

# Optimizing home networks for maximum end-to-end FTTH experience

Ronald Heron

*Lead Technology Strategist*

Nokia

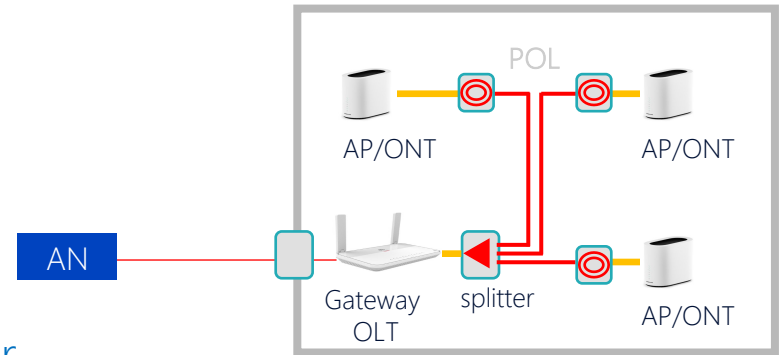
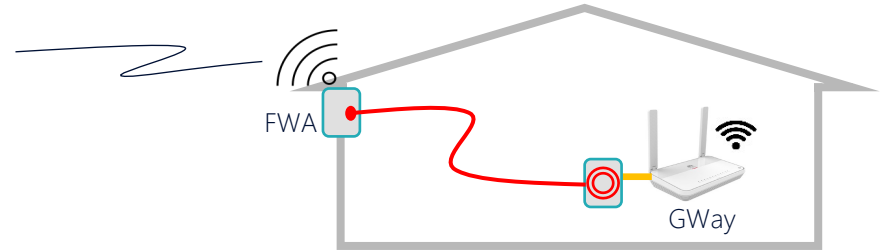
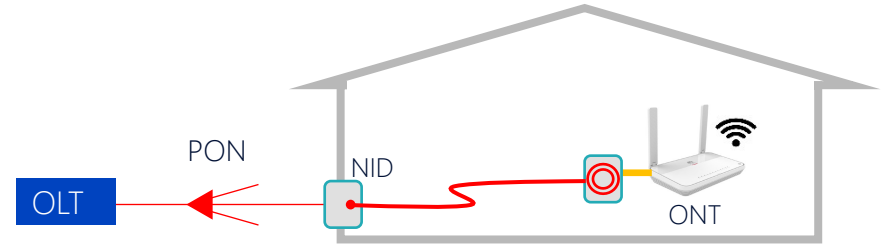
2023-06-23

# Outline

- Current situation and drivers
- P2P and P2MP Fiber in the Premises Solutions
- Making it happen
- Conclusions

# Fiber in the Home - is Not New

- Fiber to indoor ONTs
  - Fiber installed in the home to reach ONT
    - ONT often in living room in center of house
    - Sometimes through hallways and risers in MDU
- Fiber from FWA receiver to gateway
  - Receiver on wall/roof not the right place for GW
  - Generally no existing copper or coax from roof
- Passive Optical LAN (POL) for small biz.
  - Fiber in the building to ONTs at the desk



...but there are new opportunities to consider

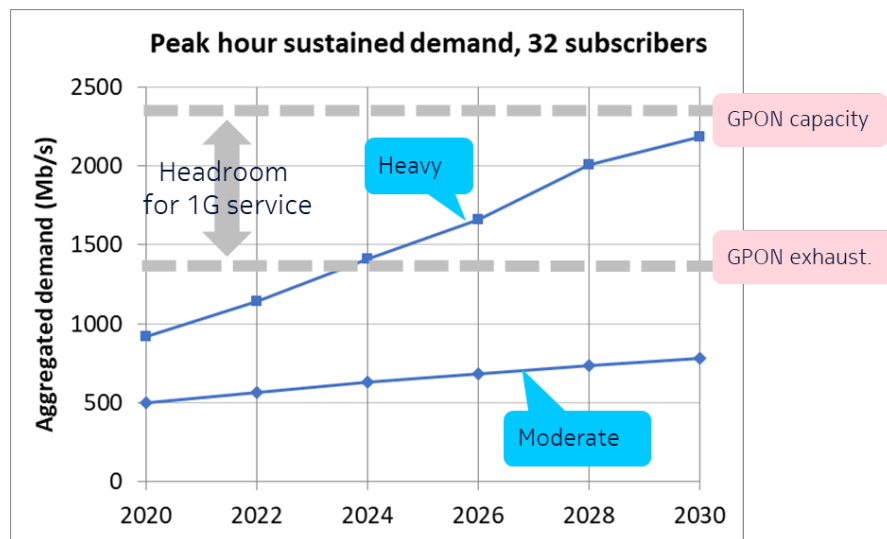
## Bandwidth needs / desires

- Desire for peak BW (i.e. speed test)  
>1Gbps → 10Gbps  
(apparent willingness to pay)
- Actual BW needs for foreseen services:  
a few 100Mbps
- As a point of reference:  
GPON (2.5G) which serves 32 homes is  
approaching exhaust in coming years

