Network Infrastructure progress update
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Welcome

1. A strong year in 2021
2. What’s next for Network Infrastructure
3. Your questions

Federico Guillén
President, Network Infrastructure
1. A strong year in 2021
2021 built the foundation to deliver on our strategic priorities

Recap of March CMD ‘21 plan:

<table>
<thead>
<tr>
<th>Strategy for growth</th>
<th>Progress in 2021:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Deliver portfolio innovation</td>
<td>Launched Nokia’s 5th generation FP5 IP routing silicon</td>
</tr>
<tr>
<td>✓ Strengthen CSP foundation</td>
<td>PSE-V optical platform gaining momentum</td>
</tr>
<tr>
<td>✓ Accelerate non-CSP growth</td>
<td>Technology leadership drove strong outperformance against market, particularly in Fixed Networks</td>
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<td></td>
<td>Increasing engagement with webscalers</td>
</tr>
</tbody>
</table>
A strong performance in 2021
Outperforming the market and continuing to gain share across our businesses

Network Infrastructure
- Net Sales (2021): €7.7bn
- Operating margin (2021): 10.2%
  - +15% y-o-y at constant currency
  - +340 bps y-o-y

IP Networks
- Net Sales (2021): +5%
- % y-o-y constant currency

Optical Networks
- Net Sales (2021): +2%
- % y-o-y constant currency

Public Network Infrastructure
- Net Sales (2021): €7.7bn
  - +15% y-o-y at constant currency

IP Networks
- Net Sales (2021): +5%
  - % y-o-y constant currency

Optical Networks
- Net Sales (2021): +2%
  - % y-o-y constant currency

Fixed Networks
- Net Sales (2021): +35%
  - % y-o-y constant currency

Submarine Networks
- Net Sales (2021): +33%
  - % y-o-y constant currency

All data 4 quarter rolling global ex. China market share
* Dell’Oro ** OMDIA WDM (excl SLTE) + Aggregation
2. What’s next
Industry pressures driving market demand

Network Infrastructure Addressable market* growth** 2020-2021

\[\text{CAGR } 5\%\]

Network Infrastructure Addressable market* growth** 2021-2024

\[\text{CAGR } 3\%\]

- CSP CAGR: 2%
- Enterprise CAGR: 3%

* Does not include submarine cables or DC switching
** at constant currency

5G infrastructure & services

Enterprise digital transformation & cloud

Pandemic-accelerated residential broadband

Industry 4.0

Critical networks are underpinning industry transformation
Our response is based on three focus areas...

Innovation

Customers

Sustainability
Networks that inspire...

Everyone and everything, everywhere
Fixed Networks
## A history of innovation leadership in Fixed Networks

<table>
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<tr>
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<tbody>
<tr>
<td>1st ADSL on market</td>
<td>1st green DSL on market</td>
<td>1st Gigabit fiber platform</td>
<td>1st 10G GPON solution</td>
<td>1st Zero-Touch Vectoring</td>
<td>1st large-scale PSTN transform</td>
<td>1st Vectoring Micro-nodes</td>
<td>1st Vplus</td>
<td>1st 10-PON fronthaul</td>
<td>Long Reach VDSL2</td>
<td>Quillion chipset</td>
<td>Innovations for low latency Wifi 6</td>
<td>1st 100G demo (with Vodafone)</td>
<td></td>
</tr>
<tr>
<td>1st IP access node on market</td>
<td>1st 10G GPON +LTE demo</td>
<td>1st Phantom Mode demo</td>
<td>1st VDSL Vectoring (100Mb/s)</td>
<td>1st G.fast Vectoring Demo 1.1G</td>
<td>1st Vplus Demo</td>
<td>1st 40G TWDM-PON</td>
<td>1st XG-FAST Demo 10G</td>
<td>1st vDAA and unified cable access</td>
<td>25G PON demo</td>
<td>1st fiber platform fit for 5G era</td>
<td>1st live 25G PON (with Proximus)</td>
<td></td>
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</tr>
<tr>
<td>1st VDSL on market</td>
<td>1st VDSL2 Vectoring Demo</td>
<td>1st TWDM-PON trial</td>
<td>1st Universal TWDM-PON</td>
<td>1st XGS-PON deployment</td>
<td>1st SDAN use cases</td>
<td>1st SDAN based PON interoperability</td>
<td>5G FWA (28-39GHz)</td>
<td>1st with 25G PON</td>
<td>1st triple coexistence: GPON + 10G + 25G</td>
<td></td>
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</tbody>
</table>

- DSL broadband
- Ultra-broadband
- Gigabit broadband
- Massive scale access in 5G era

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Our industry’s ambition: Broadband Zero

Zero left behind
Connect everyone and everything

Zero limits
Innovative technologies for new use cases and business models

Zero touch
Automate and optimize the network

Zero waste
Delivering the benefits of broadband while minimizing environmental impact
Opportunities for Fixed Networks in 2022 and beyond

