

The logo features the text "SCKiPIO" in a bold, white, sans-serif font. A dark blue, wavy graphic element is positioned above the letter "i", extending from the top of the "i" and curving over the "P".

SCKiPIO



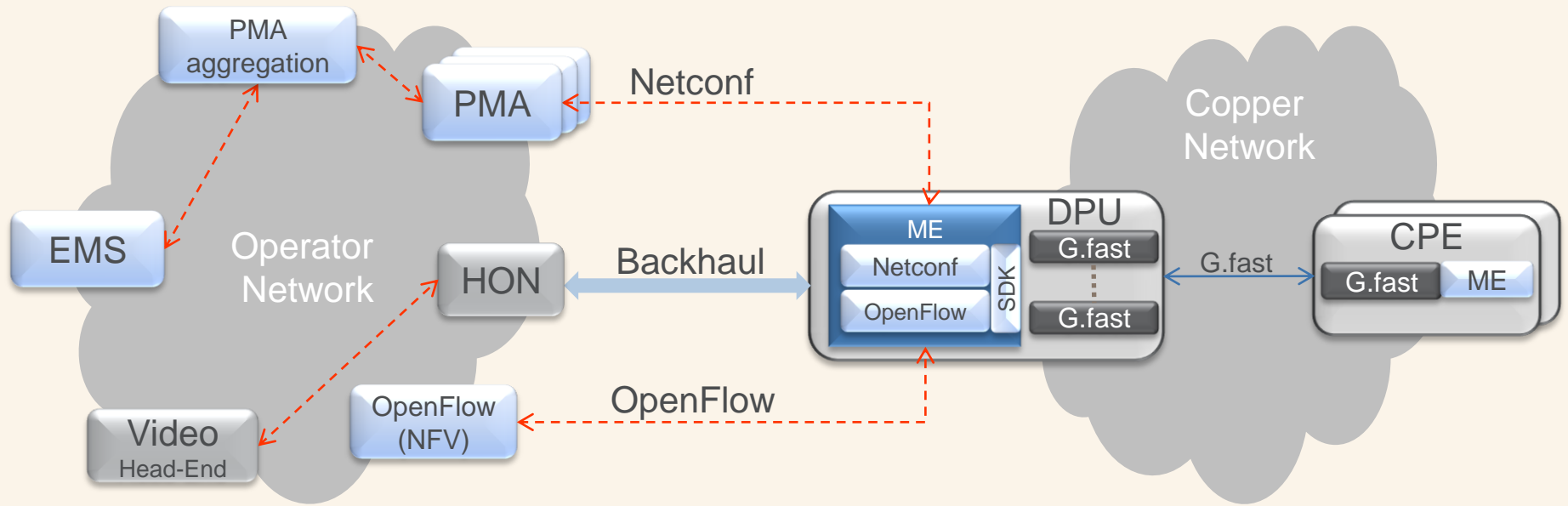
Connecting The Pieces

Putting the pieces together and some insight on the evolution of G.fast

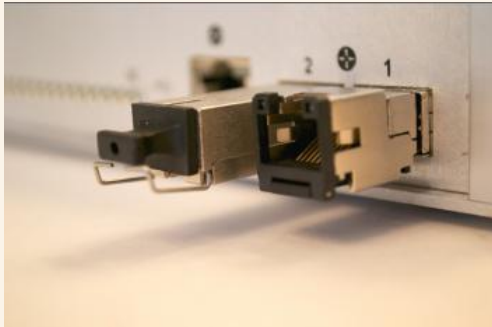
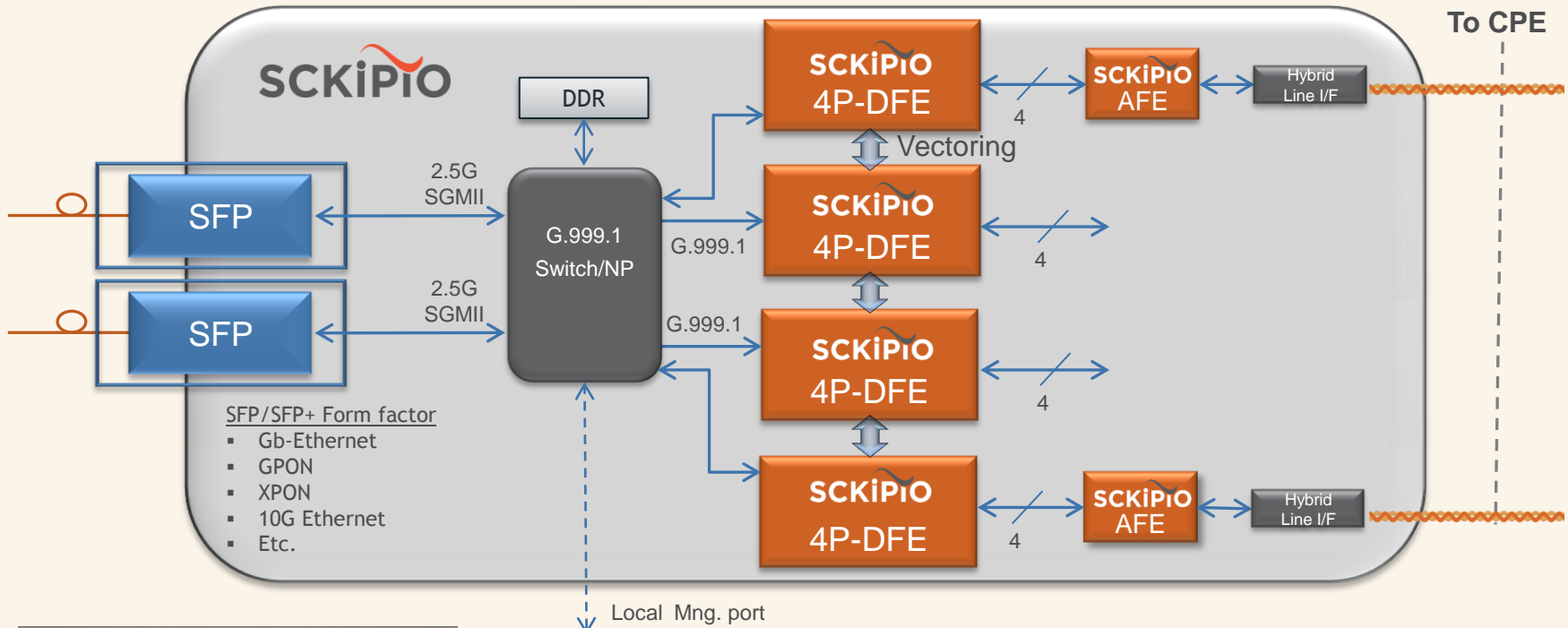
Agenda

