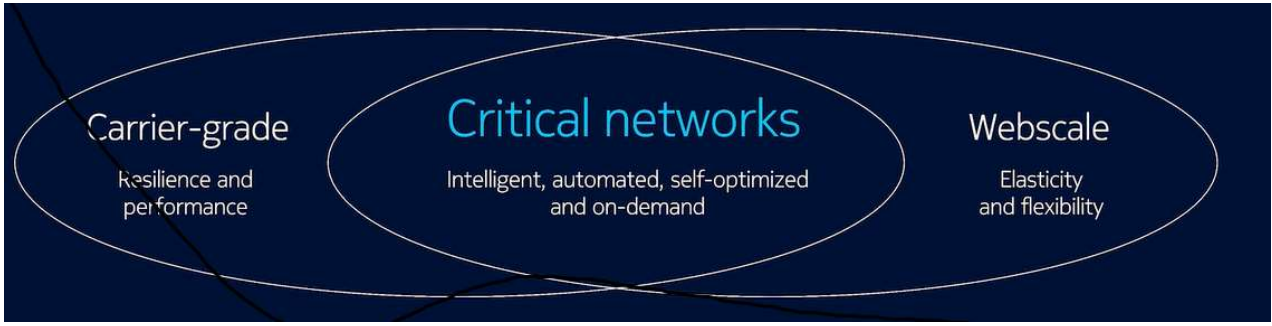
Nokia CEOの最新メッセージ

5G ＋ インダストリ4.0でビジネスの革命!

$8,000,000,000,000

7% of global GDP by 2030



5G Private 〉 Public

	Safety		Efficiency		Productivity	
Manufacturing	Injuries	22% ↓	Production line defects	30% ↓	Unanticipated breakdowns	30% ↓
Logistics	Danger zones entry	95% ↓	Time management	100% ↑	Monitoring costs	50% ↓
Ports	Staff injuries	100% ↓	Fuel consumption	25% ↓	Crane productivity	100% ↑

1st Step of industry 4.0

DX加速のために、すべてのアセット接続を可能に！

74% のデータは収集できていない！！

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産業向けプライベートワイヤレスネットワークの市場ポテンシャルは巨大

インダストリー
4.0

ネットワーク
700万
グローバル規模の
基地局

産業
1,400万
グローバルサイト

- 運輸・港湾：5万
- 軍事基地：1万
- 倉庫：330万
- 工業・製造業：1,071万
- 石油・ガス：8,000
- 発電所：4.7万
- 鉱業：5.4万
- 水道施設：14万
- 病院・研究所：26.3万

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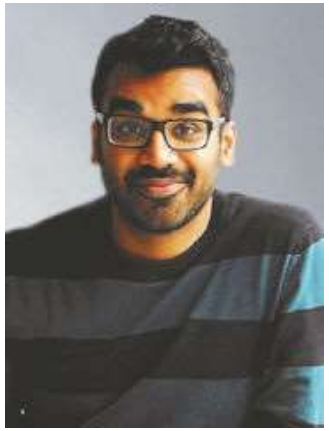
Keynote-LiveTalk with Global Expert

ノキアのグローバルエキスパートたちとのライブディスカッションによる ローカル5Gの方向性

柳橋 達也
ノキア・ジャパン
最高技術責任者CTO

ケニス・C・ブッカ博士
ベル研究所コンサルティング
シニアパートナー＆戦略アドバイザー

デーブ・ナウシアット
ノキアUS　製造・物流
マーケティング・ディレクター



ベンキー・ラマクリシュナン
ノキアドイツ　流通（物流、海運）
ソリューション・ディレクター

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NOKIA Bell Labs

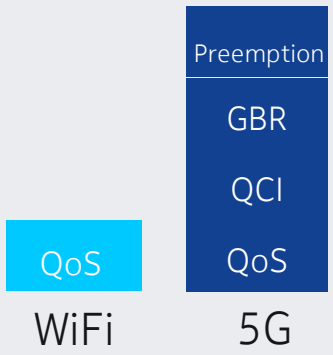
Creating Industrial Automation Value through 5G networking

Ken Budka
Sr. Partner - Bell Labs Consulting
Nokia Bell Labs

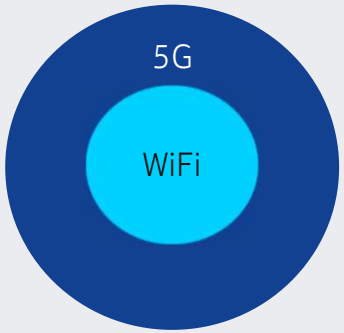
Mission-critical wireless access in hyperconnected industries

