G.fast: Deployment Scenarios Challenges & Opportunities

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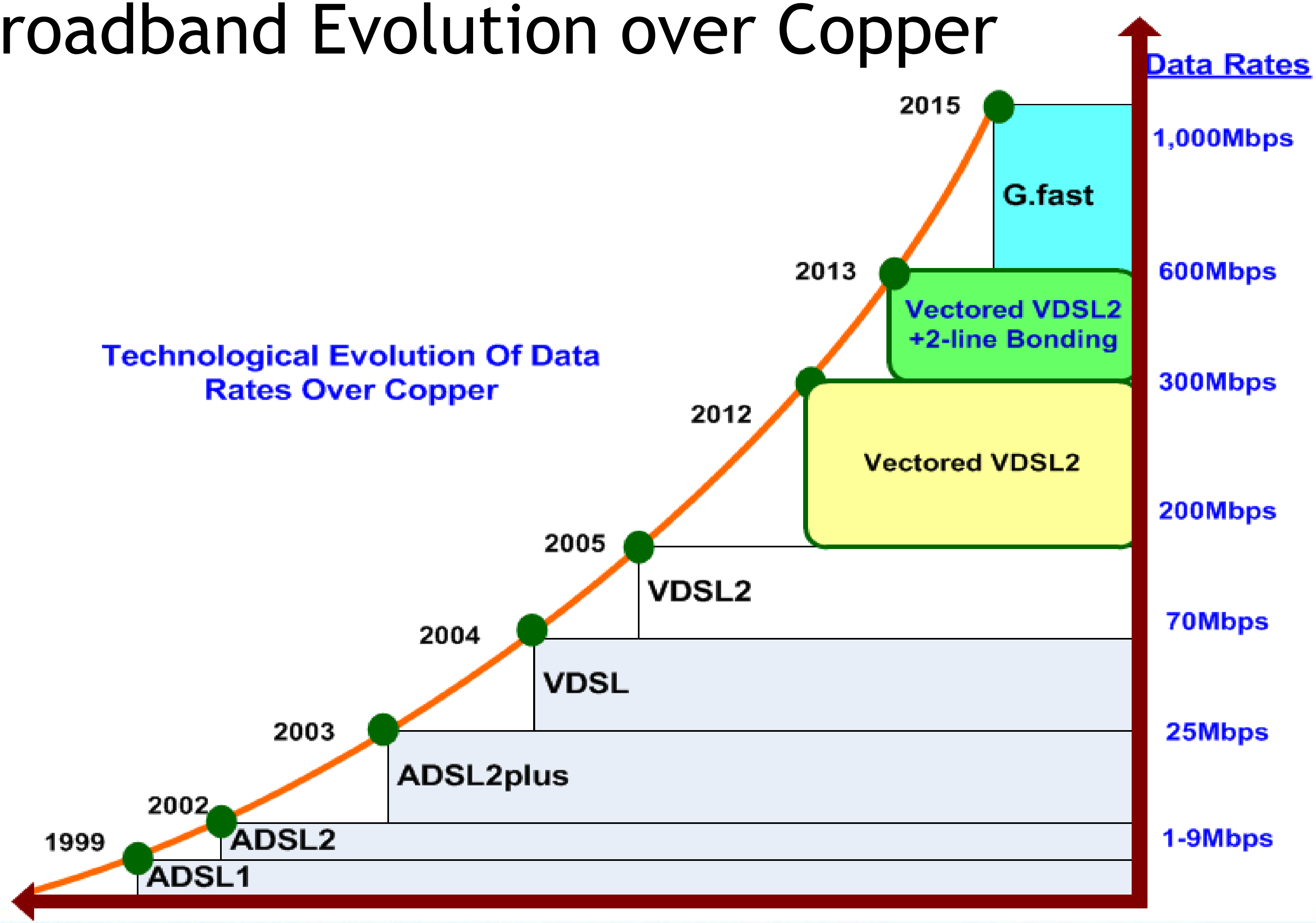