- Putting the pieces together
 - DP elements
 - GPON, RPF, VDSL coexistence/dual mode, management
 - GW elements
- What's next...
 - Market evolution
 - Next generation G.fast
 - G.fast vs. VDSL 35b

The End To End Solution



16 ports DPU



Different scenario examples

ADTRAN 500G series G.fast Outdoor ONU

- ◀ 8, 16 and 24-port variants
- ◀ Fully sealed enclosure for DPU and MDU deployment flexibility
- ◀ Passive cooling for completely silent operation in residential areas
- ◀ Zero construction: span or reverse- powered GPON (via SFP ONT) and P2P fiber uplinks
- ◀ Forward-compatible to SDN-controlled architectures



ADTRAN

Indoor DPU example

ADTRAN 624G G.fast Indoor ONU

- ◀ Supports 8-16-24 MDU living units
- ◀ Supports Gigabit Broadband
- ◀ 10Gig Ethernet Ring uplink (ERPSv2)
- ◀ GPON and NG-PON2 uplink options
- ◀ Forward-compatible to SDN-controlled architectures

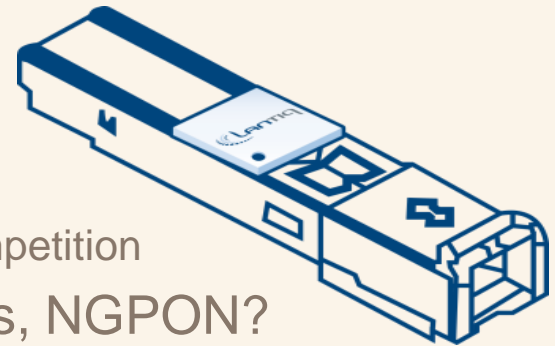


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Hardened Outdoor version is designed for outdoor passive (no fan) cabinet applications

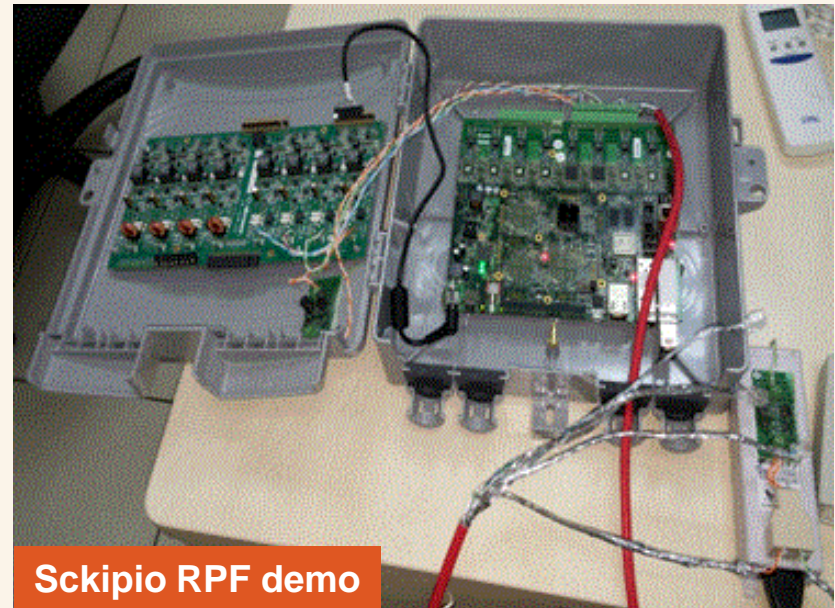
Why Using GPON SFP

- Decoupling the ONT from the DPU
 - Keeping the DPU simple
 - Lower cost
 - Opens the market to more vendor, i.e., more competition
 - Easy migration to new optical technologies, NGPON?
- No lock up to a specific GPON vendor
 - The history of GPON interoperability...
- Note – GPON SFP is gaining momentum also in the GW market, volume is ramping up