WiFi → 5G

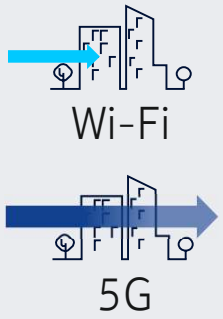
Quality of Service



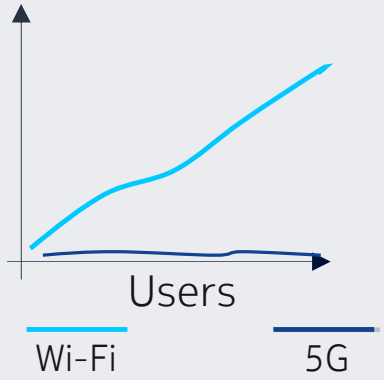
Coverage



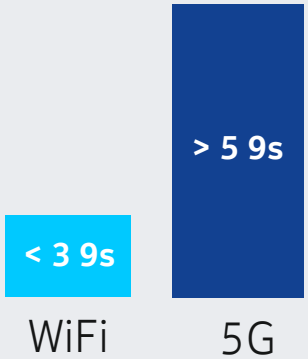
Non line of sight



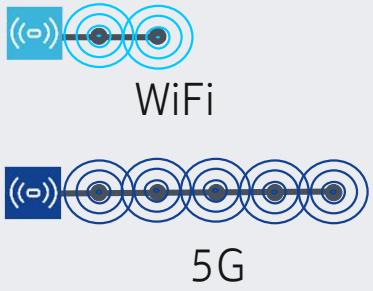
Latency / Jitter



Reliability

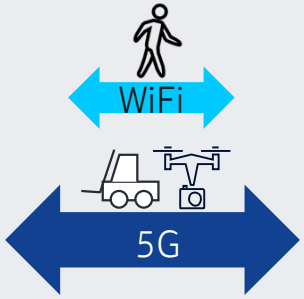


Band Support

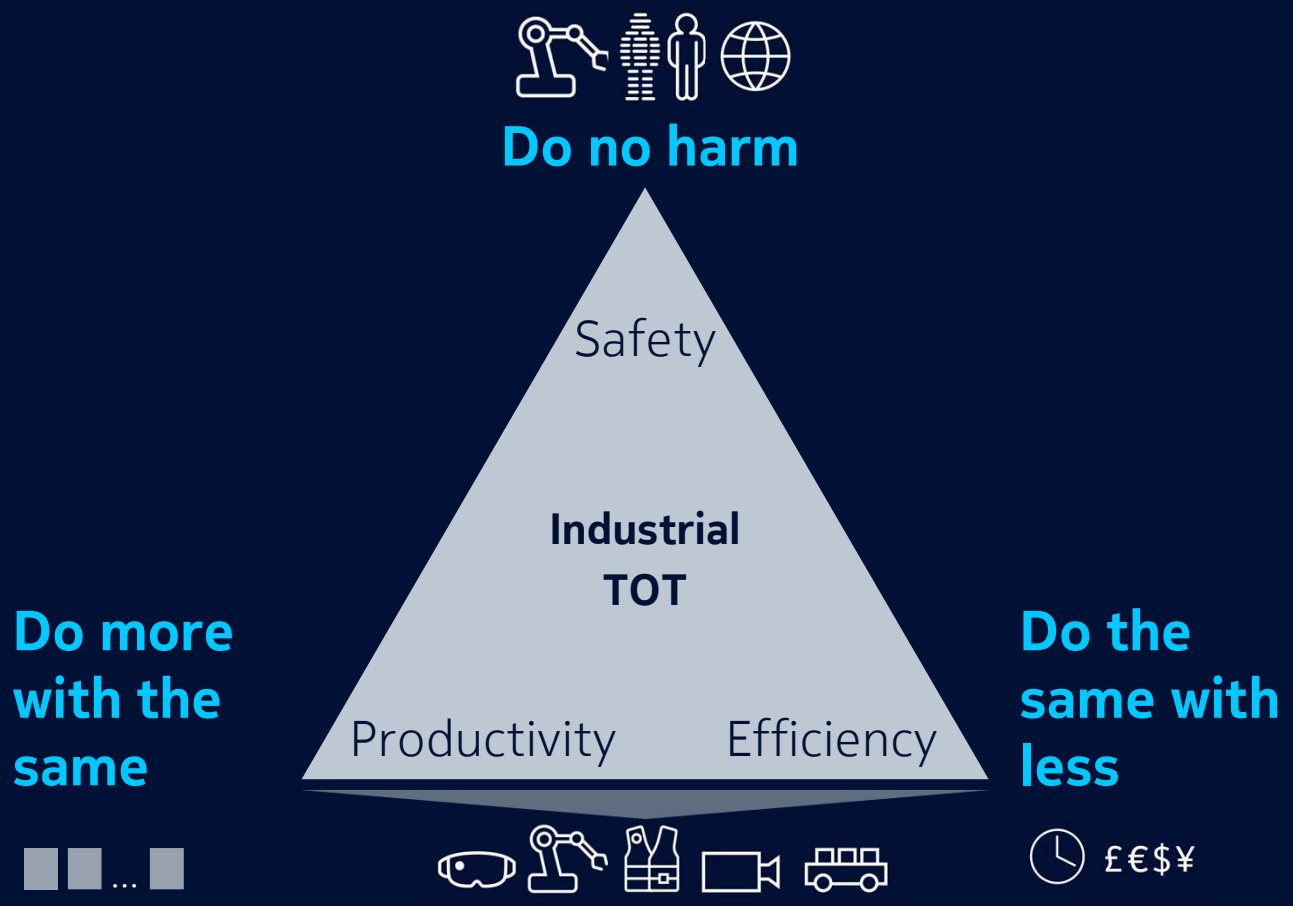


Security

Mobility



The Triangle of Truth for Industrial Automation



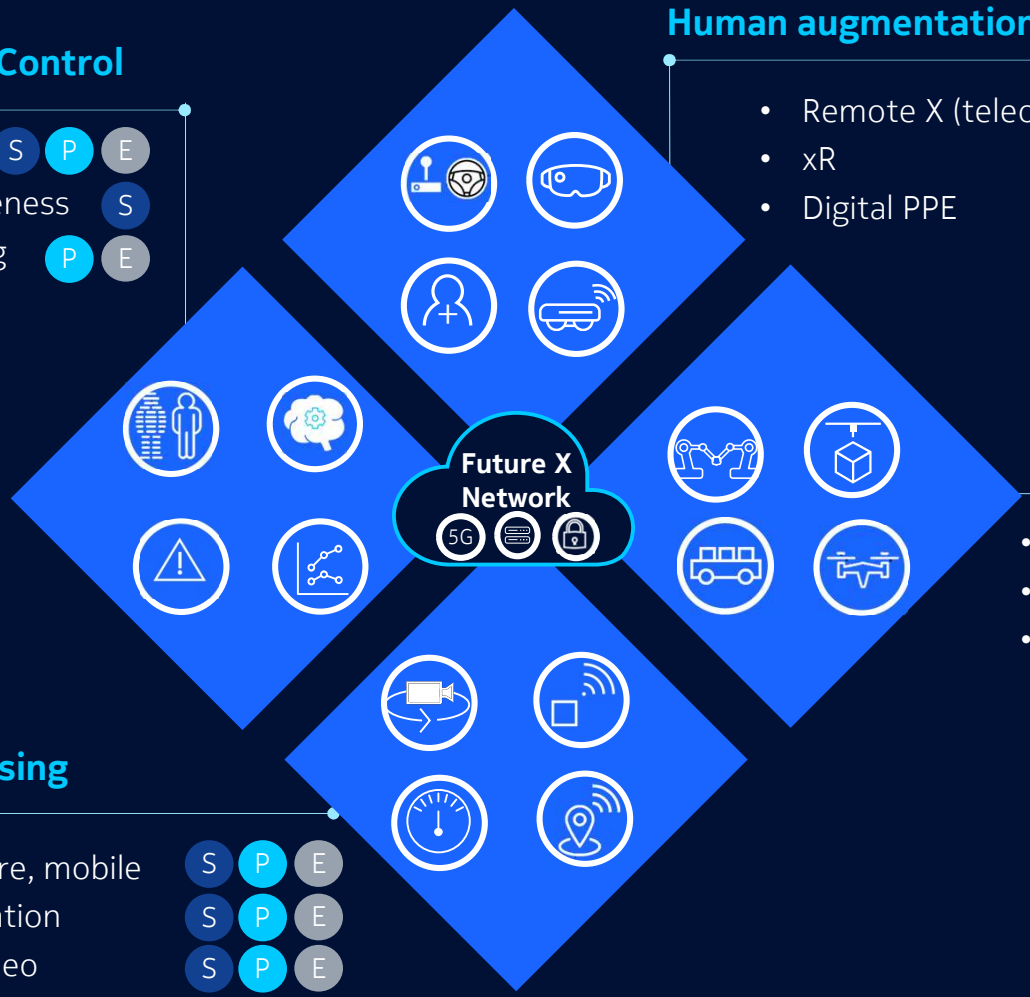
Safety, Productivity, and Efficiency Technologies for Industries

