Tomorrow’s networks today

Network Infrastructure progress update

June 2023
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Welcome

1. Network Infrastructure
   Federico Guillén

2. Fixed Networks
   Sandy Motley

3. Optical Networks
   James Watt

4. IP Networks
   Vach Kompella

5. Submarine Networks
   Alain Biston

6. Your questions
Network Infrastructure

Federico Guillén
June 2023
Many stories, one outcome

...today’s new applications need higher capacity networks...

...tomorrow’s applications will have even higher requirements
Global traffic grows at up to 28% CAGR to 2030

- Global traffic grows at up to 13x between 2020 and 2030
- Acceleration in VR/AR beyond 2025 is driven by metaverses
- Fixed consumer traffic accounts for most growth; reaches 18 to 41 ZB/year
- Mobile traffic grows at up to 13x to reach 2.6 to 7.7 ZB/year
- 5G traffic overtakes 4G by 2026
- Enterprise traffic grows at 13%-28% CAGR, reaching 1.5 to 5.3 ZB/year

Source: Nokia Bell Labs Consulting

Parameters determining conservative to disruptive scenarios include estimates of: 5G adoption rate; gaming time in aggregate; high resolution video adoption rate; virtual reality application streaming rate; augmented reality bandwidth per device; augmented / virtual reality device use time
Traffic growth will drive expansion in our addressable markets...

<table>
<thead>
<tr>
<th></th>
<th>Addressable market CAGR 2022-2025</th>
<th>Growth aspiration</th>
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<tbody>
<tr>
<td>IP Networks</td>
<td>3%</td>
<td>Grow faster than the market</td>
</tr>
<tr>
<td>Fixed Networks</td>
<td>4%</td>
<td>Grow with or faster than the market</td>
</tr>
<tr>
<td>Optical Networks</td>
<td>2%</td>
<td>Grow faster than the market</td>
</tr>
<tr>
<td>Submarine Networks</td>
<td>Single-digit</td>
<td>Grow with the market</td>
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Source (all data): Nokia Business Intelligence
All figures at constant currency
Converging market influences drive the networks of the future

Customers

Revenue expansion
Environment
Security
Total cost of ownership

Innovation

Sustainability
Network Infrastructure: delivering successive quarters of profitable growth

NI growth YoY by business line

All net sales changes presented are year-on-year in constant currency
Strategic silicon investments...  
...complete Network Infrastructure’s end-to-end portfolio

Quillion access processing
- 50% reduction in power consumption vs. previous generations
- Lightspan MF-14: the world’s most advanced fiber broadband platform

PSE-6s coherent optics
- Opportunity to leap-frog competition
- 60% less network power consumption per bit

FP5 IP packet processing
- 50+ FP5 contracts
- 75% reduction in power consumption vs. previous generations
- Additional 25-43% power savings with 800G optics vs 400G
More bits with fewer watts
Sustainable IP networks growth with 800GE, available today

Network traffic vs energy use (incl. optics)

Source: Nokia Bell Labs Consulting
Automation addresses cost and time to revenue
Quantified benefits from Network Services Platform deployments

Source: Nokia and Analysys Mason
Security with 10x scale and 10x cost reduction
Drastic reduction of undesired traffic in the network

✓ High-capacity best scaling DDoS filtering for FP silicon + Deepfield
✓ Quantum resistant transport with ANYsec flow-based, line-rate encryption
✓ Quantum safe encryption at both the IP and optical layers

New revenues
• Low-latency services
• Critical connectivity services
• DDoS defense services

Cost savings
• Up to 85% cost savings over external appliances*

* Source: Nokia Bell Labs Consulting
Fixed Networks
Network Infrastructure progress update

Sandy Motley
June 2023
Nokia Fixed Networks - a strong business

Business

~3bn
Just under €3bn revenue in 2022

0.5bn+
DSL, VDSL, Vectoring, XGS lines & GPON ports shipped to date

Leadership

#1
In xPON OLT, XGS-PON (OLT & ONT) and G.fast*
(*) Source: Dell’Oro BB Access Report Q1 2023

