



Catching the wave

Network Infrastructure
progress update

Federico Guillén
September 2024



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Welcome

1. Network Infrastructure	Federico Guillén
2. Fixed Networks	Sandy Motley
3. IP Networks	Vach Kompella Michael Bushong
4. Optical Networks	James Watt
5. Your questions	

Networks are life

A technology advantage



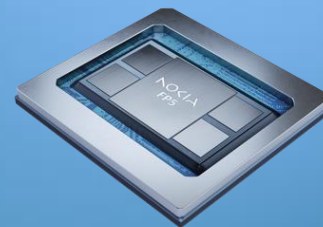
Quillion access processing

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



PSE-6s coherent optics

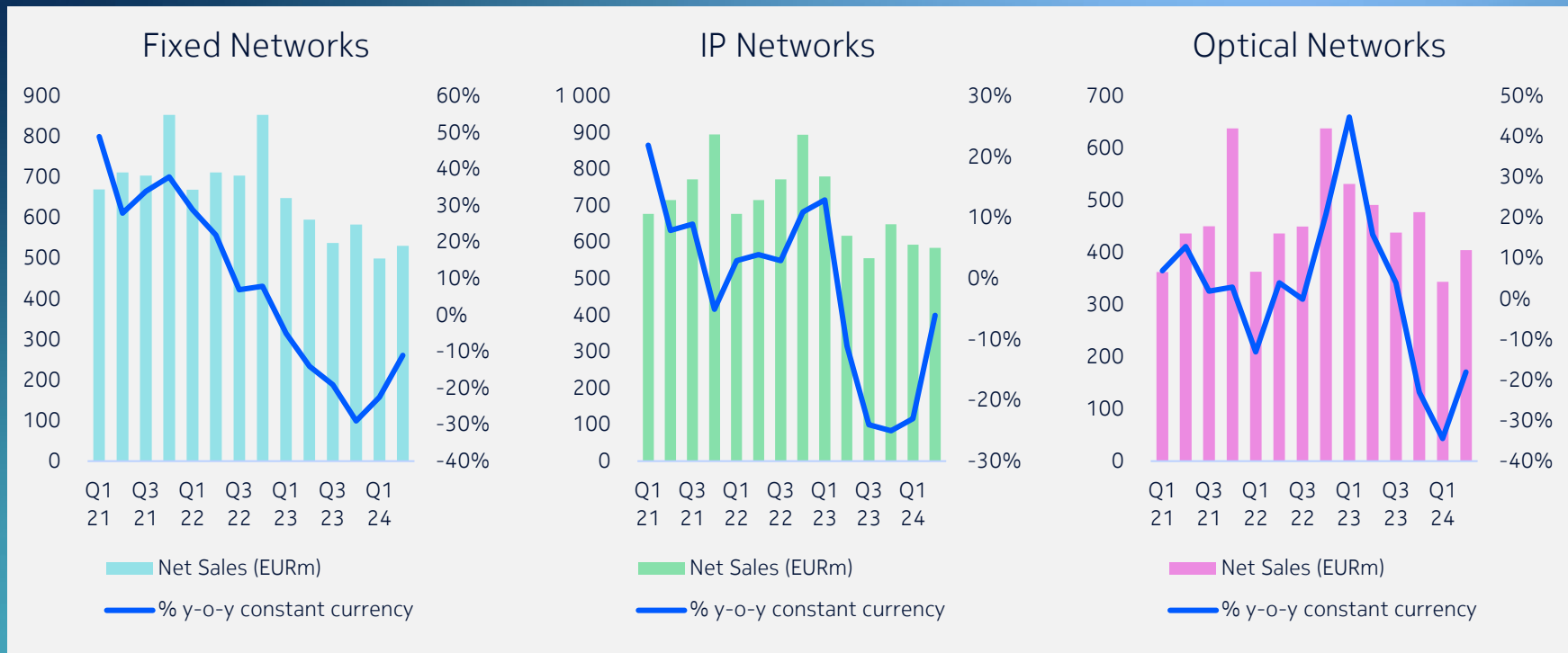
- Opportunity to leap-frog competition
- 60% less network power consumption per bit



FP5 IP packet processing

- 129 FP5 contracts
- 75% reduction in power consumption vs. previous generations
- Additional 25-43% power savings with 800G optics vs 400G

Stormy waters



Five trends that define the second half of the decade



Connectivity



Security



Geopolitics



Efficiency



Artificial
intelligence

Our response...

Help customers
make money...

Help customers
save money...