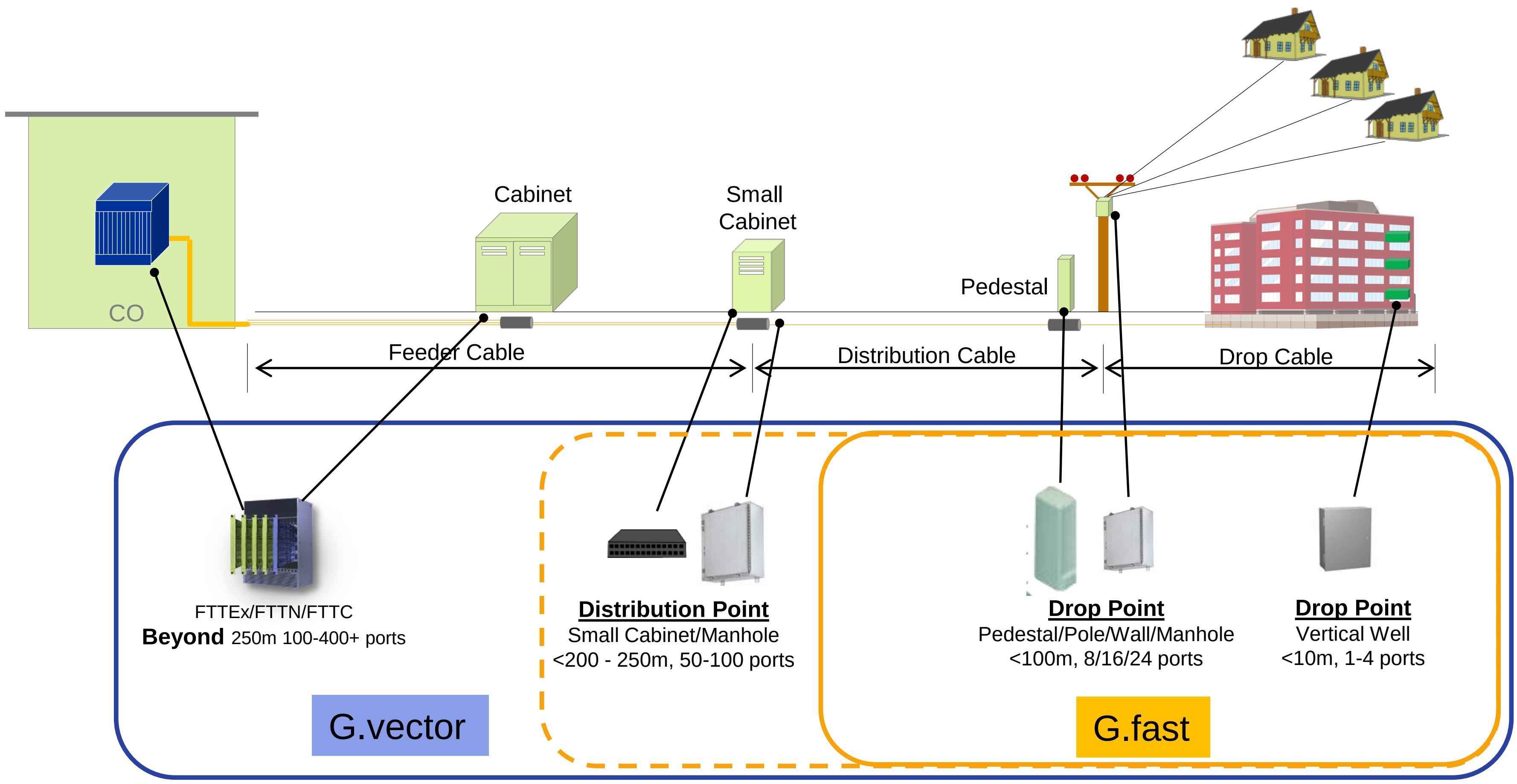
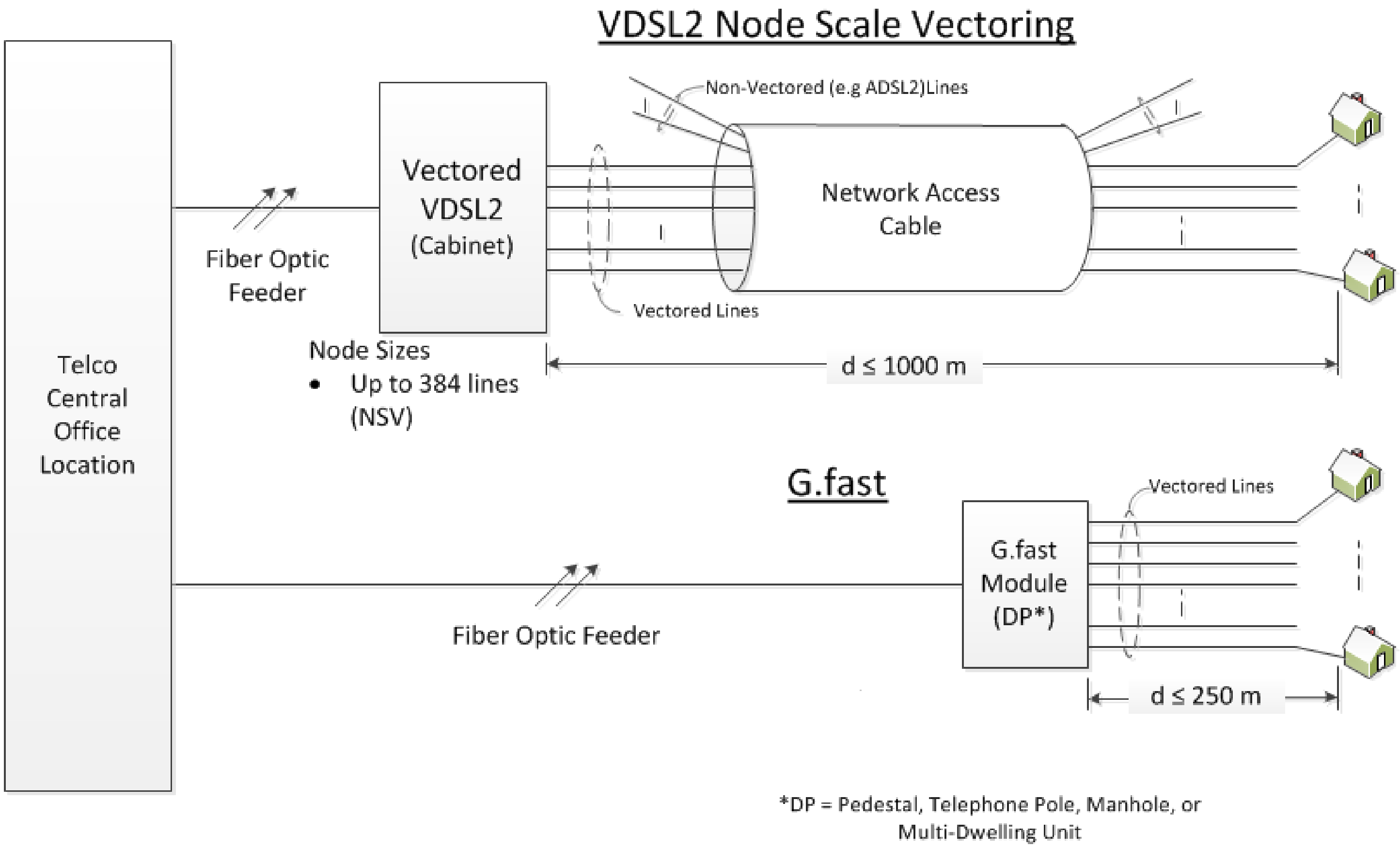
Broadband Evolution over Copper