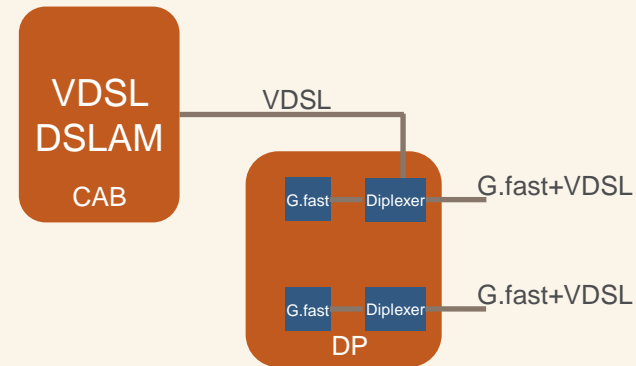
Reverse Power Feeding (RPF)

- 4 ports DPU with RPF was demonstrated in January 2015
- Requirements and challenges
- Power
 - Run one port with $<12\text{w}$
 - NP's may be power hungry
 - Special care to avoid peaks
- Noise injection from RPF
 - Special care for long loops



Dual Mode DPU (G.fast + VDSL)

- Very few customers are looking for a dual mode DPU
 - Makes no sense for CAB deployment
- Main issue is cost
 - Two line interfaces
 - Two AFE's: one for VDSL and one for G.fast
 - How to couple (or select) the two signals without a loss:
 - Diplexer or a relay
 - One DSP may be used for both but what about the ratio between the number of ports per mode
 - If you optimize for VDSL, G.fast is going to be quite expansive...