Be the most
trusted partner

Expanding horizons

- Fixed / Wireless Access
- Multi-Access Gateway
- WiFi / Corteca
- Slicing



Security

- Deepfield Defender
- Quantum-Safe Networking

Geopolitics

- Clean networks
- Digital bridges

Scale efficiently

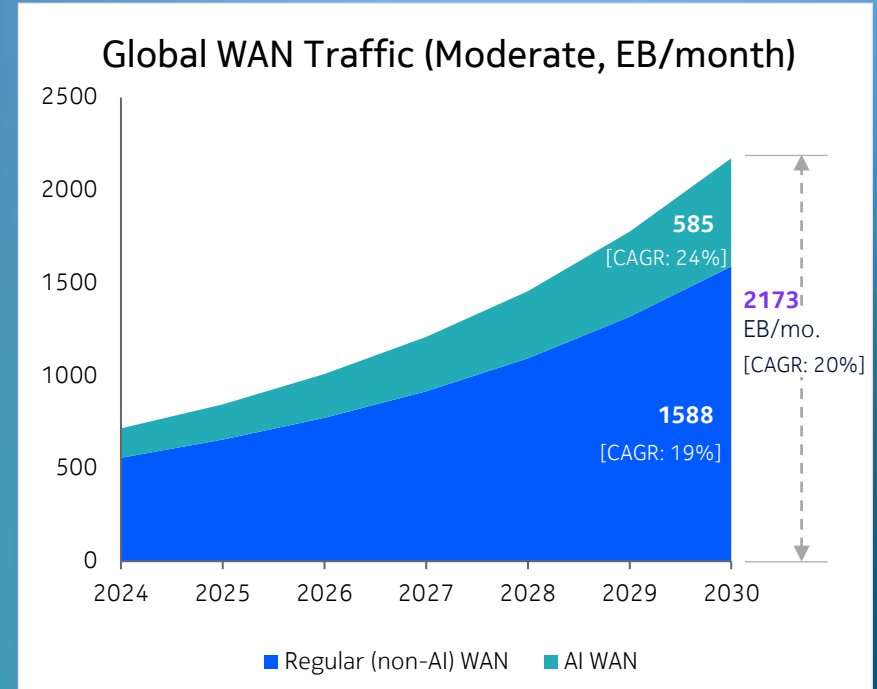
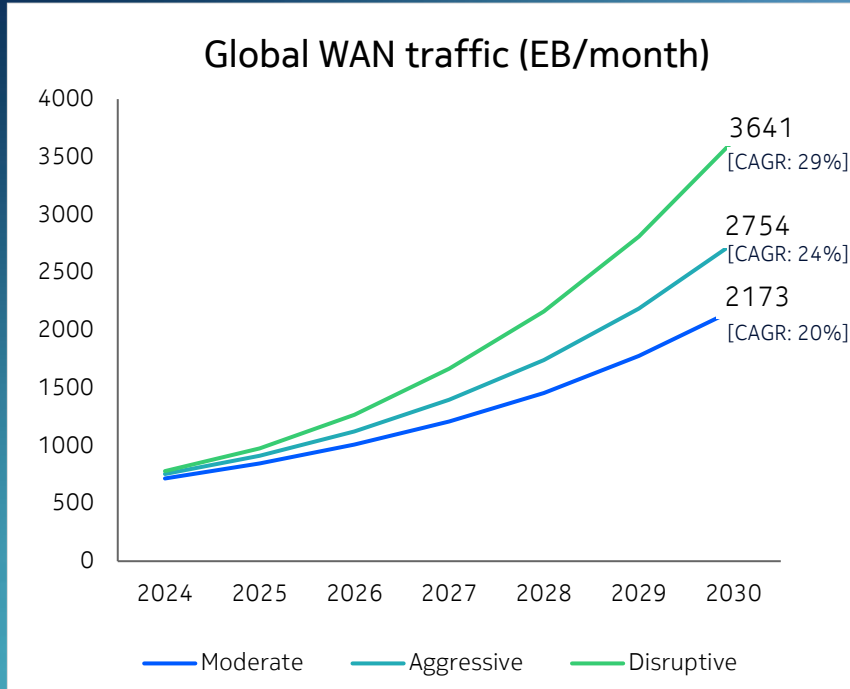
- Automation
- Natural language AI





AI on steroids

Global WAN traffic projected to reach 2173 Exabytes per month by 2030, growing at 20% CAGR



Strategic changes to the NI portfolio

- ASN sails into a new future...
- ...concentrating NI's business in three focused divisions.
- Infinera acquisition set to bring additional scale...
- ...with complementary geographical and customer footprints.





Opportunities across our portfolio

Catching the wave





Broadband for the future now

NI Fixed Networks progress update

Sandy Motley

September 2024



The undisputed leader in fiber

#1

in XGS PON for the 5th consecutive year

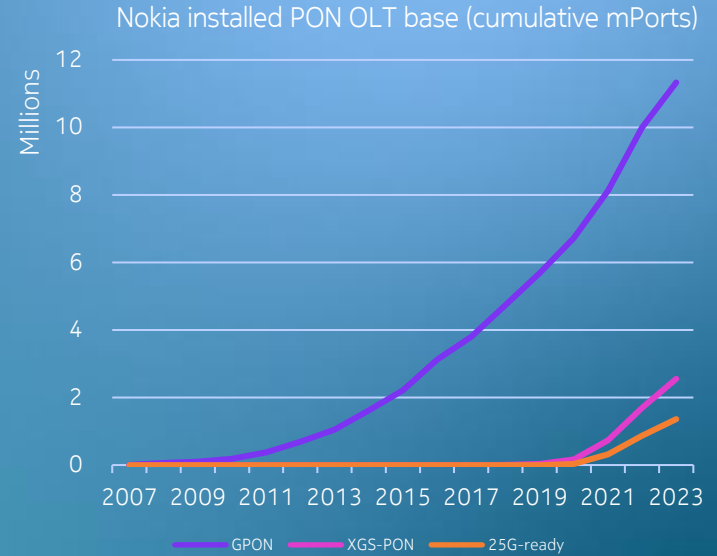
400+
fiber customers

10-25-50-
100G

The FTTH life & investment cycle

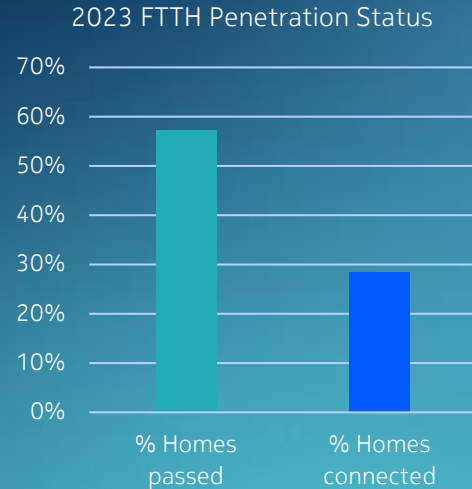


Lifecycle	5-10 years	100 years+	5-10 years (3-4 years in Wi-Fi)
Investment	10%	90%	Incl. in 10% OLT
Upgrade investment	Equipment only	zero	Equipment only