G.fast vs. G.vector: Where do they fit?



Vectored VDSL vs. G.fast Broadband Access

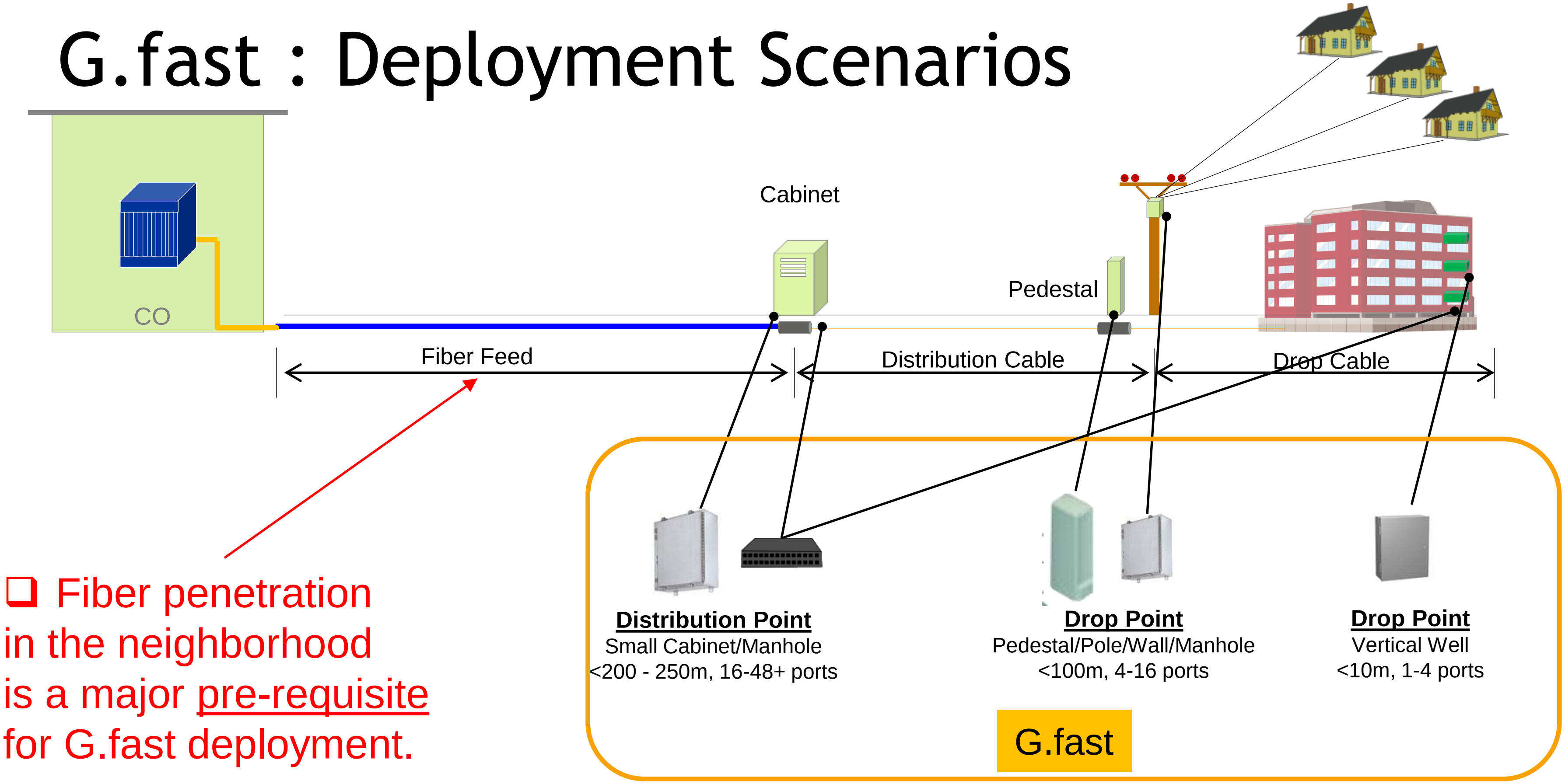


- Target Service Rates
  - VDSL2: 150 Mbps Aggregate (17a profile)
  - G.fast: 150Mbps – 1000 Mbps Aggregate (Based on loop length)

What is G.fast?