Real BW is growing  
but needs are still manageable

	Nokia BW estimate (2020 → 2030)
IPTV 8k	60 → 30 Mbps (c)
Cloud VR 8k	120 → 60 Mbps (c)
Cloud VR 16k	220 → 110 Mbps (c)

(a) Broadband Development Alliance, WP 2021  
(b) ITU-T SG15 G.9976 UHD video over G.hn, 2021  
(c) Bandwidth Demand Forecasting, Harstead & Sharpe based  
on 12k and 24k Field of View (FOV)



# Pause to Look at Existing solutions

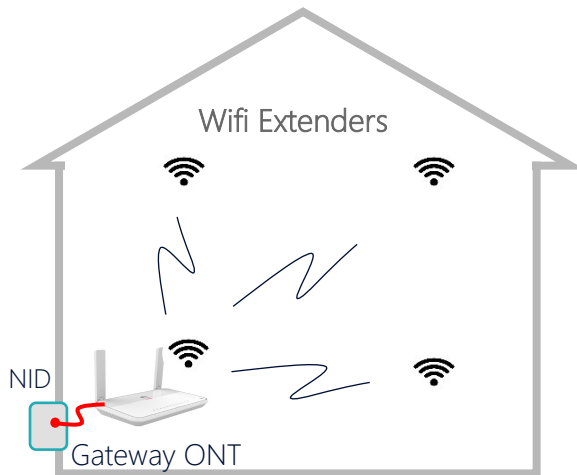
## Single Wifi

- Wifi6 & 6E = 1.2 – 4.8 - 9.6 Gbps (w 8ch and 160MHz)
  - Wifi7 allows up to 40Gbps
- Challenges
  - Spectrum pollution in dense areas
  - Concrete walls attenuate signal



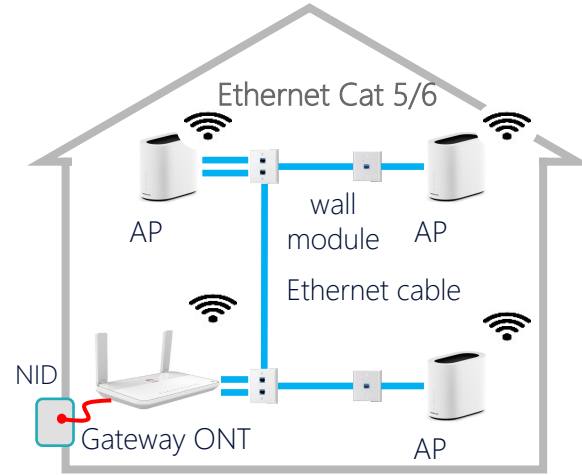
## Wifi with extenders

- Wifi6 & 6E = 1.2 – 4.8 - 9.6 Gbps (w 8ch and 160MHz)
- Significantly overcomes concrete wall
- Easy installation



## Ethernet Cat 5/6 to the room

- Cat5e = 1Gbps
- Cat6a = 10Gbps
- Installation of wires is a pain
  - We could rightly ask:  
Why not use fiber instead?



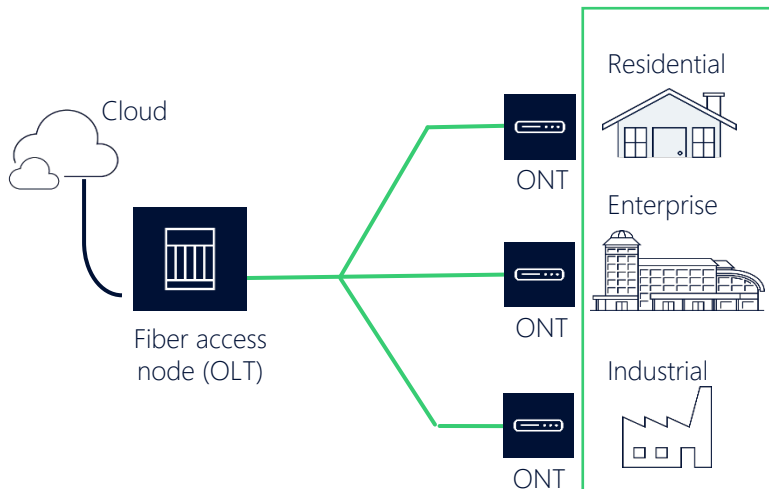
Existing solutions still have plenty of capacity