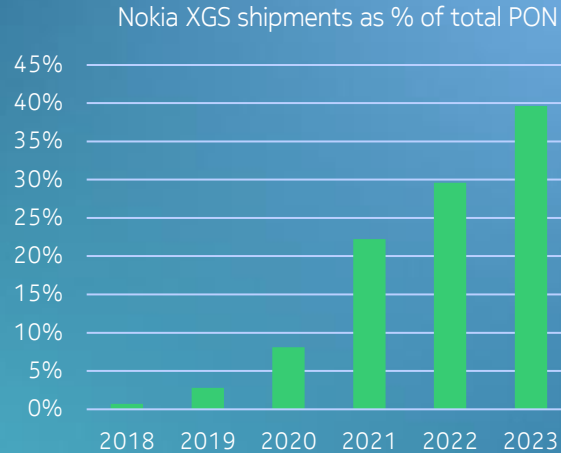
Source: Dell'Oro and Nokia (for 25G) data, Dec.2023

42% of homes still to be fiber enabled

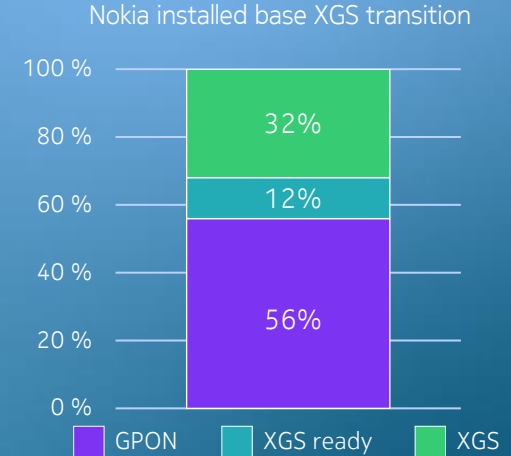


Source: IDATE World FTTX market, Dec 2023 excl. China

XGS upgrades in full swing



Source: Nokia, 2024



Source: Nokia, 2024

Nokia's unique next generation toolbox

Choose the right tool for your needs and your business case

10G

25G

50G

100G

Mass deployment
Residential

Deployments start
Residential/business

Trials 2024
Business services

2030+ (PoC today)
Business services

Our leadership in fiber opens new opportunities

In Cable:
50+ MSO's

In rural BB, government
funded programs,
Altnets :



In-home connectivity:
The critical last meter

In Enterprise:



In FWA:
As a complement
to fiber

In low ARPU markets:

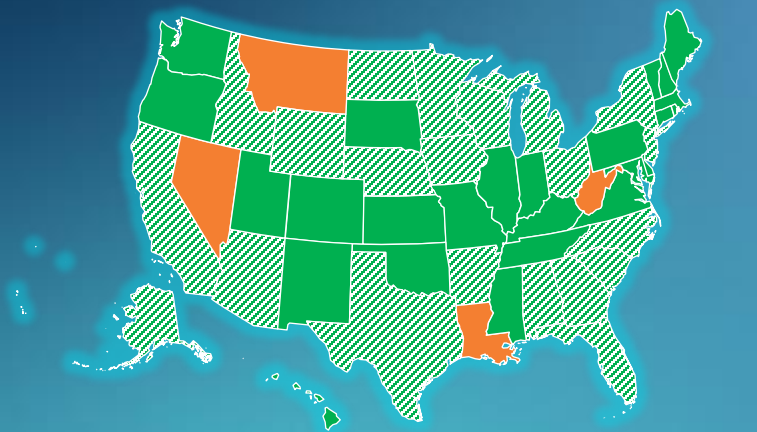


BEAD program update (August 29, 2024)

All states and territories are expected to have full BEAD (Vol. 2) approval by fall

Louisiana (LA) timeline example

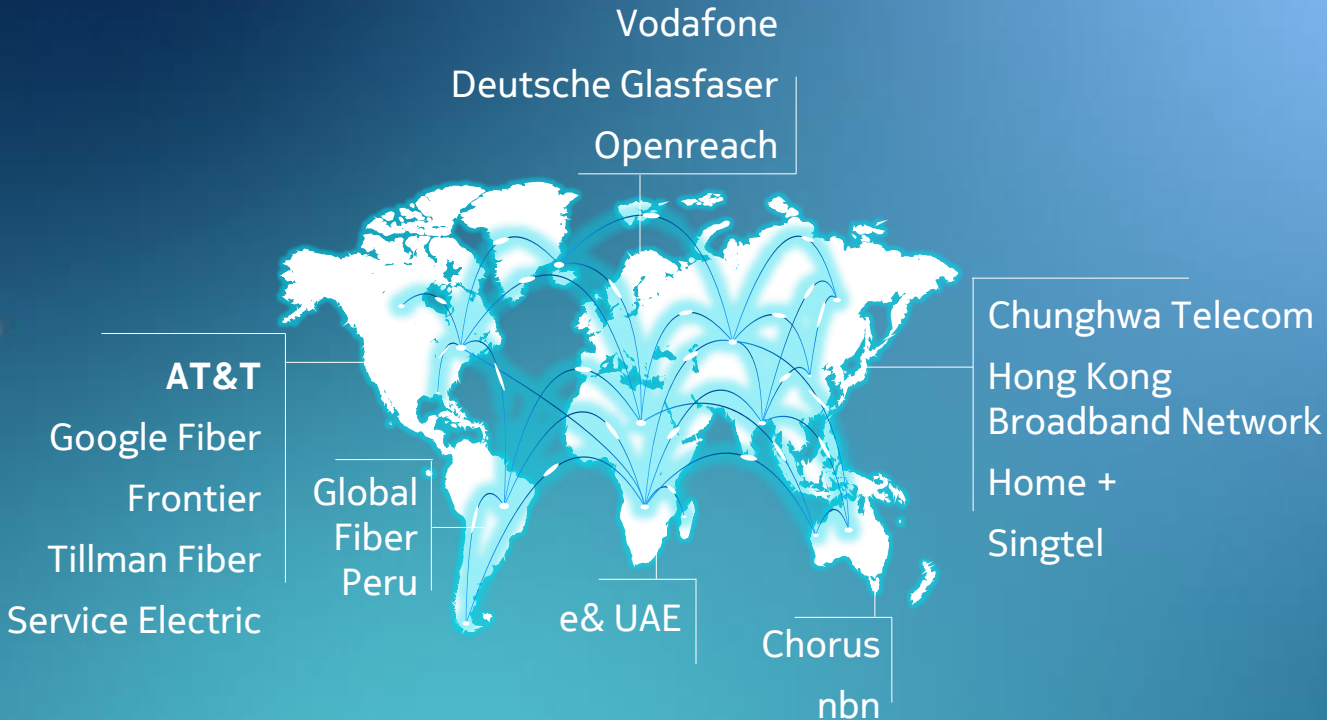
- **May 2022**
NTIA* Notice of Funding Opportunity
- **Fall 2023**
LA BEAD Volume 1 Approved by NTIA
- **December 15, 2023**
LA BEAD Volume 2 Approved by NTIA
- **July 31, 2024**
Grant window opens
- **By December 15, 2024**
LA provisional awards
- **Q1 2025**
LA Est. full approval by NTIA
- **Q2 2025-2029**
LA BEAD projects deployed