- High speed duplex transmission (≈1Gb/s aggregate) on short loops
- Deploy from a Distribution Point(DP)
  - Pedestals, Telephone Poles, Manholes, MDUs, …
  - Reverse powering (from CPE) of DP equipment
- Max distance ≤ 250m
  - Note: Certain carriers expect 400m or longer.
- Profiles
  - 106 MHz Profile (first generation) d ≤ 250 m
  - 212 MHz Profile (possible 2nd generation) d ≤ 100 m
- Targeted aggregate (US+DS) throughput rates on 24 gauge cable with 8 SFEXT and co-located CPEs:
  - 150 Mb/s @ 250m
  - 200 Mb/s @ 200 m,
  - 500 Mb/s @ 100 m, and
  - 500-1000 Mb/s for FTTB @ <100

G.fast : Deployment Scenarios



- **VDSL fallback and coexistence is necessary for mass deployment**
- **Reverse power feeding (RPF) requires low power and power management**
- **Stability, reliability and ease of installation are key to successful deployment**

Deployment Challenges & Opportunities

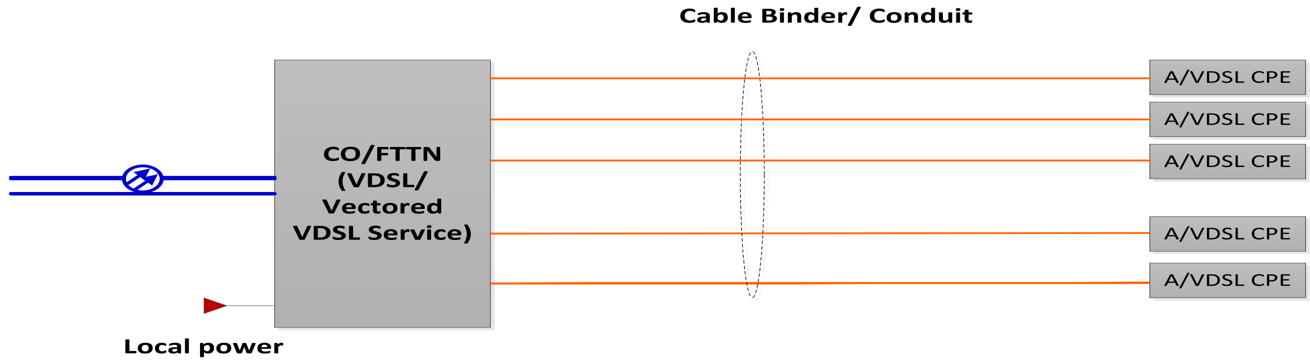
- FTTN to FTTdp migration
  - Seamless, gradual & NON DISRUPTIVE Transition from VDSL2 to G.fast
    - ***Support for VDSL2 fallback***.
- DPs must consume small amounts of power
  - Thermal consideration for sealed units without fan (4, 8 & 16 port DPs) will drive the upper limit for power consumption.
    - Upper limit ← →all ports being on and RPF must support it.
- Where FTTN & FTTdp boundaries blur!
  - Distance served by DP is greater than 250m and customers may be out of normal G.fast reach.

FTTN to FTTdp Migration

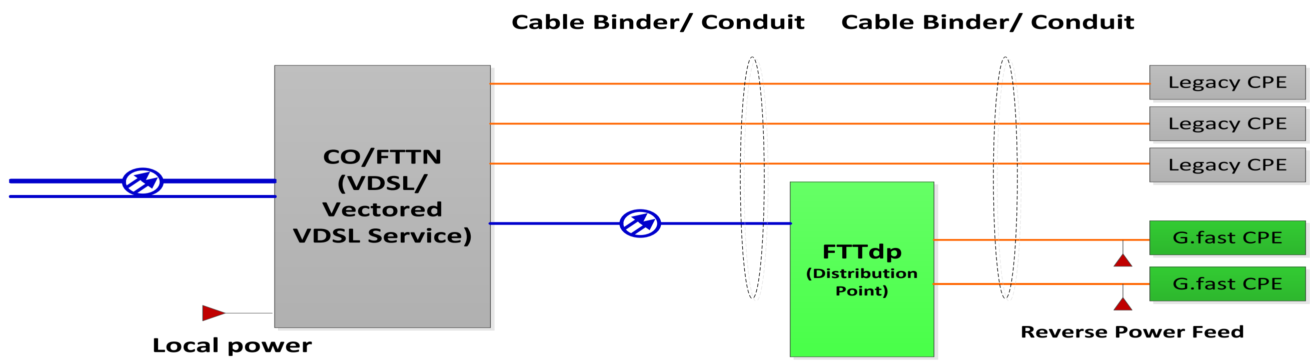
- Seamless, gradual & NON DISRUPTIVE Transition
  - Smooth Upgrade from VDSL to G.fast ⇨ VDSL fallback.