Augmented Cognition & Control

- xR Digital twin (S P E)
- 360º situational awareness (S)
- Predictive, self-healing (P E)

Human augmentation

- Remote X (teleoperation) (S P E)
- xR (S P E)
- Digital PPE (S)



Extreme robotic automation

- Autonomous machines/vehicles (S P E)
- Mobile & collaborative robots (P E)
- Dynamic orchestration (P E)

Massive-scale sensing

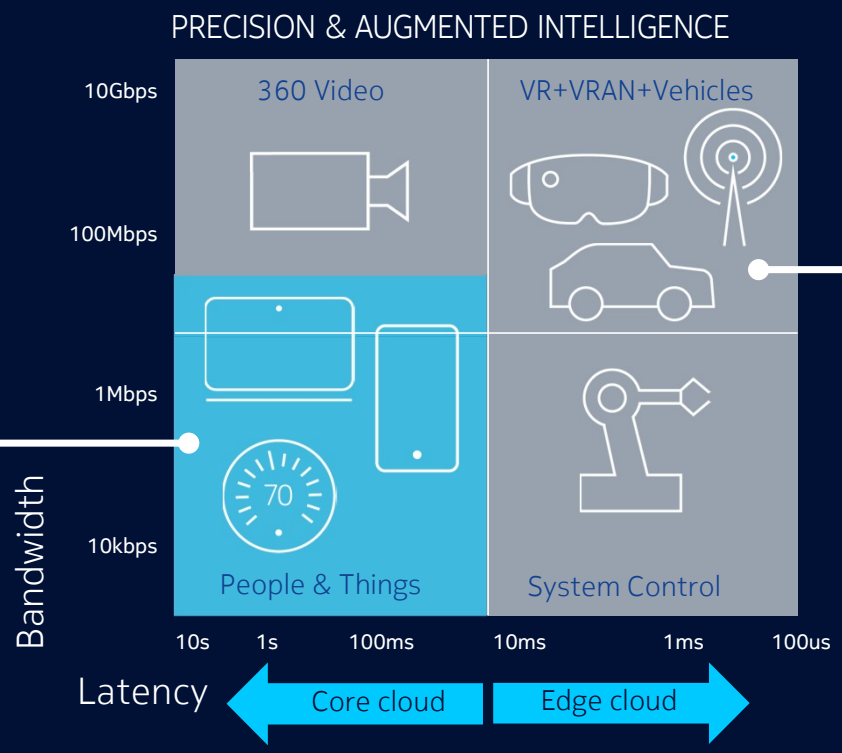
- Anytime, anywhere, mobile (S P E)
- Precision geolocation (S P E)
- 360º high-res video (S P E)

S Safety
P Productivity
E Efficiency

Bell Labs Consulting

Diverse and stringent requirements from enabling communication networks

An evolving toolset for optimizing safety, productivity, and efficiency



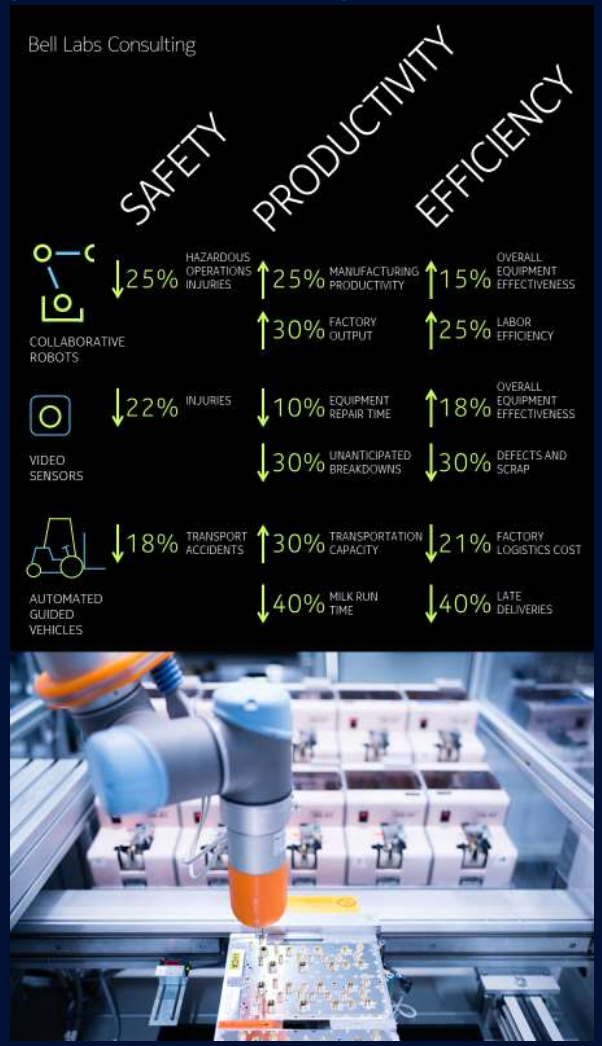
4.9G, WiFi

5G

- High-speed robot orchestration
- Fiber-like reliability
- 'Like being there' teleoperation, xR
- High-res 360° video
- High-res video-as-a-sensor