- All states Vol 1 approved (challenge process)
- 39 states and US territories V2 approved (grant program rules)
- States that have opened a grant window to accept funding request applications

(*) National Telecommunications and Information Administration

Recent public successes



Nokia customers

400+	FTTH
150+	SDAN
90+	FWA
50+	Open Access
370+	Wi-Fi
65+	Home Controller
600+	Digital Campus




Catching the wave

IP Networks
progress update

Vach Kompella
September 2024





Each of you is using Nokia routers daily

Any given packet:
crossing the planet traverses
a Nokia router along the way

> 99%

IP Networks

Net Sales (2023)

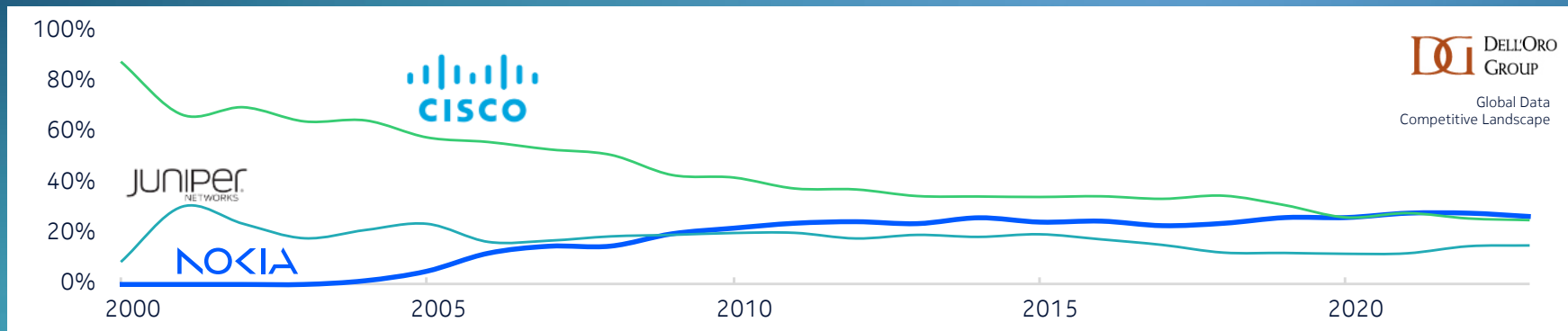
€2.6B

Edge Routing*

Global excluding China #1

Total Routing*

Global excluding China #2



Did you know? - Nokia has shipped ~2M routers to date

IP Networks

Drive

CSP Market share
Expansion

Accelerate

Enterprise Vertical
Expansion

Intensify

Webscale Use case
Expansion

Did you know? - Nokia has shipped **~2M** routers to date

Catching the transitions for over 20 years

Silicon and System

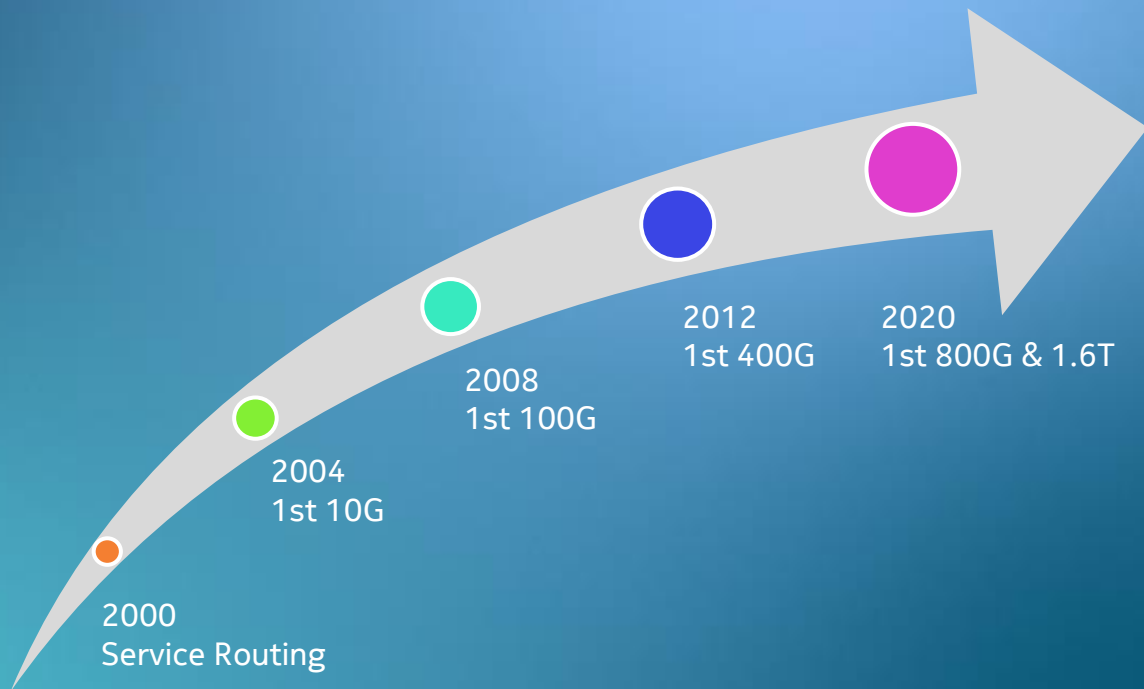
- FP and FPcx Routing Silicon
- Broadcom Merchant Silicon