# Potential Motivations for Fiber in the Premises

- Performance:
  - Concrete walls
  - WiFi interference
  - Guaranteed 1-10G to the room
- Enabled by the emergence of low-cost invisible fiber
- Possible extra revenue for operators
  - reduced trouble reports
- Increased house value for real estate developers
- Government policy, incentives

# Use Cases and requirements for FIP

FTTR4H: fiber to the room for home  
FTTR4B: fiber to the room for business  
POL: Passive optical LAN



## Market Segments:

Residential: SDUs & MDUs	Enterprise and Industry		
	micro	small	medium
2-8 terminals	<20	20-100	>100
FTTR4H	FTTR4H	FTTR4B	POL

## Requirements

### FTTR4Home:

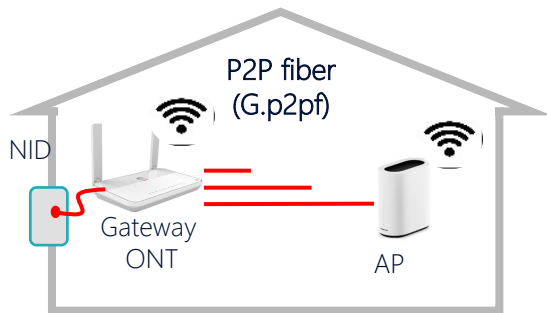
- 10G, fiber
- Management by user or operator
- 2-8 terminals (home)
- WiFi

### FTTR4Business:

- 10G, fiber
- Management by user or 3rd party (not operator)
- >20 terminals (SME)
- WiFi mobility, Cat 5/6 termination

Different market segments call for different optimized FIP solutions

# Fiber in the premises – Two Technical Options



## P2P fiber:



### Pros:

- Simple, minimal change to GW
- Low cost P2P optics
- no external splitters
- Supports WiFi EasyMesh, TR.369...
- Supports daisy-chain
- Can start with FTTFloor and grow

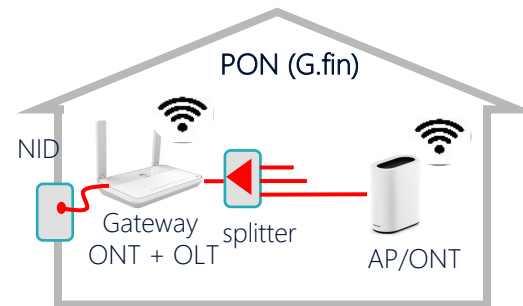


### Cons:

- Multiple fibers and ports on GW  
...but both are minimized by daisy-chaining

*Well suited for fewer terminals  
(e.g. home, SME)*

➤ **G.p2pf** at ITU Q3 – initiated in April 2023



## PON:



### Pros:

- Single port on GW
- Flexible split ratio



### Cons:

- Complexity of PON MAC (ASIC)
- Complication of splitter
- PON gives no fiber savings
- Need to adapt PON to WiFi EasyMesh