Network capabilities → Use cases that can be supported over the network → Safety, Productivity, Efficiency value

Safety, Productivity and Efficiency Gains: 4G→5G



Bell Labs Consulting

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Performance advantages of private 4G/5G over Wi-Fi for industrial applications

David Nowoswiat
Head of Manufacturing & Logistics Marketing

18-11-2022

Wireless technology performance comparison

Use Wi-Fi for office applications, 4G/5G for OT mission critical applications

Wi-Fi

- Capacity ~30-100 active connections per access point
- Indoor coverage - Access point radius of ~10-20 meters
- QoS - Best effort; lack of prioritization
- Performance - High peak rates; unstable performance/capacity
- Mobility - Loss of connection up to 15 secs on handover between APs
- Latency - Fluctuating between 1 ms and 2 secs; reliability decreases with number of connections
- Security - High risk for hacker attacks and intrusion
- Services - Co-existence with private radio, no IoT support; no handover to public network
- Interference - Poor signal penetration

LTE

- Capacity - Up to 800 connections on a single small cell; tens of thousands on a macro antenna
- Indoor coverage - Access point radius of ~20-40 meters*
- QoS - Dependable quality of service management with prioritization
- Performance - Predictable data rates; 3-5 x 9's 'carrier grade' reliability
- Mobility - Up to 350 km/h
- Latency - Between 8-20ms; remains stable with increasing number of connections
- Security - Security by design
- Services - One network for PTT/PTV, broadband, video streaming, IoT; same technology as public 4G
- Interference - Up to 3 times greater signal penetration
- Network slicing - Static QoS, radio + core only, limited slices/US, Evo to dynamic & E2E
- Basic geo-positioning - ~ 30m accuracy