Software excellence

- SROS
- SRLinux

Automation and tools

- Network Service Platform
- Event Driven Automation



Communication Service Providers

Maintain leadership while driving diversity

Profitable
market share
gains

Strategic
withdrawals
by
competitors

Government
funded
broadband
programs

Monetization
of 5G: mobile
backhaul &
FWA

^{NTT}
docomo



Singtel

vodafone
Ziggo

T Mobile

Did you know? - A **Tier 1 APAC Operator** has all 5 generations of FP currently in its network

Internet Exchange Providers

Powering the heart of the Internet

800G
Ethernet and
beyond to
1.6T

Secured
Quantum
Safe
Networks

Network
protection
via DDoS
mitigation

Close knit &
sharing
community

NLIX

linx

BIX
Budapest
Internet Exchange

topix

DE CIX

Did you know? - **7 of the top 10** IXP's are powered by Nokia routing solutions

Mission Critical Enterprises

Networks that keep you out of the news cycle

Diversity of
interfaces
supported

Success in all
geographies

High
performance
and reliability

Reliable
decades of
deployment
longevity

FINGRID

toulouse
métropole

nationalgrid
telecoms

PGE

Polska Grupa Energetyczna

450connect

Did you know? - Every time you hop on the **London Tube**, you are relying on a Nokia IP network

Research and Education Networks

Transporting petabytes of data accelerating research between scientists around the world

800G
Ethernet and
beyond to
1.6T

Secured
Quantum
Safe
Networks

High
performance
and reliability

Community
approach
towards
buying



Did you know? - **ESNet**, the research backbone network run by the US Dept. of Energy runs on Nokia

Data Center Networking done right

Providing Networks & NetOps tools with greater reliability, automation and programmability

SR Linux:
modern,
open,
Network
Operating
System

EDA, the
most flexible
automation
platform

Early
success in
hyperscalers

Relationships
with Global
System
Integrators

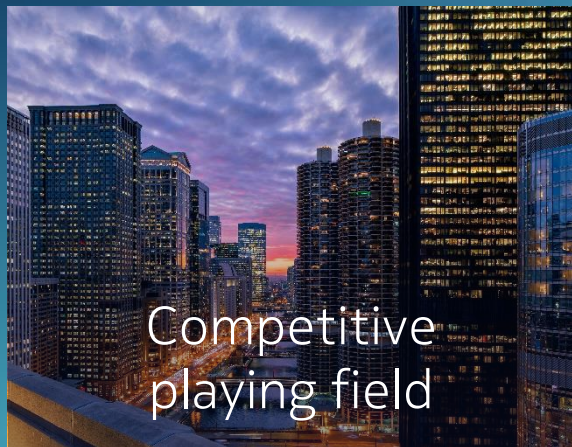


Did you know? - **GigaOm** has identified Nokia as a data center switching leader and outperformer every year for the last three years

Data centers



Changes



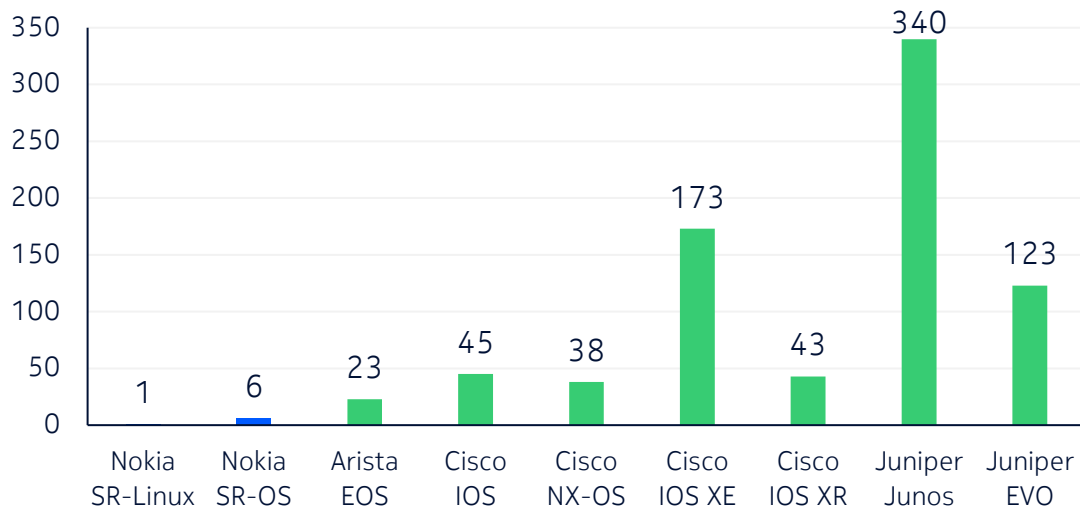


Competitive playing field

What do people want out of a data center?