300+
Fiber customers in 130 countries

Innovation

1st
First ADSL, GPON, G.fast, Vectoring, XGS-PON, 25G PON, 100G PON, multivendor SDAN

Own tech
In-house Quillion chipset, mmWave technology
Market dynamics are in our favor

<table>
<thead>
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<th>🚀</th>
<th>🏛️</th>
<th>$€£</th>
<th>🌍</th>
</tr>
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<tbody>
<tr>
<td>Solid demand that drives FN TAM growth 4% CAGR 22-25</td>
<td>Governments putting up billions of dollars for FTTH projects</td>
<td>Infra. and PE funds investing in FTTH companies or projects</td>
<td>Fiber market shifts to regions and tech where we lead</td>
</tr>
</tbody>
</table>

Our strategy puts us in the right place at the right time

<table>
<thead>
<tr>
<th>Fiber leadership</th>
<th>Own ASIC</th>
<th>Services</th>
<th>Supply chain</th>
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<tbody>
<tr>
<td>Leader in 10G PON; only vendor with a 25G solution; Fiber for Everything, campus connectivity</td>
<td>In-house silicon for differentiation &amp; supplier independence</td>
<td>Network design and build &amp; cloud integration service to support CSPs, new entrants, and smaller players</td>
<td>We have supply &amp; we can deliver</td>
</tr>
</tbody>
</table>
Fiber deployment remains strong
50% of homes globally to be connected + 10G(+) upgrade wave

FTTH Penetration Status (2022)

- MEA: 5% Homes connected, 11% Homes passed
- NAM: 28% Homes connected, 40% Homes passed
- LAT: 32% Homes connected, 66% Homes passed
- Europe (WE/EE): 36% Homes connected, 72% Homes passed
- APAC w/o China: 21% Homes connected, 42% Homes passed

Source: IDATE World FTTX market, Dec 2022

Nokia OLT ports shipments

- GPON
- XGS-PON
- 25G PON ready

Source: Nokia
Ready to seize the government-funded broadband opportunity

- #1 in NAM
- #1 in US Tier-2
- #2 in US Tier-3, overtaking Adtran
- 7/10 US fiber lines are served from Nokia equipment
- 77% CAGR 2020-22 in US non-T1
- $42bn BEAD funding June 30, 2023
Optical Networks
Network Infrastructure progress update

James Watt
June 2023
Optical Networks: leadership through innovation

<table>
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<tr>
<th>&gt;1,000</th>
<th>&gt;100</th>
<th>#2*</th>
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<tbody>
<tr>
<td>1830 PSS customers</td>
<td>PSE-V customers</td>
<td>Market share worldwide (excl. China) Q1 2023</td>
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<tr>
<th>7%</th>
<th>&gt;€2bn</th>
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<tr>
<td>TTM CAGR Q2 2020 – Q1 2023 vs. addressable market CAGR of 2%</td>
<td>Sales Q2’22 – Q1-23 LTM</td>
</tr>
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</table>

Technology differentiation

- Lowest cost/power per bit combined with greatest scale
- Market leading:
  - Wavelength module capacity
  - OTN switching
  - IP / Optical integration
  - Fiber capacity/spectral efficiency
- Unmatched data security

* Total optical market worldwide (excluding China) Source: Dell’Oro Q1 2023
Scale made simple

Enable scale
- Coherent Transponders
- Line Systems
  Market leading C+L line systems
- P-OTN Switching

Simplify operations
- Automation
  Enable scale; simplify operations. Reduce TCO
- Network architectures
  Coherent Routing
- Professional services

Application-optimized platforms
The next frontier in optical networking
PSE-6s → enabling network growth and sustainability

**Scale**
- 2.4Tb/s in a single line card
- 1.2Tb/s per wavelength

**Performance**
- 3x the reach at 800G (2000km+)
- 50% less coherent optics deployed

**Sustainability**
- 60% lower network power consumption
- Upgrade existing platforms gracefully, datacenter interconnect, [ultra] longhaul, OTN, submarine line terminating equipment
## Achieving our ambitions