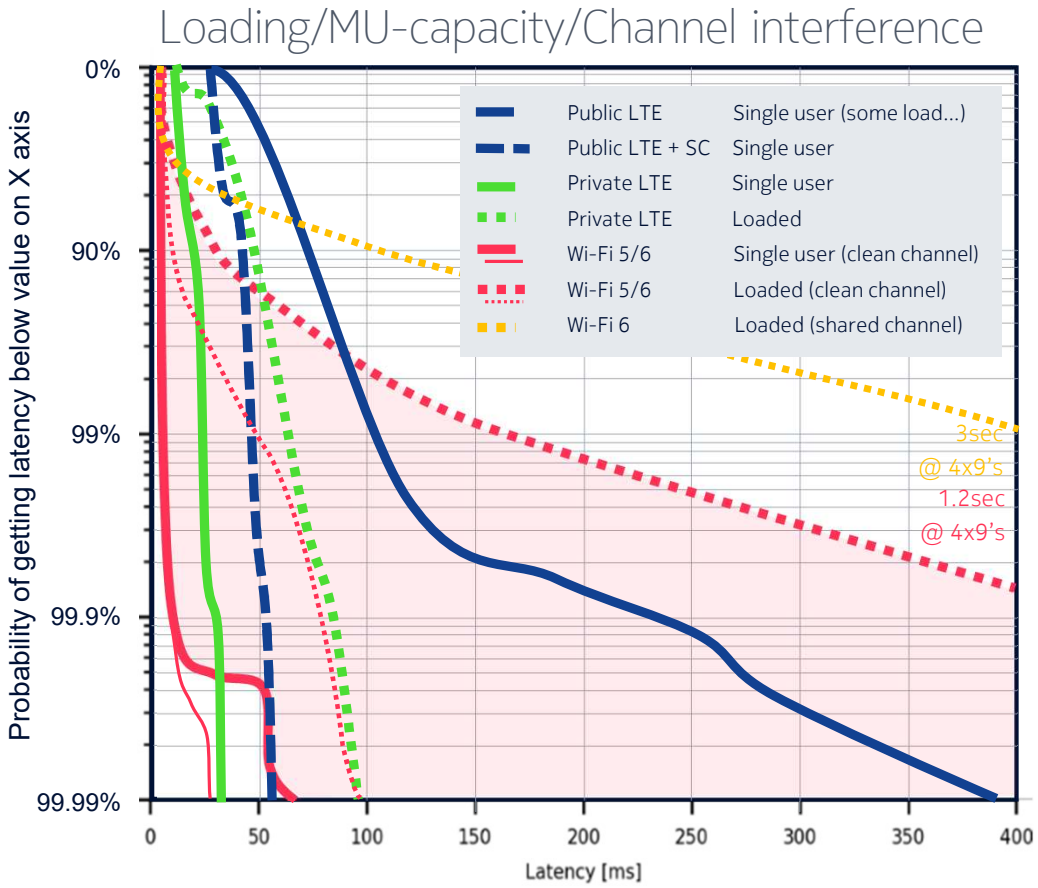
5G

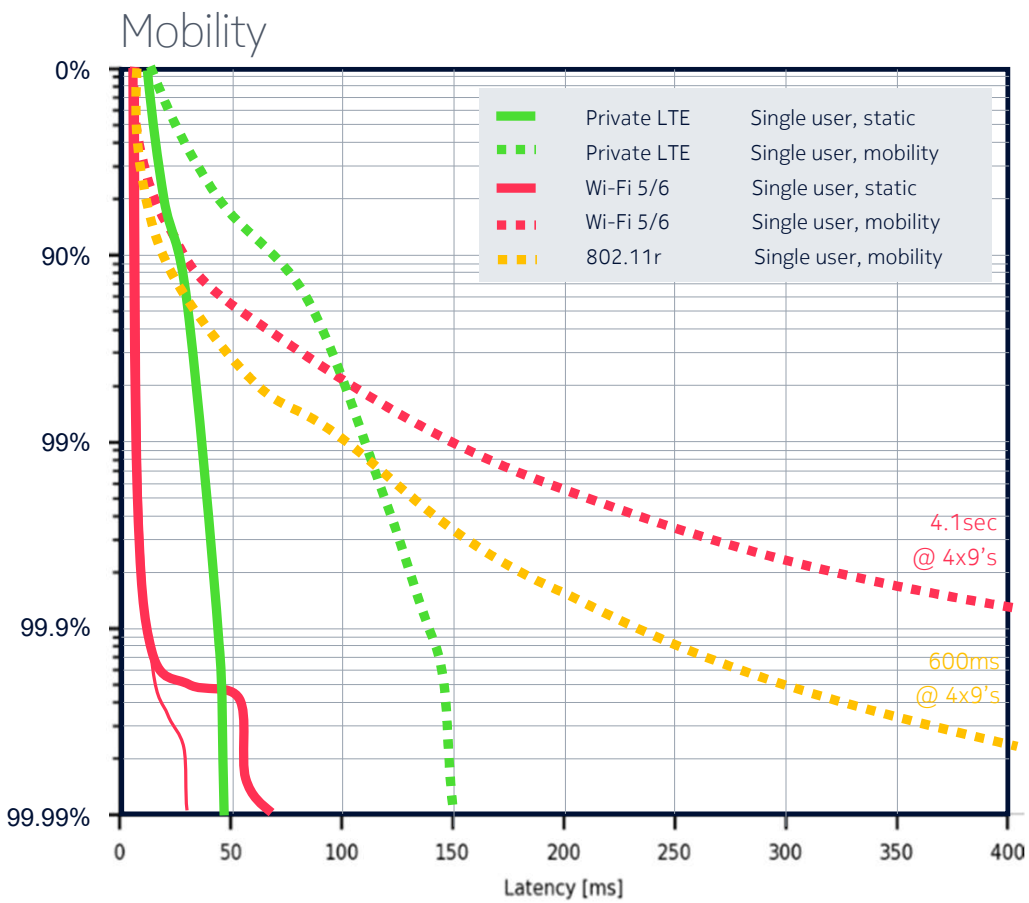
- Capacity - Tens of thousands per macro base station or distributed small cell
- Indoor coverage - Access point radius ~15-30 meters*
- QoS - Deterministic QoS management with prioritization
- Performance - Predictable data rates; 6 9's reliability @ 1ms TSC (R17-18)
- Mobility - Up to 500 km/h (R15)
- Latency - Between 2-10 ms, remains stable with more connections
- Security - Zero trust design
- Services - One network for PTT/PTV, broadband, video, IoT and TS machine control
- Interference - Up to 2 times greater signal penetration
- Network slicing - Slicing and slicing automation evolution (R16-R18)
- Enhanced geo-positioning - ~cm accuracy

*dependent on frequency selected, max output power authorized, type of radio solution used and total spectrum bandwidth

Predictable performance: Reliable latency testing (vs Wi-Fi vs public networks)

Bell Labs & Aalborg University: Manufacturing location testing





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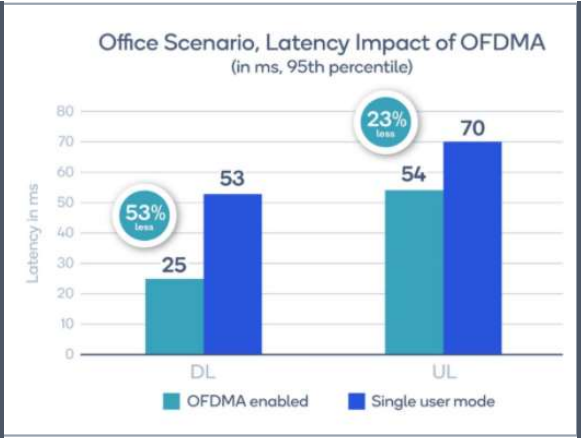
Qualcomm own Wi-Fi 6 testing confirms our view

Mission-critical OT network performance requirements can not be met with Wi-Fi

20 users/AP
No interference
No mobility
Mix traffic:
- 8x VOIP or document editing
- 3x Email sync
- 5x browsing
- 4x video streaming

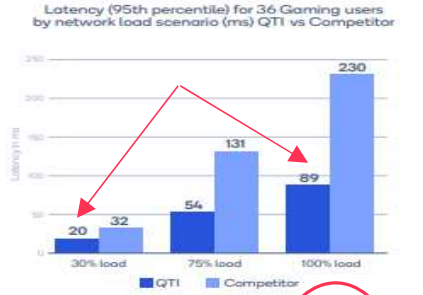


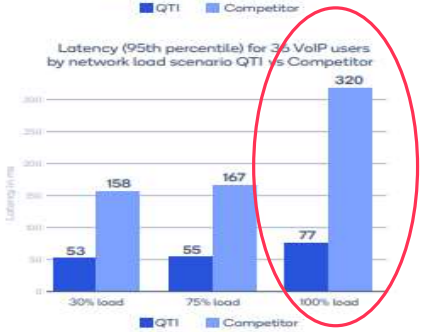
79 ms
average Wi-Fi 6 latency

Huge performance variation depends on AP vendors chipsets + software but also the # of devices connected

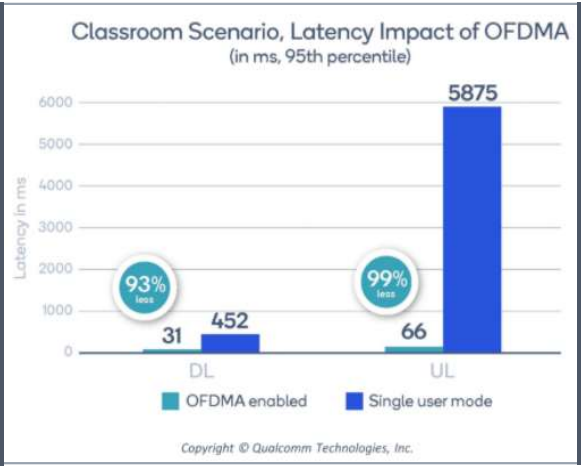
In same fully load conditions…

4.15x latency difference: 77ms vs 320ms





20 users/AP
No interference
No mobility
Mix traffic + heavy video streaming
- 20x video streaming
- 4x document editing
- 8x email/IMs

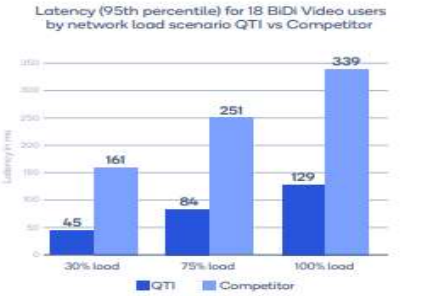


97 ms
average Wi-Fi 6 latency

Higher loading impact on performance due to simpler, less featured scheduler and greater TTI vs 4.9G/LTE