Scenario 1: Coexistance

Current Deployment



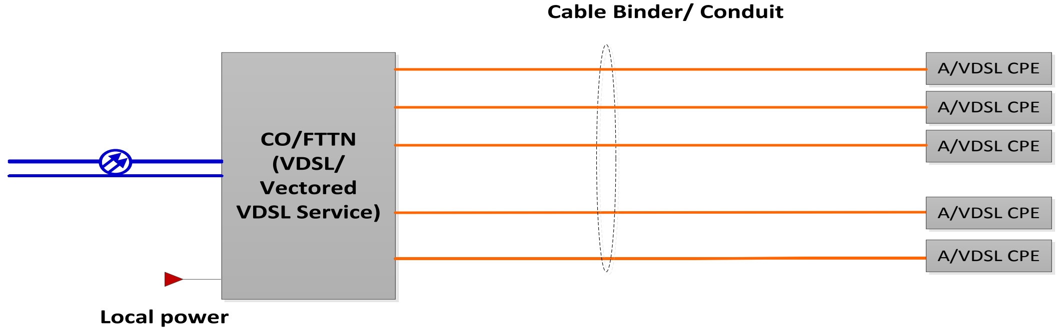
Scenario #1: Operator could move customers to FTTdp as needed



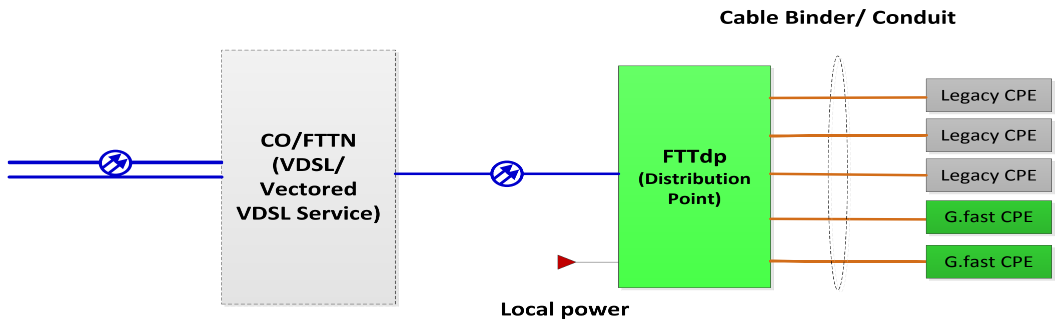
- VDSL Fallback is NOT mandatory.

Scenario 2: Seamless Transition without RPF

Current Deployment



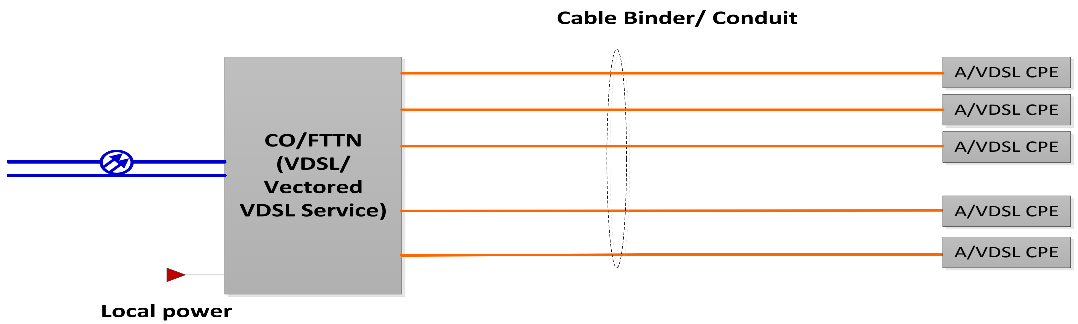
Scenario #2: Operator eliminates previous Fiber node, and moves all customers to FTTdp



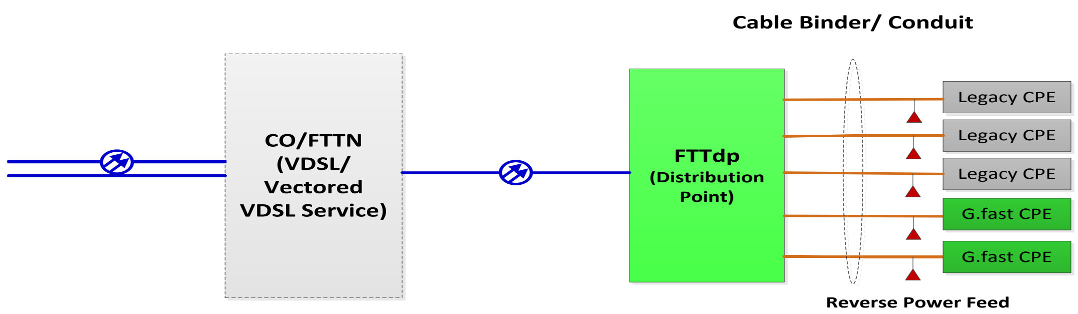
- This would be typical of a manhole or MDU deployment.
- DP has local power and does not need reverse power feeding (RPF)
- Some of the loops could be out of range for G.fast → VDSL service is preferred.
- VDSL fallback is MANDATORY.