### Technology leadership and global presence

**CSP**
- End-to-end scale and performance in a highly competitive environment
- 3x the reach @ 800G (2,000km)
- Greatest photonic line scale
- Proven strategic supplier
- Exceptional power efficiency

**Webscale**
- Massive scale coupled with unmatched performance
- Lowest TCO
- Simplest operations
- Greatest automation
- Best spectral efficiency / fiber capacity

**Enterprise**
- Evolving from mission-critical to business and society-critical
- Portfolio-application fit
- Address digital transformation needs with 10G → 100G+ upgrades
IP Networks
Network Infrastructure progress update

Vach Kompella
June 2023
Accelerate Growth in the IP Networks Business Between 2023 and 2026...

Grow
CSP Market Share

Expand
Enterprise

Overdrive
Webscale
Leadership through innovation

Net Sales 2022: €3.1bn

Leader
- IP Edge Router Global, EMEA*: #1
- Edge & Core Routing, 5G transport**: #1

CSP and Cloud Provider Customers: 1400
- CSP and Cloud Provider Customers:

Non-CSP Customers: 1100
- Non-CSP Customers:

Routers Shipped: 1.7m
- Routers Shipped:

FP5 Contracts: 50
- FP5 Contracts:

Technology differentiation
- Deterministic performance without compromise
- Unmatched power efficiency at unrivalled speeds
- A multi-layer embedded approach to IP network security

* 1Q23 Dell’Oro SP Routing
** GlobalData Competitive Landscape Assessment
Grow share with CSPs

**IP Networks**

- Internet Peering
- Core
- Edge
- Aggregation
- Access

**Mobile Services**
- Global 5G rollouts still driving network investments
- Growing bandwidth requirements from Fixed Wireless Access

**Broadband Services**
- Fixed broadband capacity driving IP buildouts
- Bridging the digital divide

**Business Services**
- Data centers moving closer to users
- Meeting the demands of dynamic digital transformation

**Robust**
- resilient & secure

**Performance**
- deterministic

**Sustainable**
- efficient

**Extreme adaptability & longevity**
Building enterprise networks that matter, at scale

Mission Critical
• Utilities
• Transportation
• Mining
• Public Safety

Diligent focus on mission critical networks

Purpose built
Teleprotection, Legacy interfaces

Multi-generational
Seamless migration

Robust
Ruggedized, resilient

Extreme productivity enabling business outcomes
Building enterprise networks that matter, at scale

Expanding from OT to IT networks to maximize impact

Mission Critical
- Utilities
- Transportation
- Mining
- Public Safety

Society Critical
- Research & education networks
- Bridging the digital divide
- Government & defense

Business Critical
- Healthcare
- Financial services
- Logistics & retail

Purpose built
open, cloud-friendly

Forward looking
Secure 800 GE

Robust
Digital twin

Extreme productivity enabling business outcomes
Webscale
Riding the wave through ongoing technology leadership

Nokia ranked “Leader” & “Outperformer”

50+ Customer Wins

- Microsoft
- cdmon
- everyWAN
- eurofiber
- Stealth Communications
- linx

- atnorth
- LASERLIGHT
- Tier 1 cloud provider
- bluechip

“We regularly upgrade our data center equipment with technology to increase efficiency and reduce energy consumption. Using Nokia’s new system will enable better networking and routing capabilities in our Viborg, Denmark facility.”

Adam Bechtel, Vice President and Networking lead at Apple

“Nokia brings density, performance and flexibility to Microsoft’s data center networks and cloud environments and is partnering with Microsoft to deliver chassis switches running the open-source networking operating system SONiC.”