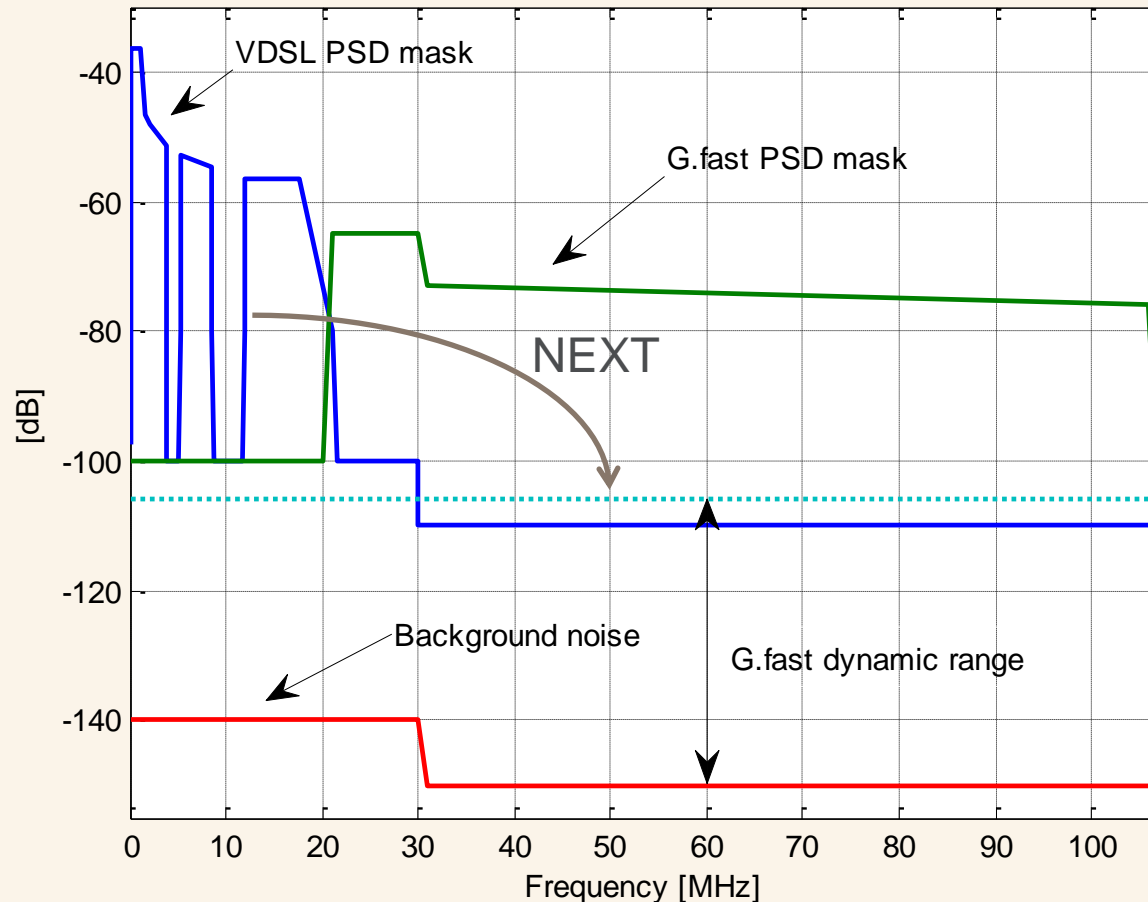
- And the alternative is quite simple

VDSL coexistence

- Issues in both directions
- G.fast -> VDSL
 - Spectral overlapping is not allowed
 - G.fast may start from 20-23MHz
- VDSL -> G.fast
 - VDSL in-band NEXT into G.fast
- Some filtering may be needed