Scenario 3: Seamless Transition with RPF

Current Deployment

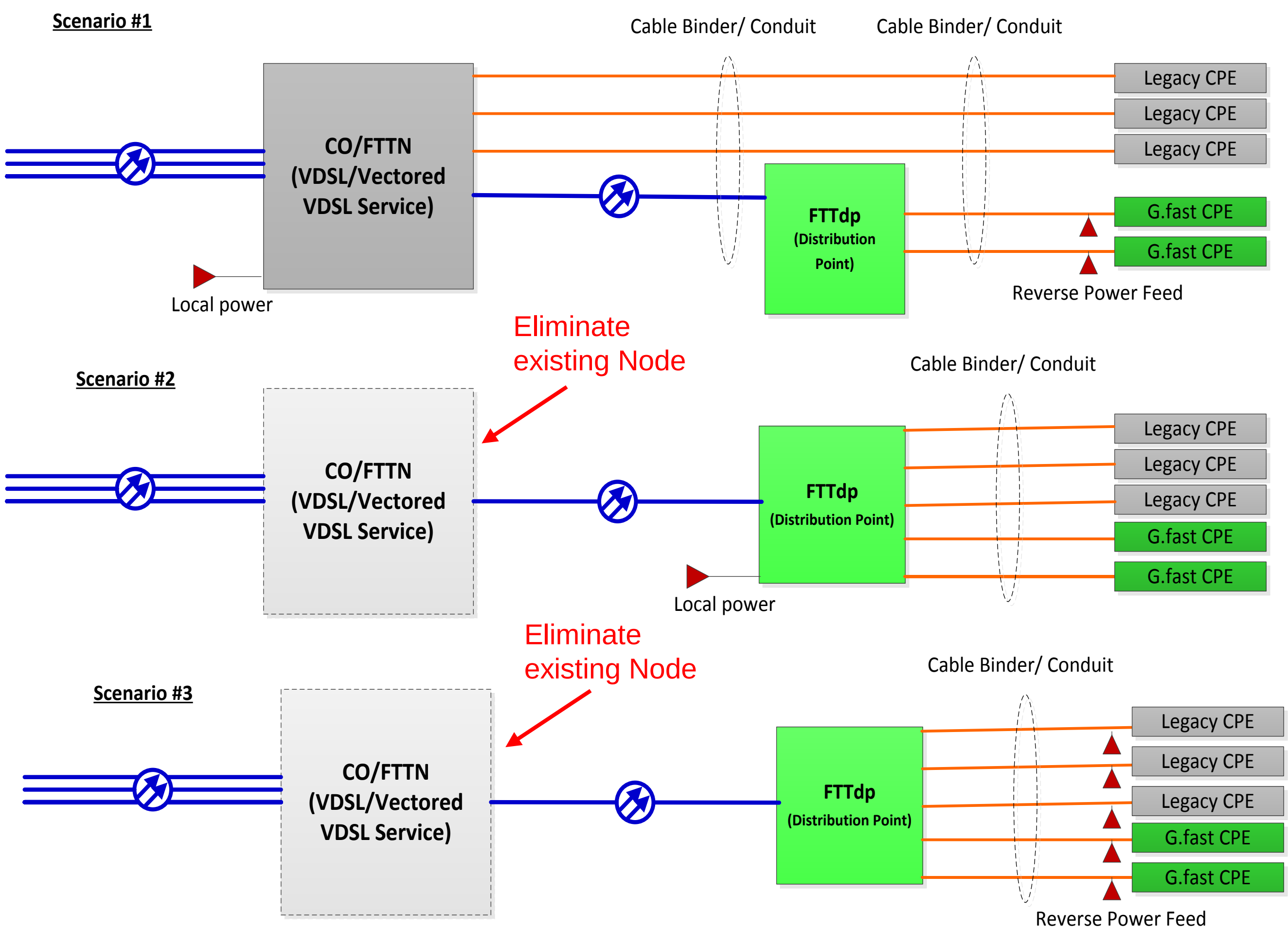


Scenario #3: Operator moves all customers to FTTdp, but DP has no local power



- VDSL fallback is optional for greenfield deployment (No Legacy CPE)
- Fallback is required in a brownfield deployment: VDSL CPEs aren’t replaced on day one
- DP has no local power, relies on reverse power feeding (RPF)
- Legacy VDSL CPEs will need RPF.