- Continuing opportunity for fiber penetration
- Neutral hosts
- FWA / 5G FWA
Potential for further fiber deployment remains strong
Broadband access potential: Europe and APAC (w/o China) to drive demand

- 200M new homes to be connected by 2025 (opportunity for OLT, ONT and Wi-Fi)
- 280M+ new home to be passed by 2025 (opportunities for OLT and Services (including SIOP))
- Europe and APAC (excluding China) will drive the growth
- China’s growth potential is lower, but refresh of installed base to 10G (XGS-PON) will represent 18% of new connections by 2025
- Potential beyond 2025 (not shown) continues especially for regions with later deployments

% Homes 2021

FTTH Evolution (2021-2025)

- Home connected: Home with BB services over fiber.
- Home passed: Home in an area where fiber exists and can be connected to the BB service

Fiber technology continues to evolve

- **1990**: Start of commercial deployment
- **1995**: APON
- **2000**: EPON
- **2005**: GPON
- **2010**: XG-PON, XGS-PON, NG-PON2
- **2020**: 25G PON
- **2025**: 50G PON
- **2030**: 100G PON
- **20xx**: Proof-of-concept
- **2021** and **2022**: 25G-ready trial
- **2023**: 25G-ready
- **2024**: KPN trial

- **Proprietary**
- **1st in live network**
New investments and neutral host networks gain relevance in FTTH market

Forecast EU27+4, Analysys Mason 2021
Fixed access contributes to greenhouse gas emission reduction targets

Fixed access promise

Traffic

decouple

Energy

60x energy efficiency

12x capacity [Gbps]
Same energy [Watt]
Shift from copper to fiber

5x capacity [Gbps]
2x energy [Watt]
10G PON & beyond speed evolutions

Same capacity [Gbps]
0.5x energy [Watt]
Quillion chipset power savings
5G Fixed Wireless Access
Benefits all operators

- Complement fiber access
  Use 5G FWA where the fiber cost or TTM is prohibitive
- Compete out-of-territory
  Quickly build footprint and grab share in adjacent areas
- Rural coverage
  Basic broadband where fiber economics don’t add up

- Fast time-to-market for fiber services
  Instant coverage with 5G; build fiber later
- Grab broadband market share
  Fast TTM, low start-up cost, instant gratification

- Mobile CSP
- Converged CSP
- Broadband Anyhaul

Compete with traditional fixed networks
Deliver a fiber-grade service with 5G
IP Networks
IP Routing
Deterministic performance, mature portfolio, extended life cycle

- FP silicon for scalable capacity, power efficiency, network security
- Operational simplicity from proven SR OS software used across all platforms
- Model-driven for simplified automation, programmability
- Systems designed for growth and longevity
- Platform choice for best fit

#1 Global SP edge routing
1.4m Service routers shipped

CSP WAN
Digital industry
Government

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## IP Networks market drivers

<table>
<thead>
<tr>
<th>Category</th>
<th>Key Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>5G</td>
<td>Fast service delivery</td>
</tr>
<tr>
<td>Residential broadband</td>
<td>New SLA capabilities</td>
</tr>
<tr>
<td>Cloud</td>
<td>Improved operations efficiency</td>
</tr>
<tr>
<td>Industry 4.0</td>
<td>Deterministic performance, reliability, scalability, network security</td>
</tr>
<tr>
<td></td>
<td>Power savings, investment protection</td>
</tr>
</tbody>
</table>
Foundational elements
Delivering an agile, secure and sustainable IP Network

Silicon and systems
We build the right systems with the right silicon foundation for the right places in the network enabling optimum network performance and efficiency
- FP routing silicon
- Broad router portfolio

Software excellence
Software quality is the heart of what we do - developed 100% in-house for total control, proven predictability, and demonstrated quality
- SR OS router software
- SR Linux network OS

Automation and tools
Open APIs, fully integrated real-time analytics, assurance, and closed-loop automation are critical to address increasing network scale and complexity
- NSP
- Fabric Services System
- Deepfield
FP5 – master the unexpected

Easily adapt to new services and growing traffic demand
• 1st with 800GE interfaces
• Upgrade to 3X capacity
• Fully programmable

Protect against escalating network security threats
• New ANYsec flow-based encryption
• Enhanced DDoS protection and mitigation

Reduce carbon footprint of networking equipment
• 75% reduction in power consumption
IP Networks priorities: 2022 and beyond

Take Share in CSPs
- Continue to win in 5G IP transport
- Deliver on FP5
- Differentiate through collaboration with FN and ON
- Adaptive Cloud Networks

Expand in enterprise
- Export success into new geographies
- Expand into new verticals
- Bring new enterprise solutions to market