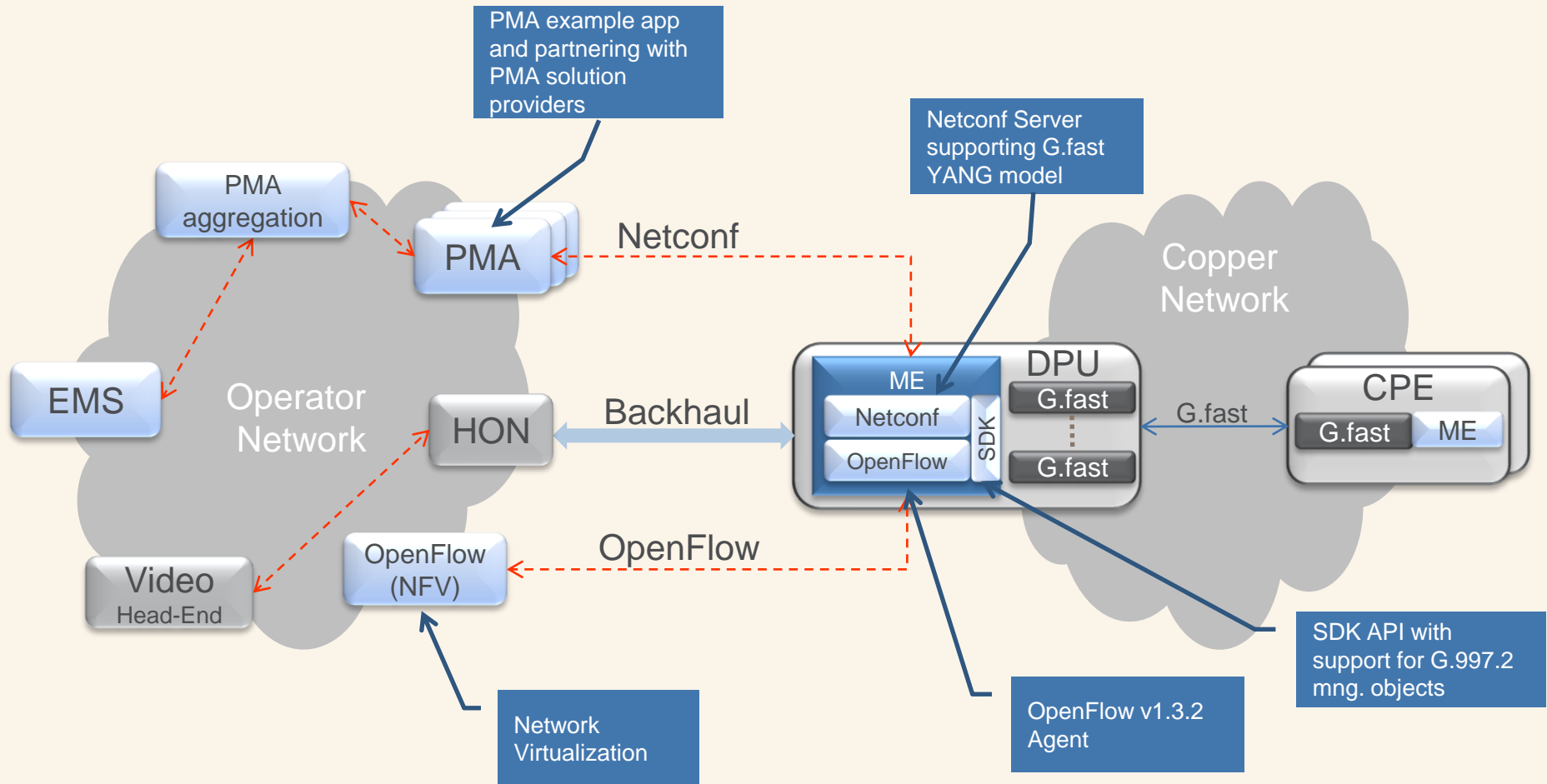


VDSL-G.fast coexistence

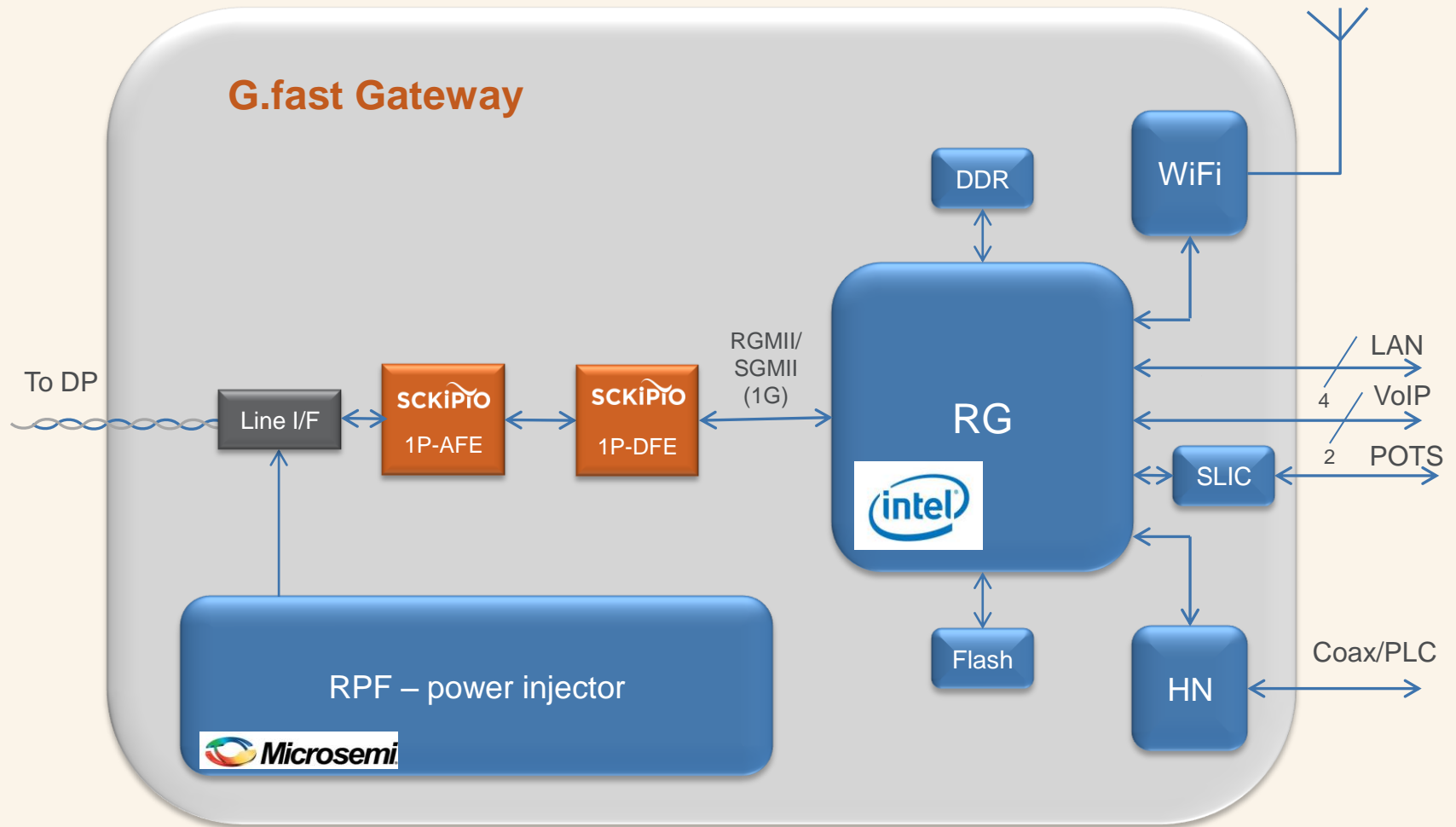


- VDSL in-band signal may couple into G.fast receiver via NEXT and limit its dynamic range (higher noise floor)

Data, Management and Control Plane



G.fast Integrated Gateway (CPE)



G.fast CPE Examples

ADTRAN 500RG series Residential Gateway



- ▶ SFP i/f for Gigabit Broadband
- ▶ Rapid home installation from eliminated home wiring
- ▶ Optimized for multi-user homes via MU-MIMO technology