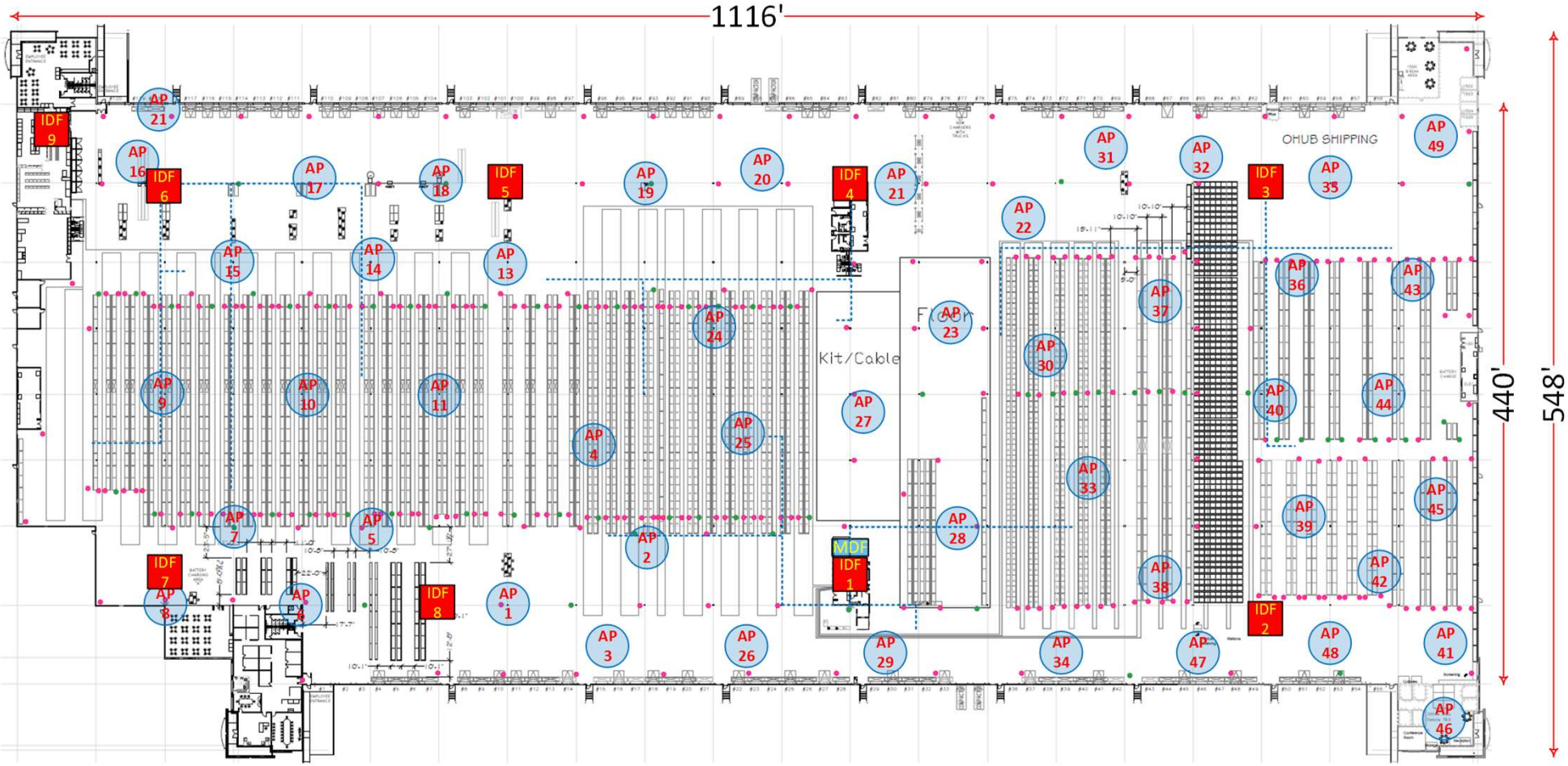
Low data rate, bursty traffic:

4.45x latency difference 20ms vs 89ms



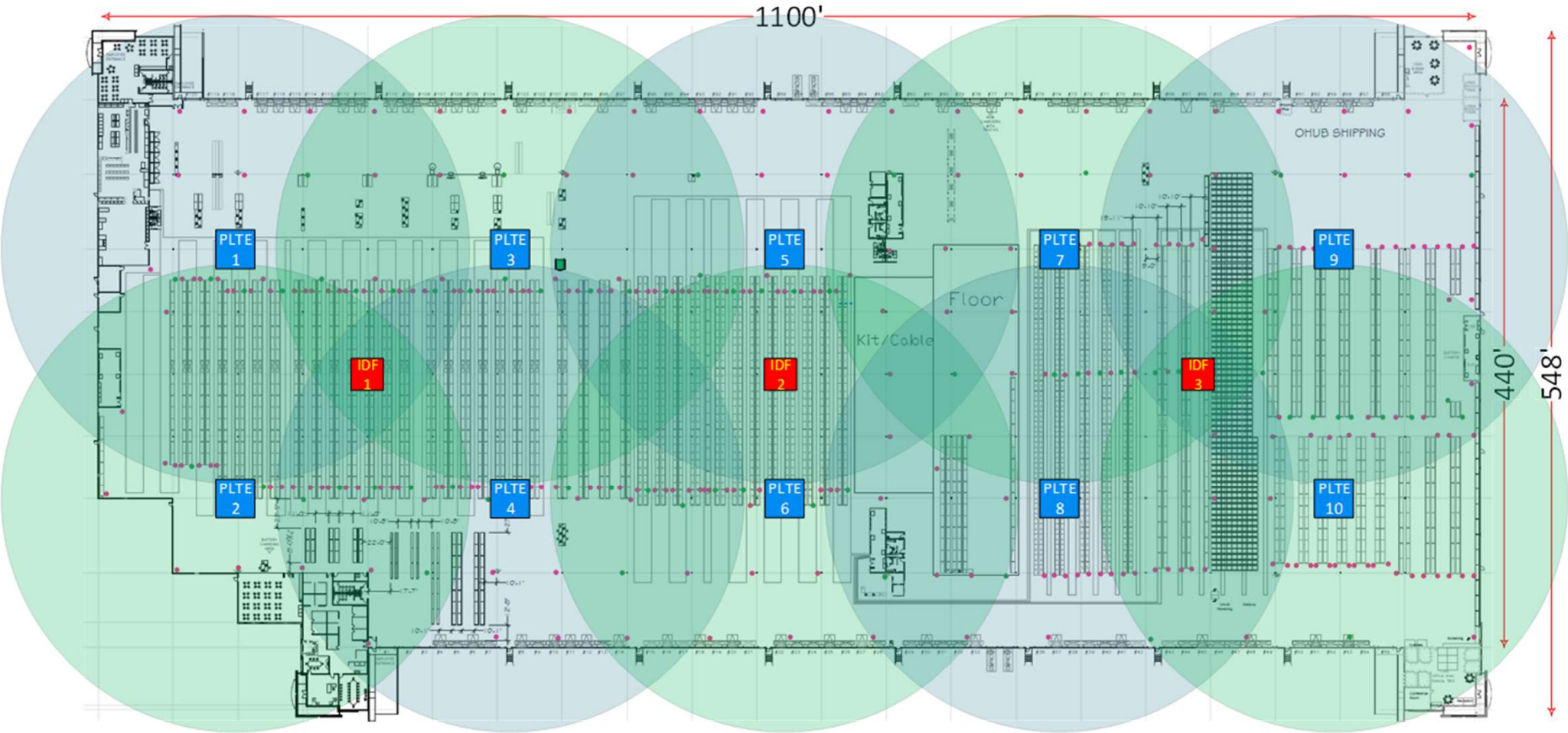
*Reduced latency benefits of Wi-Fi 6 OFDMA | Wi-Fi Alliance (wi-fi.org) & the-benefits-of-ofdma-for-wi-fi-6-a-technology-brief-highlighting-qualcomm-technologies-competitive-advantage.pdf