- It just works
- It's easy
- It's affordable

CVEs by enterprise network OS

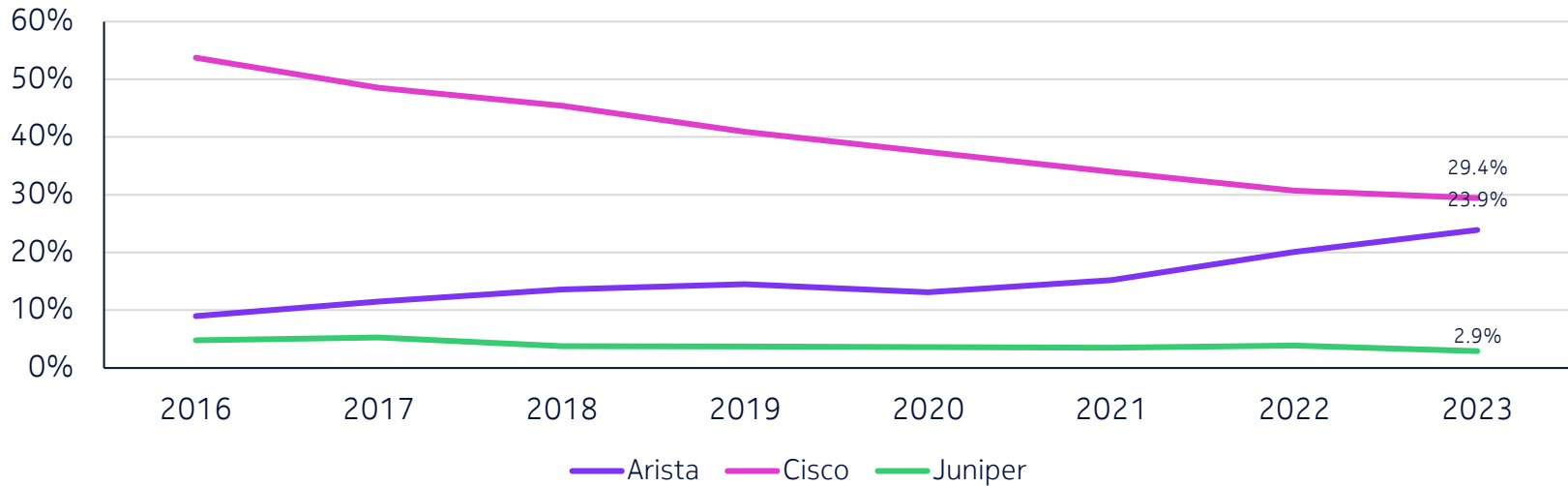


Nokia's sustained commitment to ultra-reliable software gives you peace of mind, so you can focus on innovation and growth

Source (slide): <https://lnkd.in/duzTmhTz>

Source (data): <https://nvd.nist.gov/vuln/data-feeds>

Ethernet switch market



Source: Dell'Oro Ethernet Switch Data Center 1Q24

A man and a woman are sitting together at night, looking at a tablet. The woman is smiling and holding the tablet, while the man looks on. They are wearing winter clothing like scarves and hats. The background is dark with colorful bokeh lights from a city street.

Buyer behavior

Observations

- Networks are fragile
- Network engineers are aging out
- Next-gen engineers are born in the cloud

Implications

- CLI and certifications as a competitive advantage are gone
- Operations as a consideration changes how people buy considerably
- New methods and tools favor Nokia's offering


The background features a complex, abstract digital landscape. It consists of numerous thin, glowing lines in shades of blue and purple that form a series of undulating, wave-like patterns across the frame. Interspersed among these lines are many small, square shapes, some of which are also glowing. The overall effect is one of a dynamic, interconnected network or data flow, typical of modern technology themes.