David Maltz, Technical Fellow and Corporate Vice President, Microsoft Azure Networking

Proven systems

Cloud-Native open & extensible

Hyper-Scale green & performant

Extreme scale at speed
Submarine Networks

Network Infrastructure progress update

Alain Biston

June 2023
Our success is driven by digital transformation and internet growth

35% International traffic CAGR, ‘21 – ’26*

1Pb/s – 5Pb/s Requested cable capacity by 2030*

x20 Predicted internet traffic increase by 2032**:

35% Opportunities identified to end 2024

99% Internet traffic carried by submarine cables*

1Pb/s – 5Pb/s Requested cable capacity by 2030*

x20 Predicted internet traffic increase by 2032**:

35% Opportunities identified to end 2024

99% Internet traffic carried by submarine cables*

#1 Market leader in submarine networks***

Only one Industry’s only end-to-end turnkey supplier

Increasing customer diversity:

Telecoms, Hyperscalers, Oil & Gas, Services

€7bn Sales in 2022 (sales doubled between 2019 and 2022)

€1bn Sales in 2022 (sales doubled between 2019 and 2022)

* Nokia estimate
** Credit Suisse: ‘A guide to the Next-Gen internet, 2022’
*** Based on orders on three-year rolling basis
We are well-placed for growth and margin expansion

Capacity enhancements complete
• five main lay vessels
• two maintenance vessels
• 96,400 m² manufacturing plant

New R&D program to meet capacity and climate change demands

Submarine / Terrestrial
• SLTE (submarine line terminal equipment coordinated roadmap - common coherent transponder)

Improved profitability towards mid, then high single digit OM (commercial management; Ts&Cs; marine resources)
More than €2bn revenue in long-haul systems by end 2025

- **EllaLink**: 6,000 km, Portugal to Brazil, 4 FP
- **SX NEXT**: 13,700 km, Australia to USA, 4 FP
- **West Africa**: 8,500 km, (five countries), 2 FP
- **Equiano**: 15,000 km, Portugal to South Africa, (six countries), 12 FP
- **AfricA-1**: 10,000 km, France to Pakistan, (nine countries), 8 FP
- **Amitié**: 6,750 km, USA to Europe, 12/16 FP
- **Bifrost**: 15,000 km, Singapore to USA, (five countries), 12 FP
- **2Africa**: 45,000 km, Europe / Africa / Middle East, (33 countries), 8/16 FP
- **Blue & Raman**: Blue: 15,000 km, Raman: 7,000 km, (six countries), 16 FP
€7bn in upcoming opportunities (until 2027/2028)

3 Atlantic
Three transatlantic & European deals (>€840m)

5 Middle East
Five deals (~€2bn)

5 Intra-Asia
Five deals (~€3bn)

5 Other Telco
Five deals (>€1.4bn)

Oil & Gas
Several deals (~€400M)

*If won these opportunities then support revenues from 2025 and beyond
Driving new environmental standards

**DAS**
(Distributed Acoustic Sensing)
- Real time detection of threats to submarine environment
- Seismic activity monitoring
- Oceanographic and environmental conditions monitoring

**Offshore field digitalization**
(Oil and gas production, carbon storage, scientific research)
- Delivering power and communication to subsea assets
- Connecting offshore assets to fiber for remote operations
- Producing high resolution images of reservoir for efficient reservoir operation

**SMART**
(Scientific Monitoring and Reliable Telecommunications)
- Wet plant embedded sensors
- Disaster warning (tsunami, earthquakes), sea level rise, climate change
- Supports governments, scientists and marine science institutes

**Modernization**
(Global transformation program)
- Fleet rejuvenation
- 5G private network for factory digitalization in Calais and Greenwich
- State-of-the-art end-to-end business processes and tools deployed
There are opportunities for growth in our markets

- Fast-developing technologies depend on network infrastructure, driving demand

We are well placed to take advantage of those opportunities

- We continue to invest in our leading, differentiated portfolio
- We have a strong foundation in Fixed Networks and momentum in IP Networks and Optical Networks

We offer superior technologies and customer-focused innovation...

- ...giving us opportunities to outperform the market