*Well suited for more terminals  
(e.g. enterprise)*

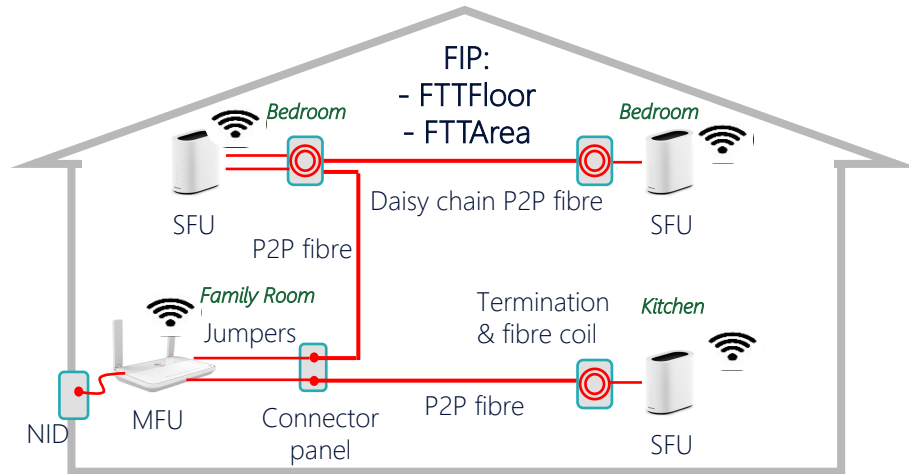
➤ **G.fin** at ITU Q3



# G.p2pf Fiber in the Premises Solution

## Basic elements

- Main Fiber Unit (MFU) & Sub Fiber Unit (SFU)
- Fiber to the Floor & Fiber to the Area
- Jumpers, connector boxes, fiber coil



## Point to Point optics

- Potential to leverage IEEE 802.3 Ethernet
  - 802.3z – Optical 1G Duplex
  - 802.3ae - Optical 10G Duplex
  - 802.3cp – Optical 1G / 10G BiDi
- Duplex vs BiDi

	Duplex	BiDi
Pros	<ul style="list-style-type: none"><li>• Cheaper optics</li><li>• Single module</li></ul>	<ul style="list-style-type: none"><li>• 1 fiber</li></ul>
Cons	<ul style="list-style-type: none"><li>• 2 fibers</li></ul>	<ul style="list-style-type: none"><li>• More expensive</li><li>• Two modules</li></ul>

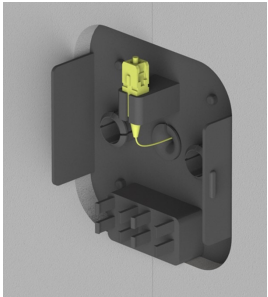
# Ergonomic Concepts to Facilitate Fiber installation