Technology landscape

AI

Cloud,
Multicloud,
K8s

Operations,
automation,
AIOps, DevOps



Capitalizing on the data center opportunity



Catching the wave

Optical Networks
progress update

James Watt

September 2024



Optical Networks business highlights

€1.94bn

Net sales 2023

#1

Europe (excl. Russia),
APAC (excl. China), India R4Q¹

1,100+

1830 PSS customers

Scale made Simple
from edge to core

850K+

100G equivalent ports shipped

#2

MEA and LAT R4Q¹

300+

1830 PSS-x P-OTN customers

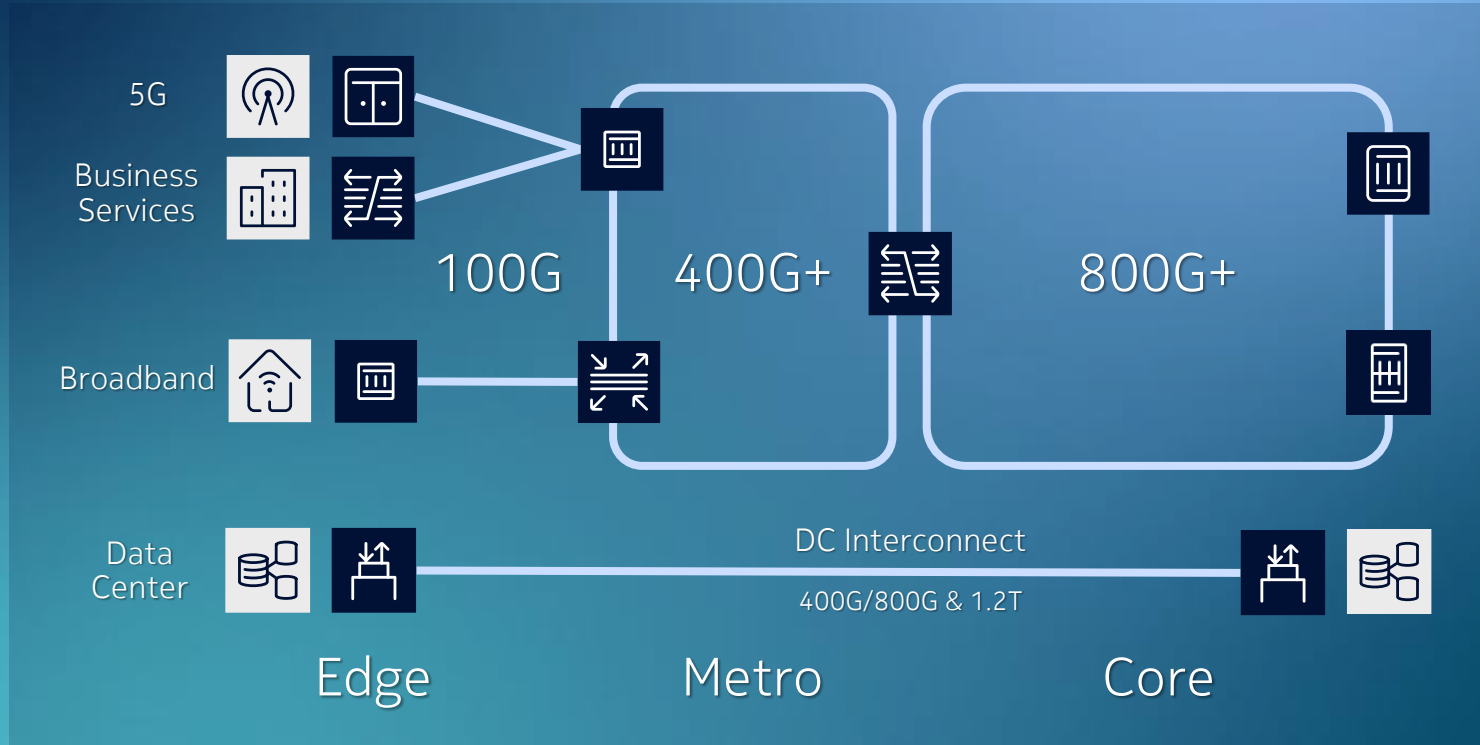
Leader

Breadth of portfolio
and global reach



Revenue figures for FY2023, ¹Omdia 4Q23

Optical Networks customer drivers



Investment priorities

Coherent
Engines and
Modular Service
Platforms

Open
Line Systems

Network
Automation

Underpinned by Scale

Differentiated innovation

Generations of industry firsts and evolution of Photonic Service Engine (PSE)

2010

2024

1st 100G coherent

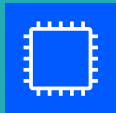
1st SD-FEC

1st 2-ch 500G

1st PCS

1st continuous
variable baud rate

1st dual 1.2T



PSE

Super-Coherent
Performance-
optimized

PSE
2s

PSE
3s

PSE
Vs

PSE
6s



Compact
Pluggable
& power-
optimized

PSE
2c

PSE
3c

PSE
Vc

PSE
6c



1st low-power
100G

Pluggable
200G ACO

Pluggable
400G DCO

Pluggable long-
haul 800G DCO

Differentiated innovation

Record breaking, award-winning coherent leadership at 800G/1.0T/1.2T



Differentiated innovation

Enabling network scale, optimization and monetization

Scale

Network capacity

Optimize

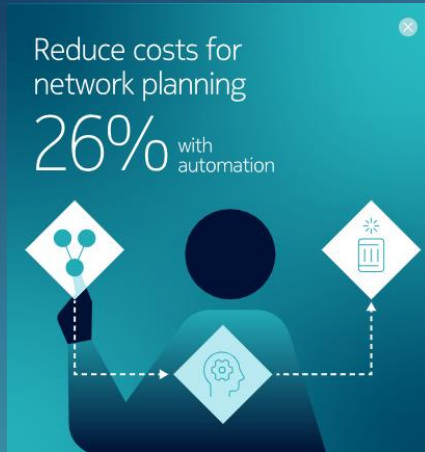
Network operations

Monetize

Network assets

Differentiated innovation

Enabling network scale, optimization and monetization



Source: Analysis Mason, 2024 Study

Ongoing market momentum

Tier 1 CSPs



Carrier-neutral



Quantum-safe networking



Emerging and expanding opportunities

Subsea and digital bridges



Cloud



Enterprise

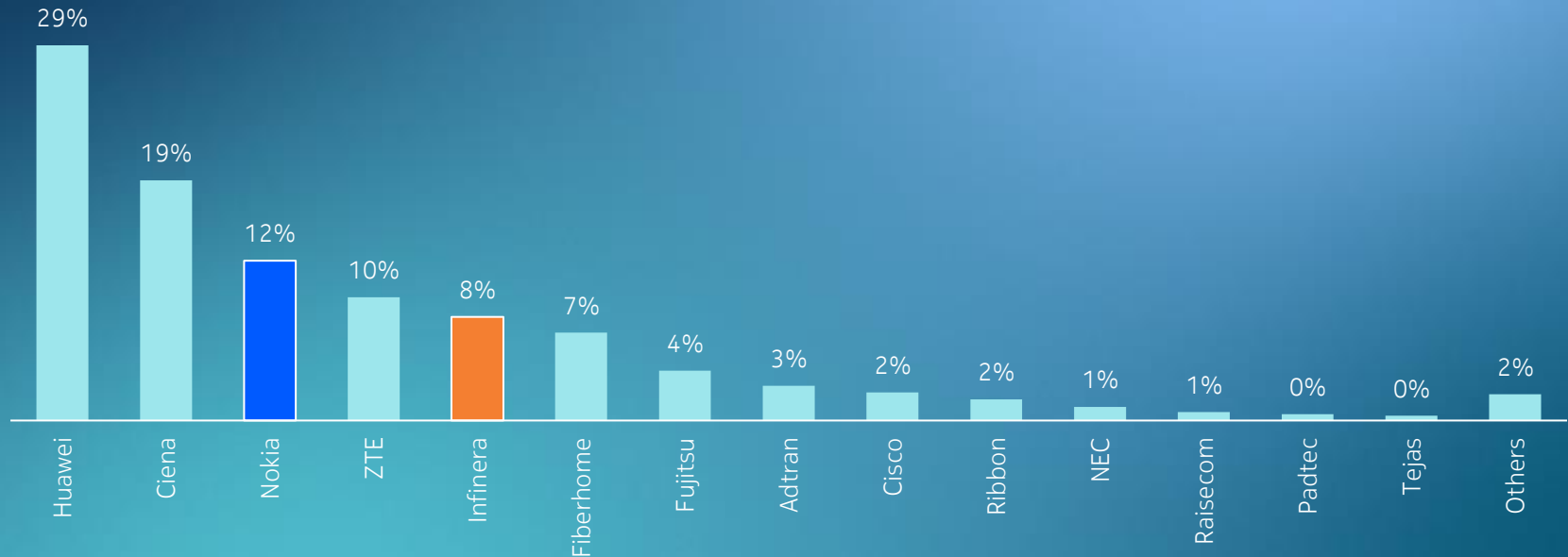


Commentary on planned Infinera acquisition



Scale is critical in highly fragmented optical market

Share of optical networking (2023)*

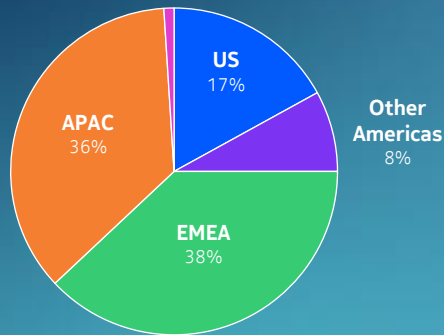


* Source: OMDIA Optical Networks report Q4 2023

Highly complementary geographic footprints in Optical ...