Deployment Scenarios – *VDSL Fallback and RPF*



High OpEx

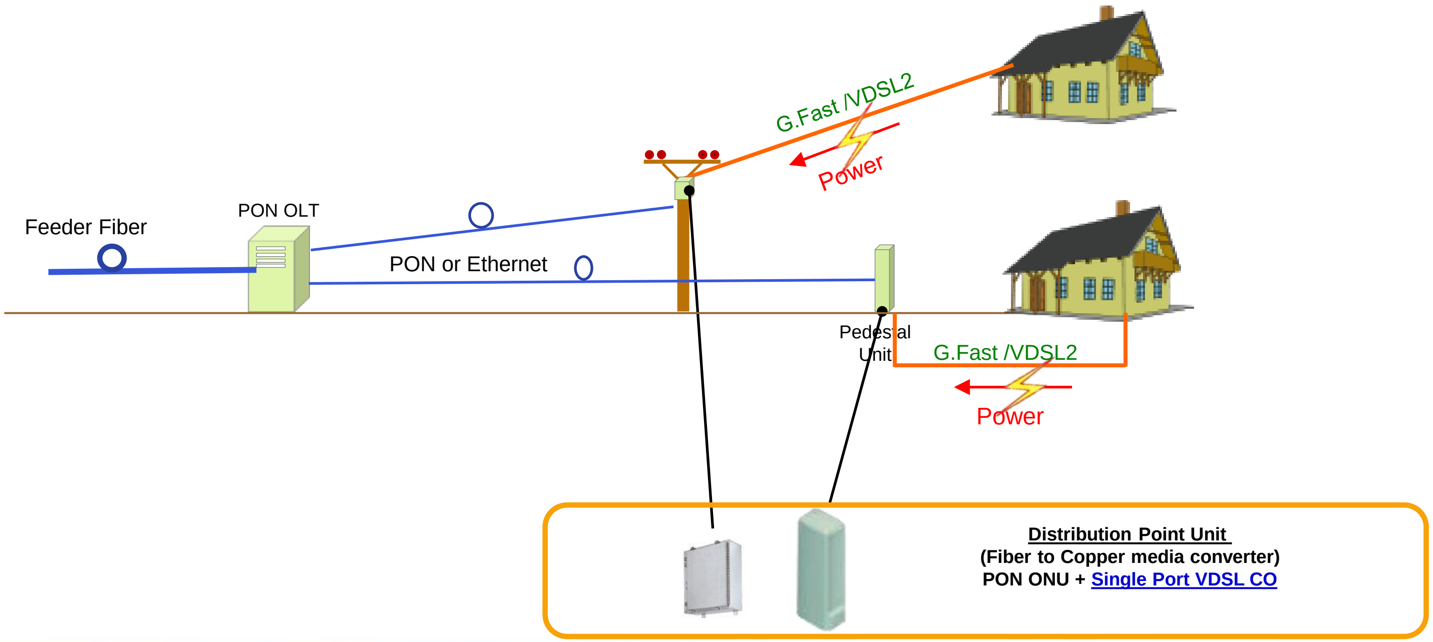
Seamless Transition W/O RPF

Seamless Transition with RPF

Market Pain Points and 1p FTTdp Use Case Scenario

Market pain points, creating opportunity for 1port FTTdp

- Last leg challenge
  - Final access to the house is the most expensive (>50% of FTTH cost in last 100m)
  - Customers refuse intrusion (yard, wall or in-home)
- RPF makes FTTdp simple, swift to deploy
- Potential bundling of multiple connections create crosstalk problem that reduce performance



VDSL Fallback: It is almost always required

Deployment Scenario	VDSL2 Fallback
VDSL2 MDU/DPU gets replaced with G.fast capable MDU/DPU	Required
Serve customers who are beyond G.fast reach	Required
Phasing out copper network	Required
Offloading VDSL2 from cabinet to DPU	Required
Migration from FTTn to FTTdp	Required
Customer moves to a G.fast location with his legacy CPE	Required
Greenfield deployment	Preferred
VDSL2 (still) offered from cabinet	Not required

