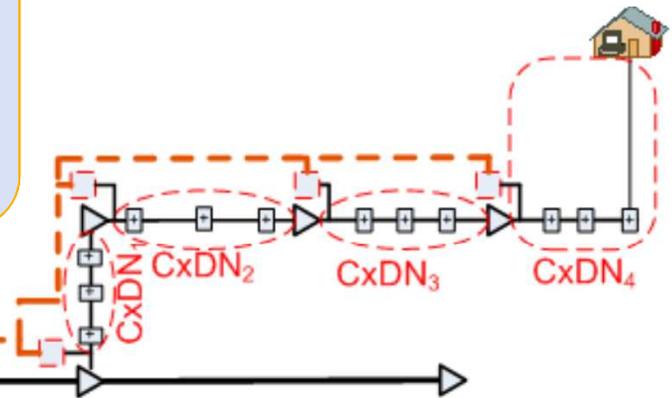
- While node+0 is an all-passive coax build, there are still questions regarding in-house actives.
- A Node+0 build would look similar to the one below.
- Fiber is overbuilt on the trunk and feeder cables.
- EPoC would be inserted after every active in this case and would be filtered at the next active.
- For complete EPoC deployment this would require fiber overbuild of all trunk coax segments and nearly all feeder coax segments.
- The only segments not requiring an overbuild would be the drop cables.

## Acronym Watch:

**CxDN** (used below) is Coaxial Distribution Network, analogous to ODN or Optical Distribution Network



New Fiber Build

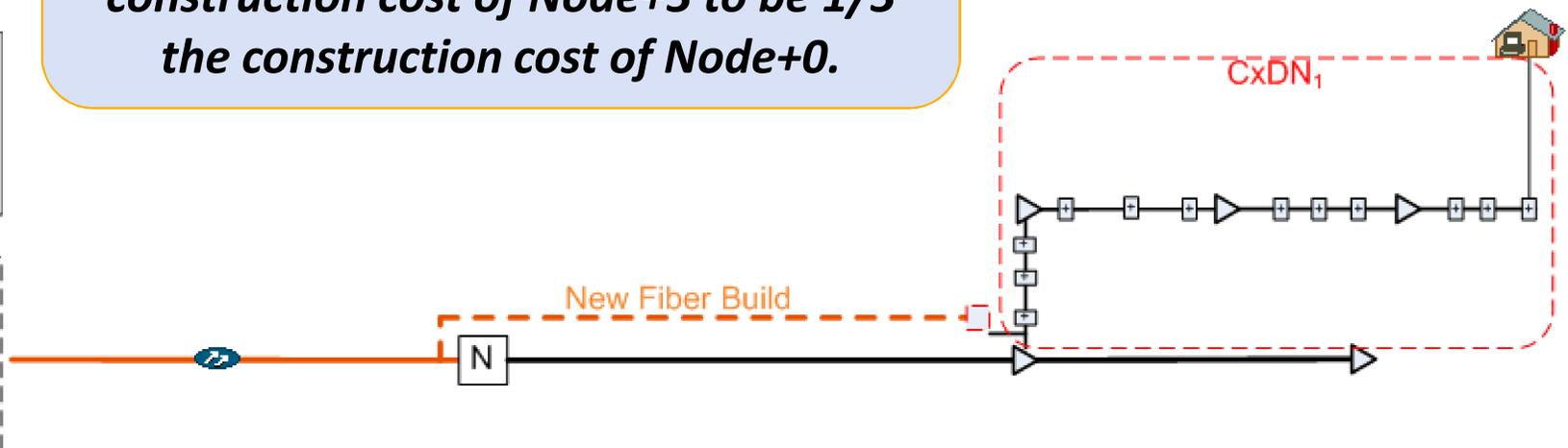
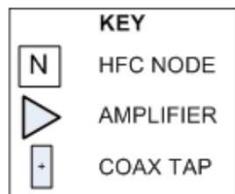


# NODE +3

- Node+3 might look a lot like Node+4 in cases where in-home actives are deployed.
- A Node+3 build look like the one diagramed below.
- Fiber is run along the trunk cable and inserted at or after the active onto the feeder cable.
- Fiber overbuild is only required over trunk segments.
- This aligns directly with BHN's new build HFC construction.

**Note:**

*BHN Internal studies indicate the construction cost of Node+3 to be 1/3 the construction cost of Node+0.*





# Spectral Allocations (1/2)

- **At BHN different markets have different spectrum available for use without significant modification to the current production spectrum allocation.**
- **In general, it is expected that (at least initially) any solution would have to coexist with the lineup of existing services.**
- **While forward frequency amplification occurs beyond the product ratings, performance outside the rating varies greatly.**

## Profile 1: 750MHz Plant

Forward Channel Width	6MHz
Existing Forward Amp.	54MHz - 750MHz
Return Channel Width	1.6MHz - 6MHz
Amplified Return	5MHz - 42MHz
Spacing	22dBmV