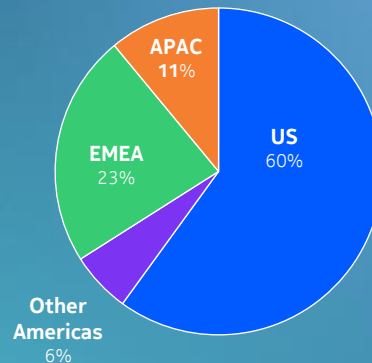
... Significantly strengthens presence in Webscale and North American market

NOKIA Optical



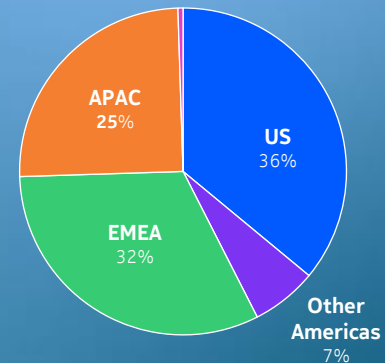
€1.9bn
2023 Revenue

 **Infinera**



€1.5bn*
2023 Revenue

NOKIA Optical
+  **Infinera**

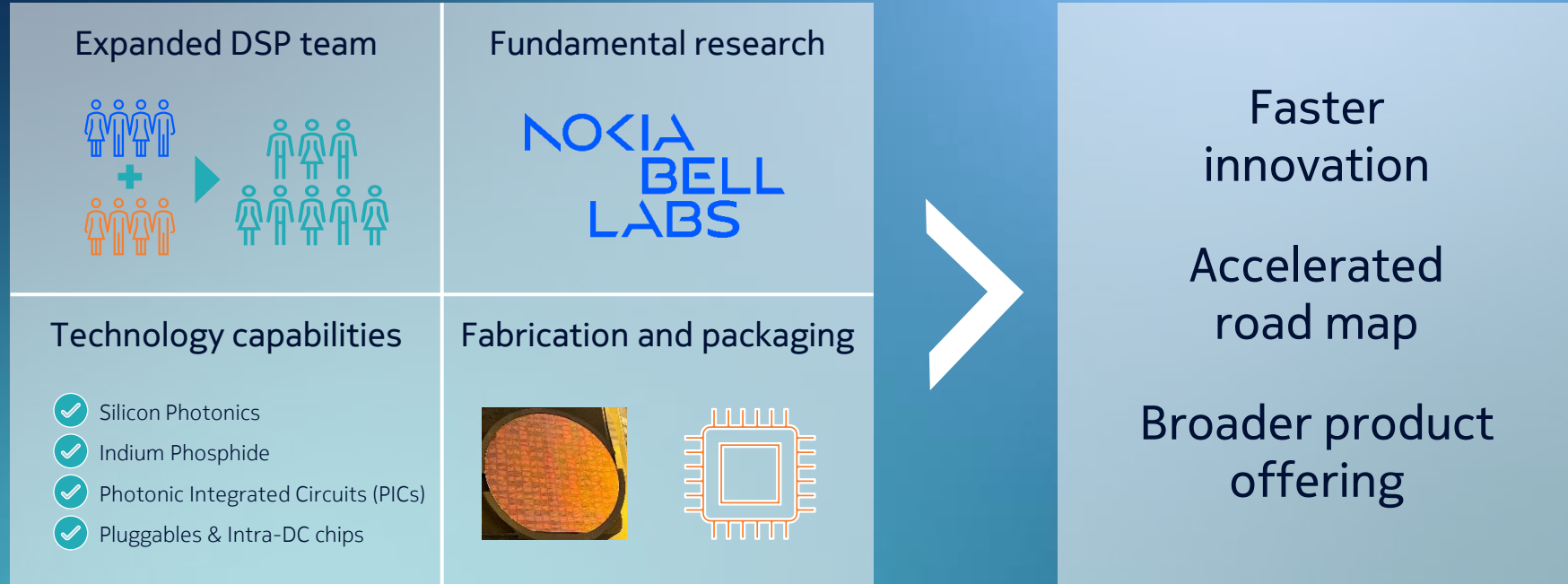


€3.4bn
2023 Revenue

* Calculated assuming the 2023 average exchange rate of 1 EUR = 1.08 USD

Combined company expected to deliver faster innovation

A special mix of ingredients that can deliver the best outcomes for customers



Network Infrastructure is built on three market leading pillars

Attractive market leading provider of fixed network infrastructure

		Nokia Growth Opportunity	Net Sales 2023	Operating margin - 2023	Operating margin - aspiration	Key Competitors
Fixed Networks		<ul style="list-style-type: none"> Demand for fiber build remains strong Mature markets starting to upgrade to XGS/25G-PON Government funding programs starting to impact Target mid-single digit growth 	EUR 2.4 bn	High teens	Mid to high teens	Adtran, Calix, Ciena, Fiberhome, Huawei, ZTE
IP Networks		<ul style="list-style-type: none"> Continued ramp of FP5 and FPcx products Momentum in Enterprise/webscale market Target mid-single digit growth 	EUR 2.6 bn	Mid teens	High teens	Arista, Ciena, Cisco, Juniper, Huawei
Optical Networks*		<ul style="list-style-type: none"> Increased scale to accelerate product roadmaps Well-positioned for webscale / AI opportunities Target mid-single digit growth 	EUR 3.4 bn	Mid single digit	Mid teens	Adtran, Ciena, Cisco, Fujitsu, Huawei, Ribbon, ZTE
Network Infrastructure		<ul style="list-style-type: none"> Target mid-single digit growth 	EUR 8.4 bn	~ 12%**	Mid to high teens	

* Combined proforma with Infinera; Operating margin including impact of share-based compensation

** Proforma operating margin for Network Infrastructure in 2023 reflecting the Infinera acquisition and recently announced sale of Submarine Networks

NOKIA