Transmit PSD

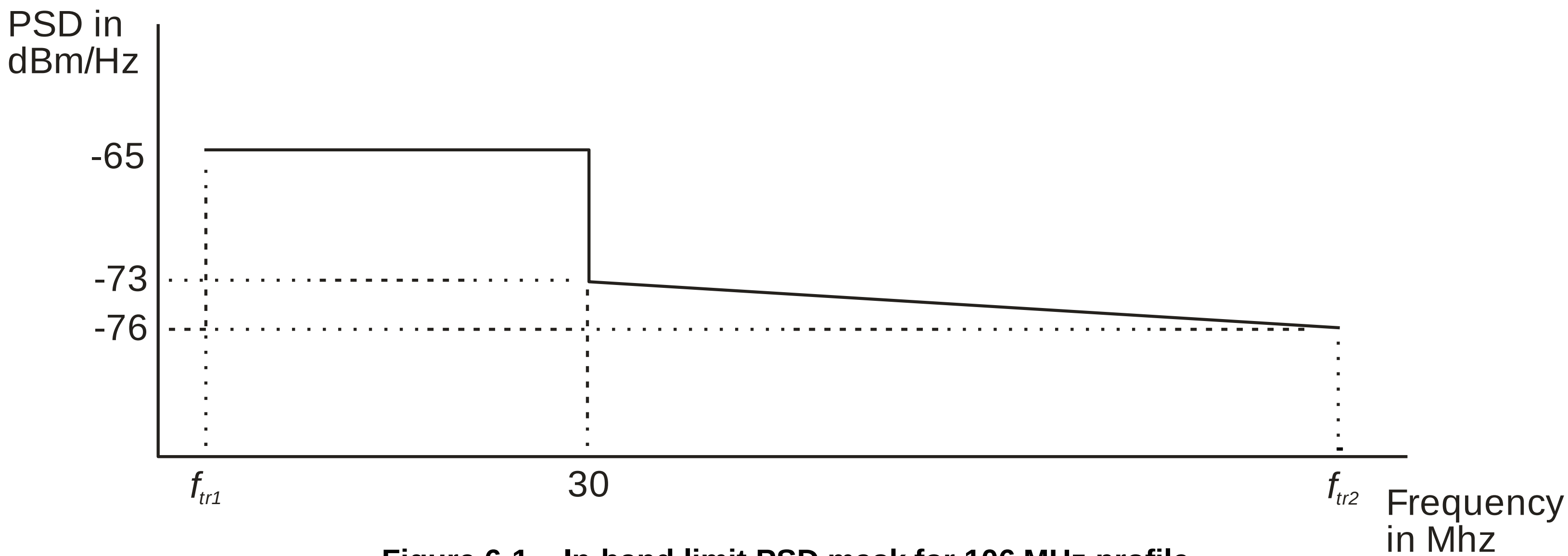
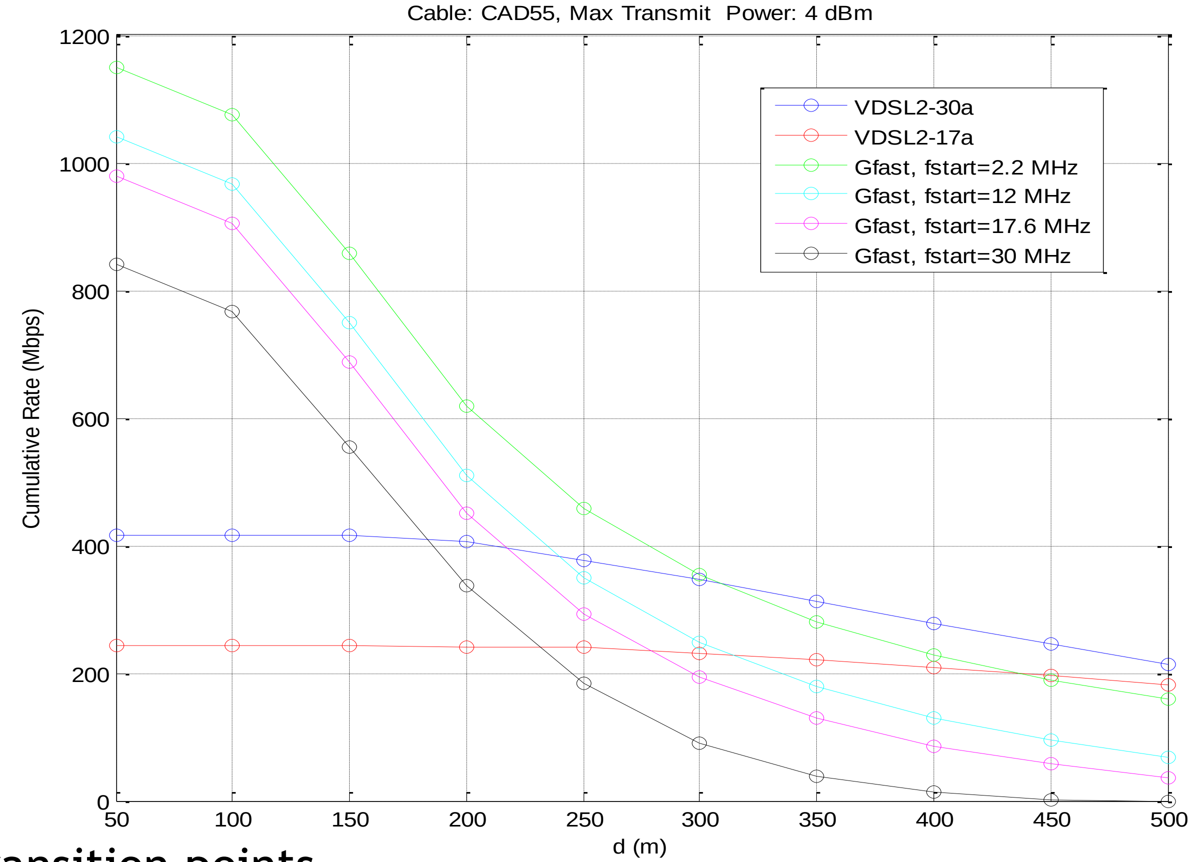


Figure 6-1 – In-band limit PSD mask for 106 MHz profile

- G.9700 – PSD Specification for G.fast (Determined July 2013 in TAP)
- Max P_{TX} = +4 dBm
- Rules defined for notching and out-of-band PSD levels

G.Fast & VDSL2 Fallback Comparison



Max Bit Loads

- VDSL2: 15 bits
- G.Fast: 12 bits

- Transition points
  - VDSL2 profile 30a & G.fast 2.2 MHz start: 300 m @ 350 Mb/s agg
  - VDSL2 profile 30a & G.fast 30 MHz start: 183 m @ 409 Mb/s agg
  - VDSL2 profile 17a & G.fast 17.6 MHz start: 280 m @ 240 Mb/s agg

DPs must consume small amounts of power

- Reverse Power Feeding (RPF)
  - ➢ RPF is required for a typical FTTdp deployment
    - ❖ Unavailability of local power
  - ➢ Mandates lower power consumption
    - ❖ Ability turn off unused parts of the system on a per user basis

- Challenges:
  - ➢ 1W per port challenge without Discontinuous Operation (DO)
    - ❖ Analog Power will be the deciding factor
    - ❖ Low power AFE technology is a MUST to remain below a WATT !

Where FTTN & FTTdp boundaries blur!

- Distance served by DP is greater than 250m and customers may be out of normal G.fast reach.

- Challenges
  - ➢ Higher Transmit Power
    - ❖ Support for ***greater than 4dBm Transmit (Tx) power*** for G.fast
    - ❖ Support for ***VDSL fallback + VDSL with greater than 4dBm of Tx Power.***
  - ➢ DPs get bigger → Vectoring gets more complex!
    - ❖ ***4, 8 or 16 port vectoring is NOT sufficient.***
    - ❖ System Level (Node Scale) Vectoring: DPs for Manhole & MDU type deployments will be large (e.g. 48 ports)

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Q&A

Thank You

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