Typical WLAN 500k ft^2 Warehouse Deployment – 49 APs, 9 IDFs



IDF = Intermediate Distribution Frame, MDF = Main Distribution Frame

Same warehouse with 10 Private Wireless 4G/LTE APs, 3 IDFs



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Port Terminals

Private Wireless Networks for harsh outdoor environments

Venky Ramakrishnan Head of Transport & Logistics Vertical

18-11-2022

NOKIA

Wireless in port terminal operations today

Private LTE or 5G as future wireless technology of choice

Fragmentation of existing systems

- Multiple networks and systems = **high TCO**
- Multi-devices for operations = **inconvenient and unsafe**

Voice	Data	Data (backup)	Localization	M2M	...
Private PMR (TETRA / P25)	Private Wi-Fi	Public 3G / LTE	Private Transponder network	Private Proprietary	...

Voice	Data	Data (backup)	Localization	M2M	...
Private LTE or 5G					

Converged wireless infrastructure

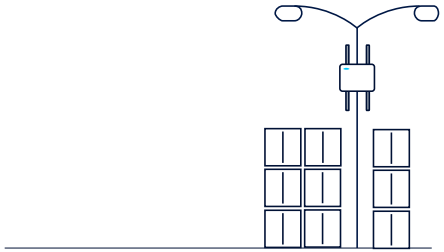
Low reliability of existing systems

- Interferences of neighbour networks = **risk of downtime**
- Reflections of container blocks = **unreliable data**
- Signal blocked by cranes = **blind spots**

High reliability by seamless coverage with QoS

High network expansion and maintenance cost

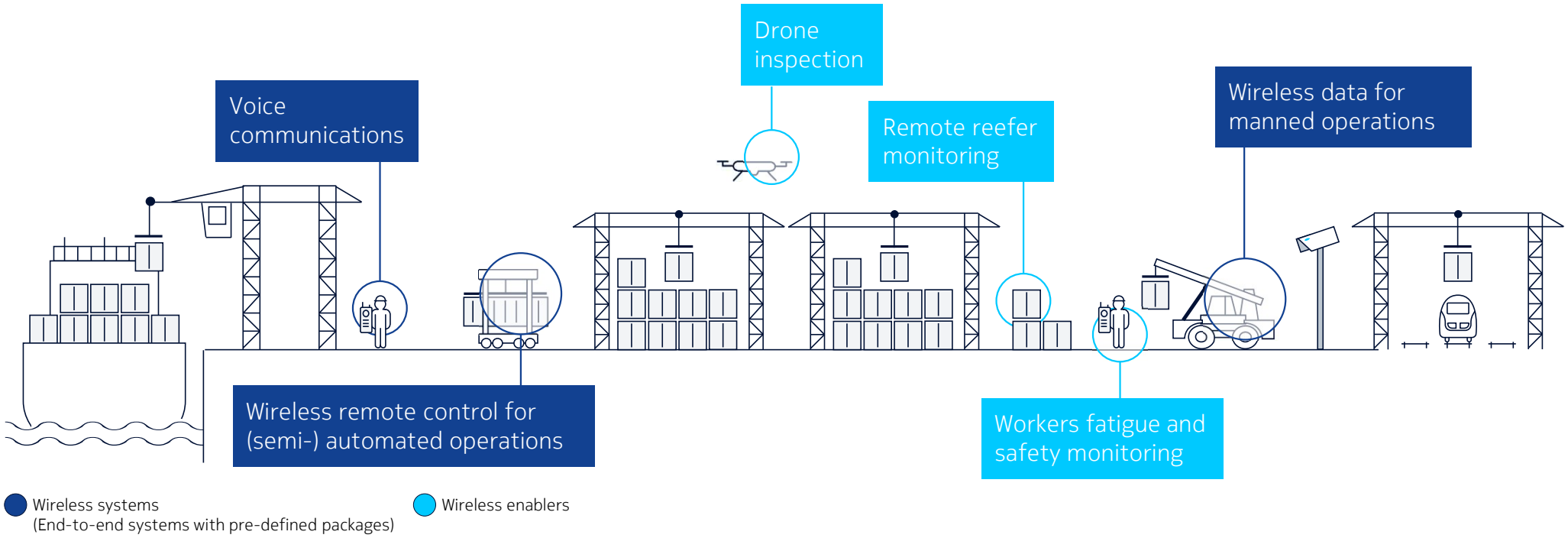
- Wi-Fi with low output power requires cells at every light masts = **high TCO**
- Cell located in middle of 24/7 operations = **difficult maintenance**