Invisi-fiber glue gun



ADHESIVE APPLICATION TOOL

Wall connector



Cover & Dust protector



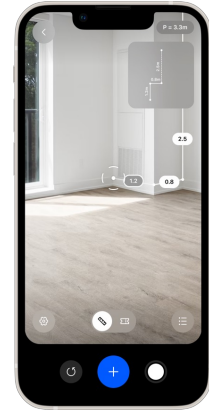
Add Wifi



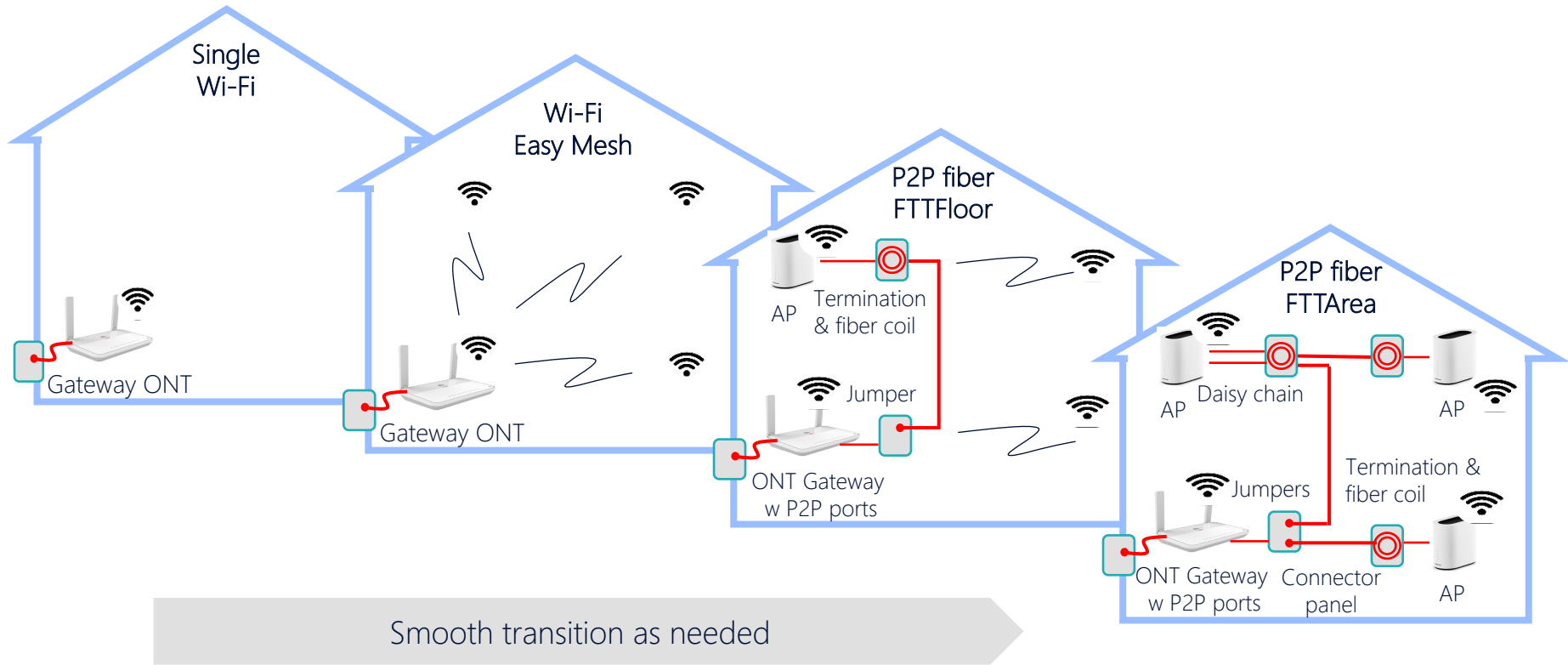
Wifi box



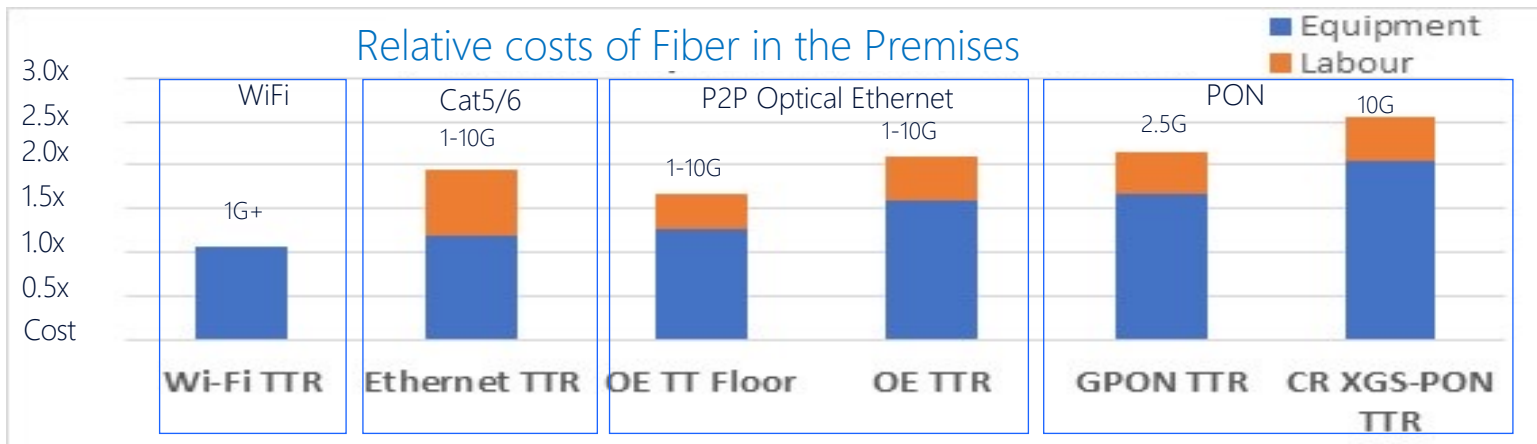
Wiring Ap



# P2P fiber allows simple progression to FTTFloor, then FTTRoom



# Cost Comparison for Higher Speeds in the Home



- Wi-Fi is cheapest (i.e. the reference)
- XGS-PON is most expensive
- P2P fiber is cost effective vs PON
- Lowest cost is P2P FTTFloor

Assumptions:

- Labor rate for developed countries.
- Shown for RG + 3 AP/ONTs

# Conclusions

- Fiber in the premises has been around for a while
- Existing solutions are largely sufficient for current needs  
...but there are potential motivations for increase use of Fiber in the Premises
- P2P and P2MP fiber solutions each have their places
  - P2P is well suited for homes, small business and applications with lower number of terminals
  - P2MP is well suited for larger applications with many terminals
- G.p2pf is a newly launched project at ITU Q3 seeking to leverage existing P2P optical technologies and optimize the solution for fiber in the premises

# Thank you

## NOKIA

Ronald Heron

Lead Technology Strategist

Fixed Networks CTO

Nokia

[Ronald.heron@Nokia.com](mailto:Ronald.heron@Nokia.com)