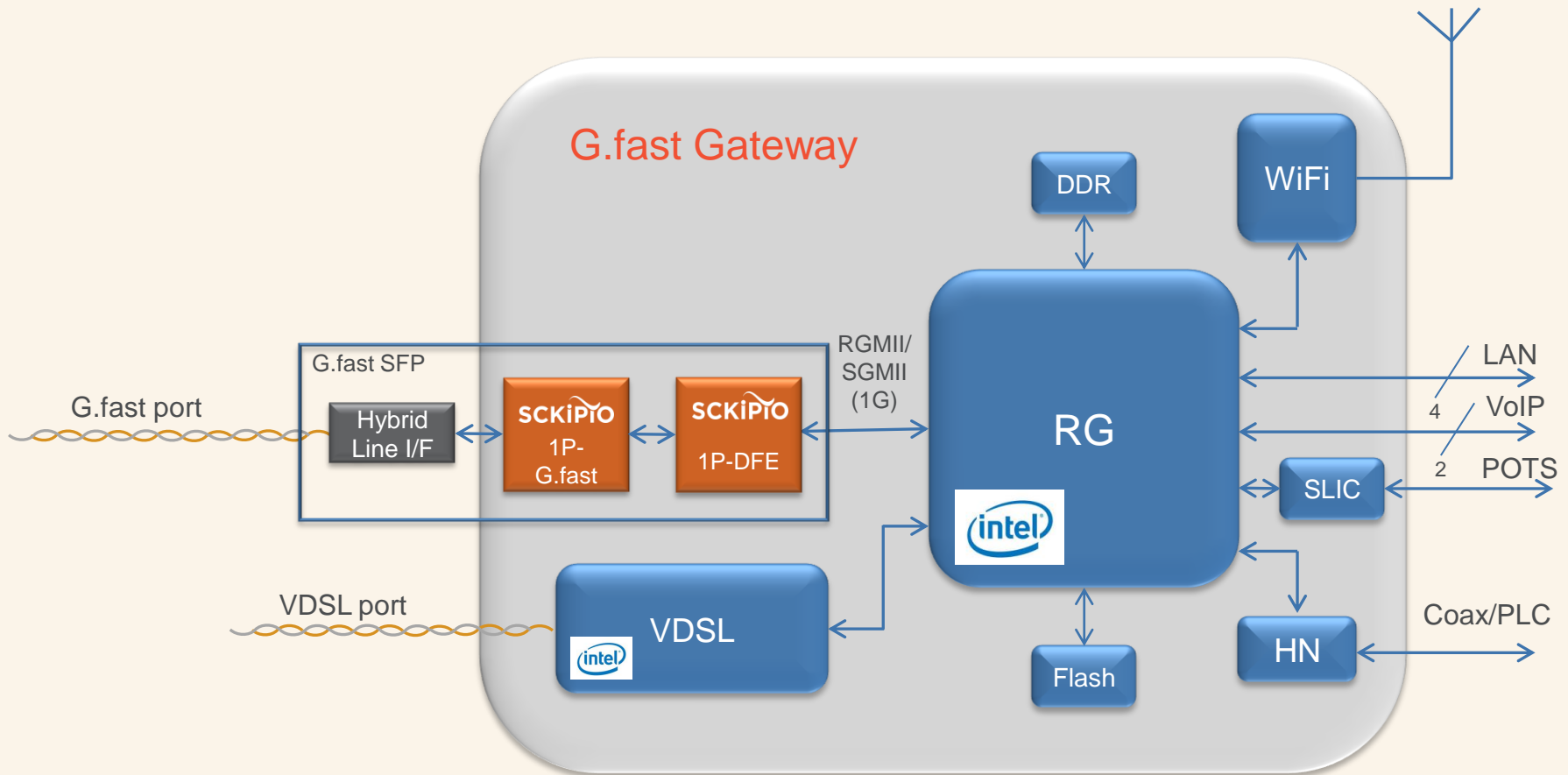
ADTRAN 5660 and 6360 IP Business Gateway



- ▶ Converged Gigabit Access Router
- ▶ Layer 2/3 managed service delivery
- ▶ Support for mobile network timing distribution
- ▶ Programmed and monitored through open APIs using **NETCONF/YANG** and **OPENFLOW**

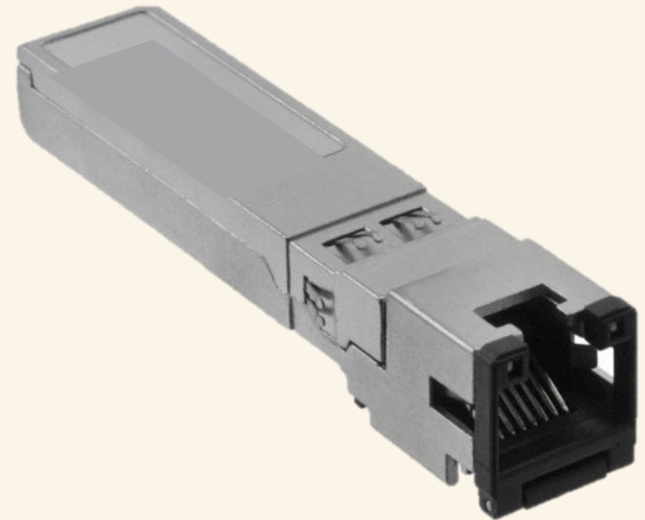


SFP based G.fast Gateway



Why G.fast SFP

- Migration strategy from VDSL to G.fast become easy
- Reuse existing VDSL Residential **and** Business CPE
- Future proof
 - G.fast amendment 2?
 - Interop. fixes
- Multi-mode GW
 - G.fast
 - GPON
 - 1G Eth.
- Reduce risk of interoperability