## Profile 2: 860MHz Plant

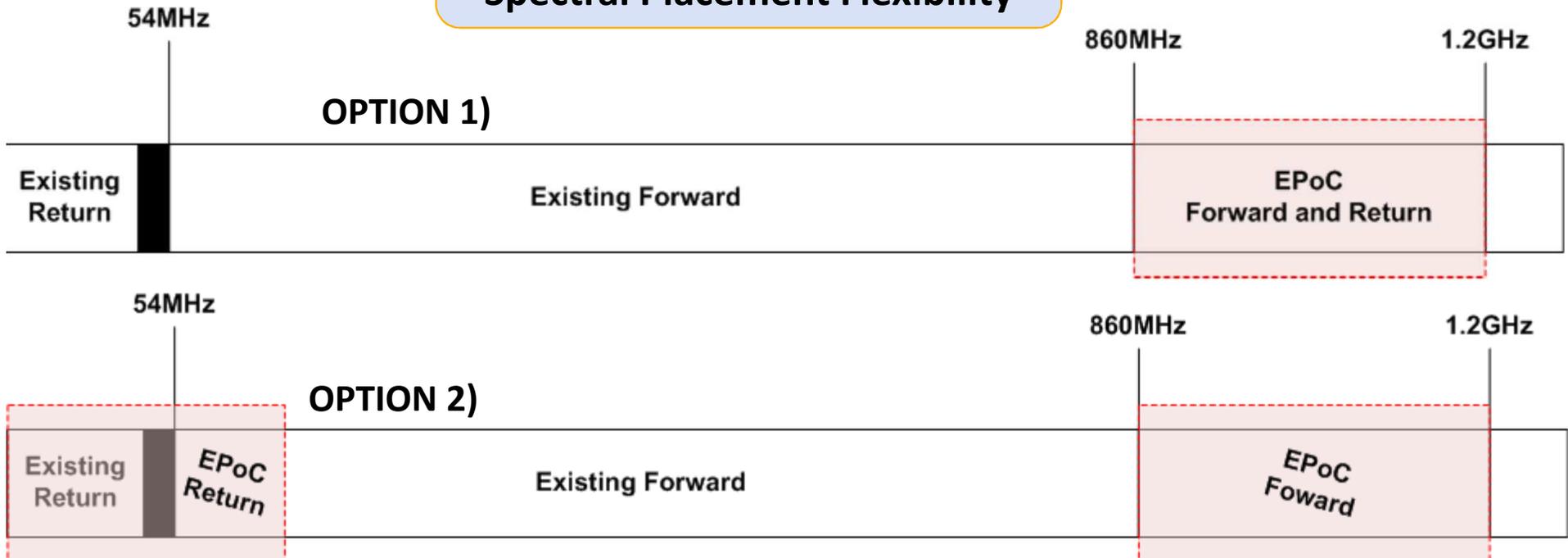
Forward Channel Width	6MHz
Existing Forward Amp	54MHz - 860MHz
Return Channel Width	1.6MHz - 6MHz
Amplified Return	5MHz - 42MHz
Spacing	25dBmV

# Spectral Flexibility

- **Option 1) High-Split** – both forward and return EPoC ranges are above the top used frequency range – 860MHz to ~1.2GHz.
- **Option 2) Mid-Split** – increase low split >54MHz for return, as an example to 200MHz) and use the frequency range about 860MHz for forward. The return here may be contiguous or non-contiguous.

**Key Requirement:**

**Spectral Placement Flexibility**





# Service Profile

## © **Residential / Business Service Coexistence a MUST:**

- **Residential and Business Services will exist on the same access network, and on the same EPOC network, scheduled by a common scheduler, just as they do today in our DOCSIS access.**
- **Residential and Business Services may also exist on separate access (optical / coax?) distribution networks.**

## © **Symmetric and Asymmetric Services are both a MUST:**

- **Residential services are largely expected to continue the asymmetric trend, though there is concern that the asymmetry for some services will become less pronounced due to emerging applications.**
- **BHN Business services are targeted to be symmetric; Business services provided by DOCSIS are asymmetric though this is often not ideal.**
- **BHN Business services provided by EPON are universally symmetric.**

# EPOC and Services

- At BHN, HFC and EPON access technologies support various (and often non-overlapping) services.
- EPOC is envisioned to bring a common access technology for all services

<u>Services</u>	<u>HFC</u>	<u>EPON</u>	<u>EPOC</u>
Residential Phone Services	YES	NO*	YES
Commercial Phone Services	YES	YES	YES
Advanced Commercial Phone Services (Managed PBX, etc)	NO	YES	YES
Residential Video Services	YES	NO*	YES
Commercial Video Services	YES	YES	YES
Residential Internet Services	YES	NO*	YES
Commercial Internet Services	YES	YES	YES
Basic Commercial Data / VPN Services	YES	YES	YES
Advanced Commercial Data (MPLS L2VPN / MPLS L3VPN)	NO	YES	YES

**\* YES only in trial – high construction cost preclude widespread deployment.**



**Questions?**