Drive webscale
- Build on success
- Develop tier 2 business
- Offer broad range of solutions

Deliver fundamentals
- Execute on fundamentals
- Continuing commitment to technology leadership
Optical Networks
## Strong momentum in 2021

<table>
<thead>
<tr>
<th>Networkwide migration</th>
<th>Sole supplier breakthrough for NEWTON</th>
<th>Successful 914Km trial with 13 hops and 4 ROADMls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deutsche Telekom</td>
<td>swisscom</td>
<td>orange</td>
</tr>
<tr>
<td>Data center interconnect across the Middle East</td>
<td>IP/MPLS and DWDM, SDH network replacement</td>
<td>Modular data center interconnect solution</td>
</tr>
<tr>
<td>ARC</td>
<td>RED ELECTRICA DE ESPAÑA</td>
<td>Espanix</td>
</tr>
</tbody>
</table>
Optical Networks are the foundation of all networked services
Scaling from edge to core

| Network Automation | • Open and Transformative Software  
|                    | • Connected NaaS Partner Ecosystem  
|                    | • Value-added Professional Services  

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1830 ONE</td>
<td>Edge P-OTN and ROADM family</td>
</tr>
<tr>
<td>WaveLite</td>
<td>Multiservice CPE and WDM transport family</td>
</tr>
<tr>
<td>1830 PSI-M</td>
<td>Compact Modular Disaggregated transponder/SLTE</td>
</tr>
<tr>
<td>1830 PSI-L/CL</td>
<td>Open Optical Disaggregated line systems</td>
</tr>
<tr>
<td>1830 PSS</td>
<td>Optical Transport Transponders, packet transport, and ROADM family</td>
</tr>
<tr>
<td>1830 PSS-x</td>
<td>P-OTN Switching ODUk switching with Integrated WDM</td>
</tr>
<tr>
<td>1830 PSD</td>
<td>10G CPE</td>
</tr>
<tr>
<td>1830 VWM</td>
<td>Access WDM family</td>
</tr>
</tbody>
</table>

Photonic Service Engines (PSE)

Vertically integrated coherent opto-electronics and pluggable DCOs
Delivering scale, efficiency and business outcomes

Building networks that inspire

<table>
<thead>
<tr>
<th>Scalable solutions from edge to core</th>
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<tbody>
<tr>
<td>Enabling new services and revenue streams</td>
</tr>
<tr>
<td>Efficient network scaling through automation</td>
</tr>
<tr>
<td>Differentiated features and capabilities</td>
</tr>
<tr>
<td>Power/space savings and investment protection</td>
</tr>
</tbody>
</table>
End-to-end IP/optical management coordination and automation

NetNet CONFiguration Protocol = NETCONF, YANG is a language used to describe data models of network devices.
Submarine Networks
The customer base for subsea projects has changed radically

- **Internet traffic through submarine cables**: 99%
- **Hyperscaler investment in recent years**: ~2x
- **Nokia leadership position, expertise, experience and capability**: #1
- **Continuous actions to retain leadership**
  - Delivery capacity
  - Innovation
  - Digitalization

### Telecom submarine long-haul projects*

<table>
<thead>
<tr>
<th>Year</th>
<th>Others</th>
<th>Hyperscaler-driven</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>30%</td>
<td>70%</td>
</tr>
<tr>
<td>2016</td>
<td>33%</td>
<td>67%</td>
</tr>
<tr>
<td>2017</td>
<td>48%</td>
<td>52%</td>
</tr>
<tr>
<td>2018</td>
<td>47%</td>
<td>53%</td>
</tr>
<tr>
<td>2019</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>2020</td>
<td>71%</td>
<td>29%</td>
</tr>
<tr>
<td>2021</td>
<td>78%</td>
<td>22%</td>
</tr>
</tbody>
</table>

* Source Nokia: orders for telecom submarine long-haul projects
Success based on continuous innovation and operational excellence

<table>
<thead>
<tr>
<th>Project</th>
<th>Distance</th>
<th>Quarter</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>2Africa CV</td>
<td>45,000km</td>
<td>Q1 2021</td>
<td></td>
</tr>
<tr>
<td>Bifrost</td>
<td>18,000km</td>
<td>Q1 2021</td>
<td></td>
</tr>
<tr>
<td>Europe-MEA-India</td>
<td>9,000km</td>
<td>Q3 2021</td>
<td></td>
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<tr>
<td>O&amp;G</td>
<td></td>
<td></td>
<td>Fiber Optic Connectivity 2021</td>
</tr>
</tbody>
</table>

Continuous innovation

Manufacturing and Marine operations
Focused actions to retain our leadership position

Continuous innovation

Business transformation

Operational excellence
Networks that inspire

Differentiation through innovation

Protecting customer investment

Sustainability and power efficiency
3. Your questions