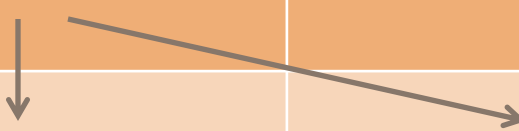


What's next with G.fast

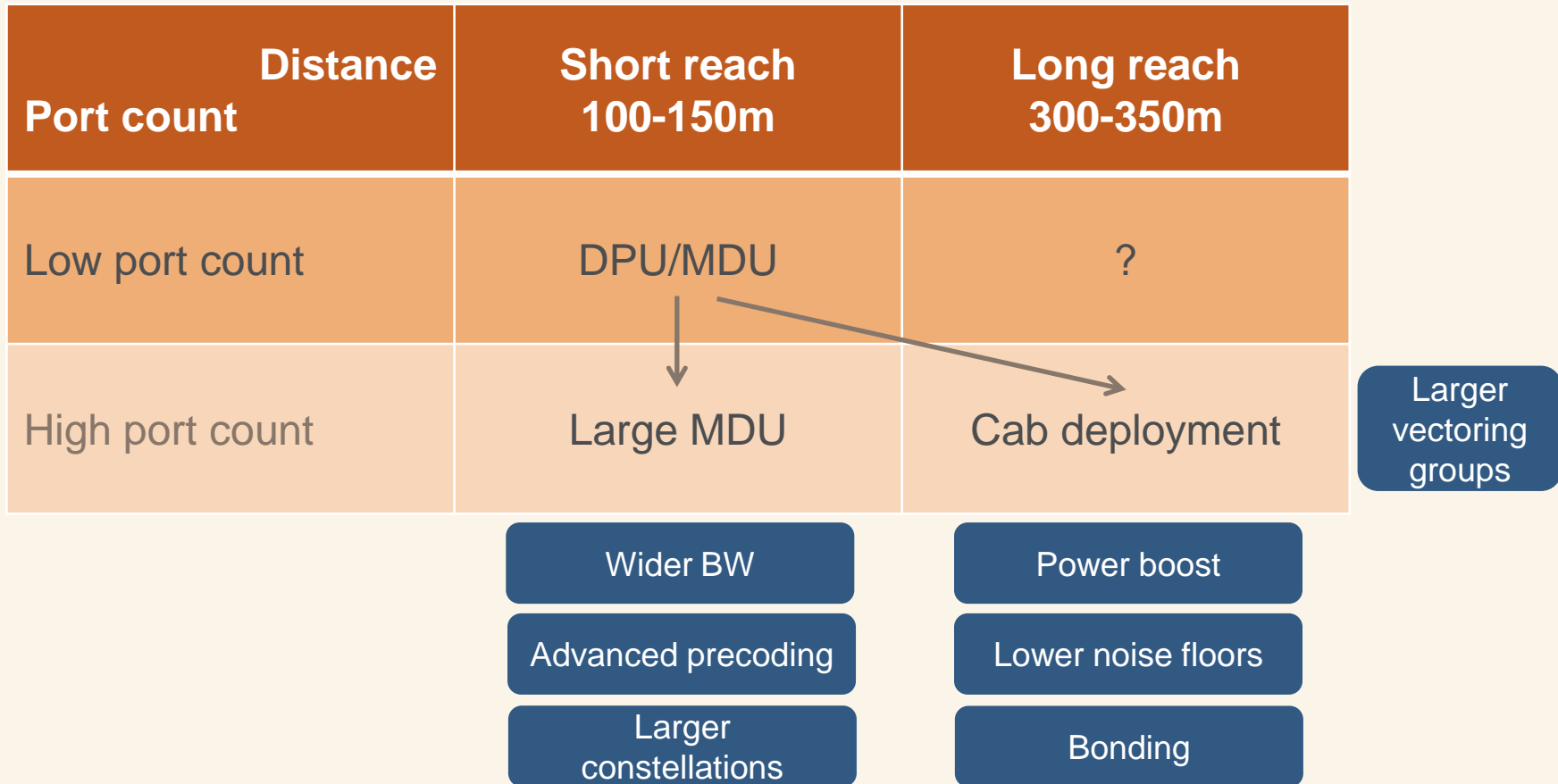
G.fast technology going forward

G.fast is extending its scope

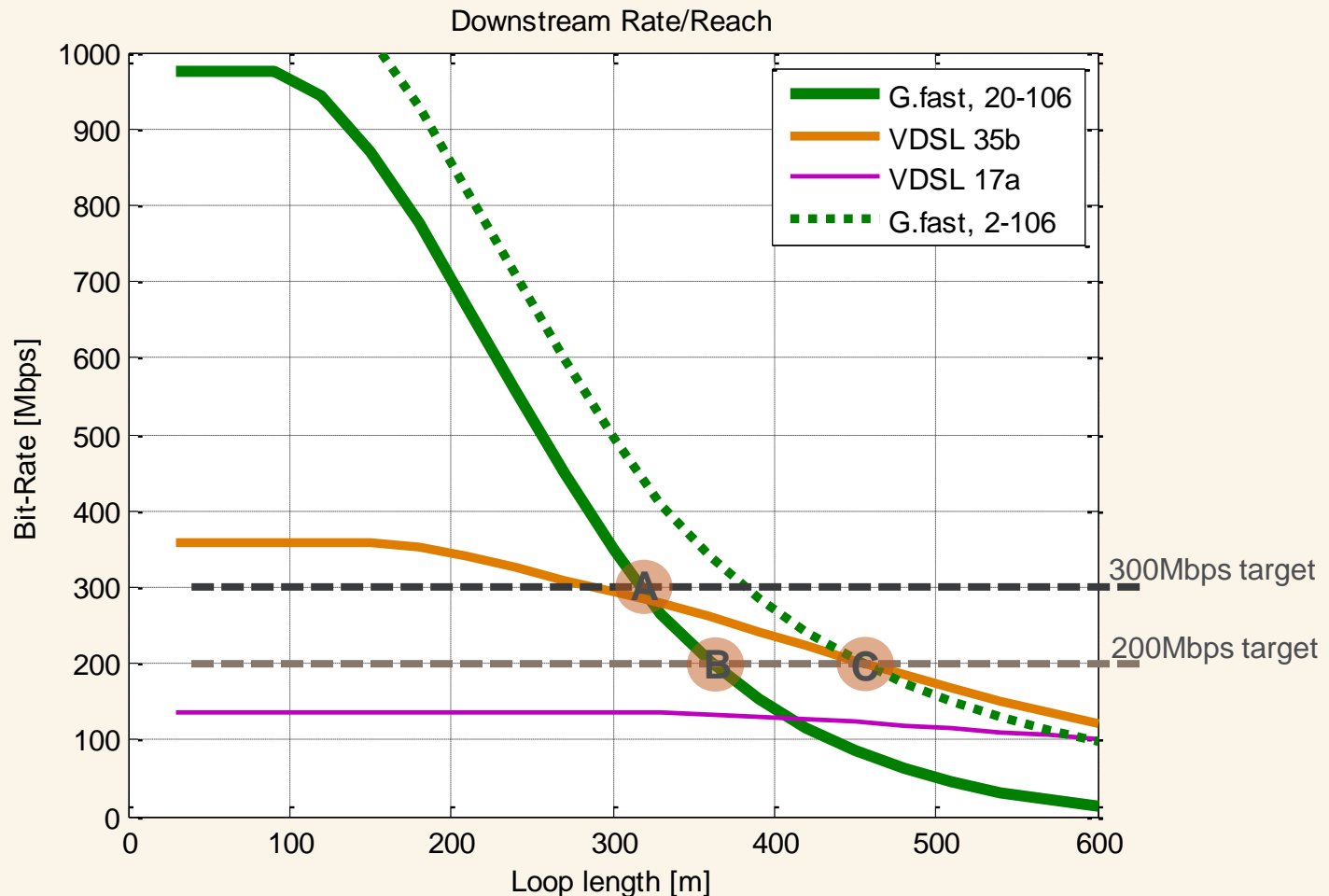
Distance Port count	Short reach 100-150m	Long reach 300-350m
Low port count	DPU/MDU	?
High port count	Large MDU	Cab deployment



G.fast is evolving - more features to be added...



G.fast vs. VDSL 35b, downstream



- Huge advantage for G.fast for short lines. Similar performance if the target rate is 300Mbps. Advantage to VDSL+ if the min rate target is 200Mbps (100m). No real advantage for VDSL+ if G.fast can start from 2MHz.

V+ (35b) vs. G.fast Comparison

Parameter	G.FAST	VPLUS (35b)
Bandwidth	2-106MHz, 2-212MHz (future)	2-35Mhz
Max Rate	Up to 1Gbps with path to even faster future G.fast performance	Up to 400Mbps for 0m loops, no path to higher speeds
Down/Up ratio	Configurable: 90:10 to 30:70	Fixed ratio
Complexity	2K Carriers (more efficient)	8K Carriers (results in 4x more memory required for vectoring)
Vectoring	Designed to cope with the high FEXT level in the G.fast band	Designed for the low 17MHz VDSL frequencies. Significant performance loss when FEXT is high.
Customer Self Install	Likely – the huge rates leave margin for handling tough in-home networks	Unlikely – performance may drop under 17a rates
Openness	7 silicon vendors participate in the G.fast interop. event (Plugfest)	Single vendor? No BBF certification plan

Summary

- We have all the elements in place
 - Ready to start the evaluation of the complete solution
- New deployment strategies are developed for G.fast
 - G.fast technology is evolving to align with the new requirements

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Thank You