Fewer cell sites (factor 5-10x)

Digital transformation of terminal operations

A portfolio of end-to-end wireless systems and wireless enabling blocks



Wireless systems
(End-to-end systems with pre-defined packages)

Wireless enablers

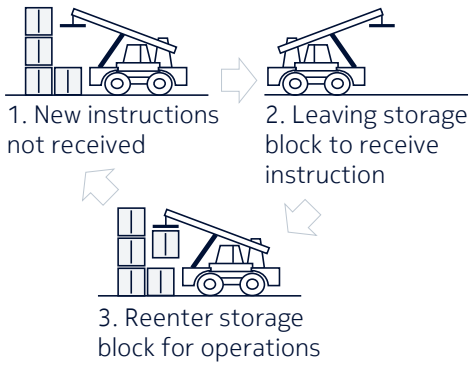
Value add – at a glance

Industrial wireless for manned operations	To increase annual berth moves by overcoming **Wi-Fi limits**	+25,000
Terminal workflow optimization	To increase **terminal TEU throughput**	7-10%
Industrial wireless for (semi-) automated operations	To increase **annual availability** per Straddle Carrier	+49 hours
Voice communications	To benefit from **network simplification**	Convergence
Remote reefer monitoring	To reduce **manual work** and damage of **perishable goods**	-30% manual work; -90% perished goods
Worker's fatigue and safety monitoring	To ensure safety and well being of port terminal personnel	Safety
Drone inspection	To ease **asset inspections** and response to **emergency situations**	Aerial insight

Use case: Wireless data for manned operations

Description

Status quo



Receiving instructions inside storage blocks
= **saving up to 30 sec per job**

Customer challenge

- Modern Terminal Operations Systems (TOS) require seamless data link between mobile and central applications for dynamic queuing
- Interferences, reflections and white spots limiting wireless connectivity today: forcing container handling equipment to do unnecessary moves

Nokia response

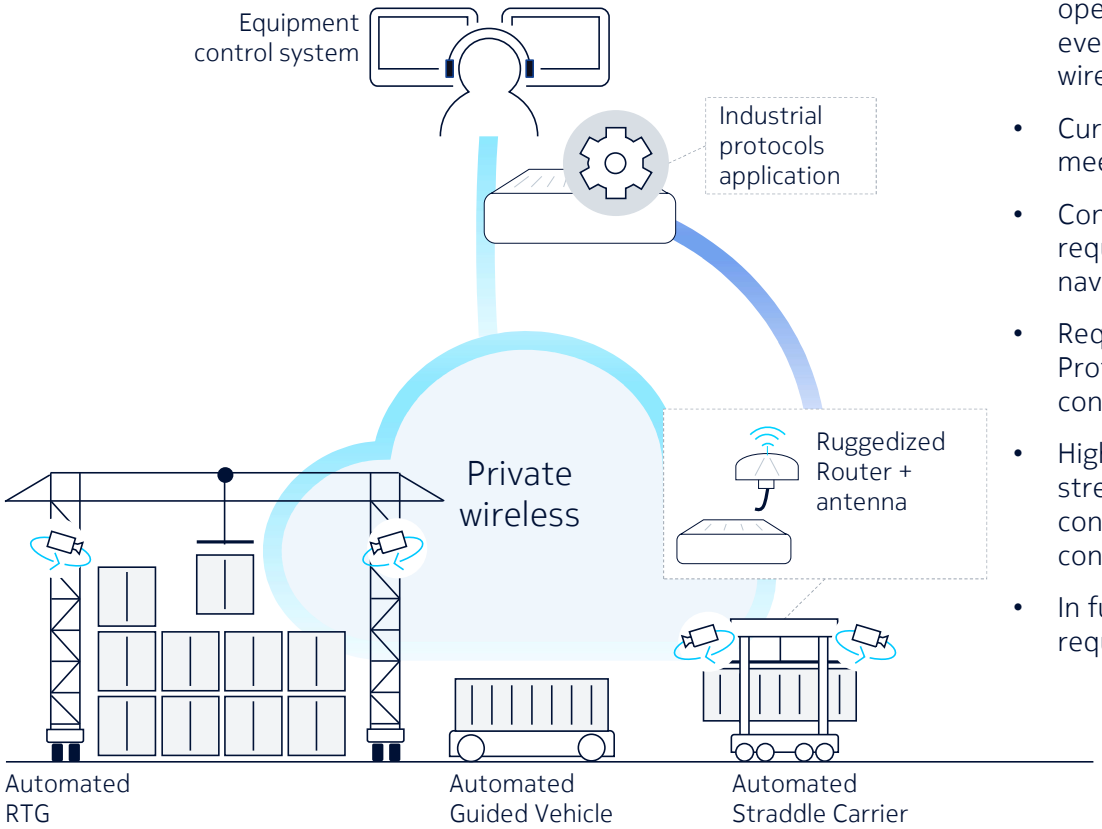
- Purpose-build private LTE or 5G network powered by Nokia DAC in dedicated spectrum
- **Highly available and reliable wireless connectivity** across whole yard with **Quality of Service (QoS**)
- End-to-end systems with user equipment and TOS integration

Business benefits

- **5-11% yard productivity increase**, up to 450.000 additional container moves per year
- **16-27% wireless TCO reduction**, reduced radio equipment in yard (~10x less)
- **Investment protection**, future-ready wireless platform for terminal automation

Use case: Wireless remote control for (semi-) automated operations

Description



Customer challenge

- Remote controlled yard operations require – more than ever – highly reliable and available wireless
- Current wireless not designed to meet needs of remote control
- Consistent low latency requirement with mobility while navigating yard
- Required support of Profinet / Profisafe protocol for remote control
- High uplink requirements for video streaming as feedback to human controller: 8-18 cameras per container handling equipment
- In future, even further low latency requirement for haptic data

Nokia response

- Purpose-build private LTE or 5G network powered by Nokia DAC in dedicated spectrum
- **Highly available, reliable and low latency wireless connectivity** across whole yard with **Quality of Service (QoS**)
- End-to-end system with user equipment, industrial protocol gateways, and end-to-end use case commissioning

Business benefits

- **90% less emergency stops**, zero system related accidents or injuries
- **28% typical yard productivity increase**, with 860.000 additional automated container annually
- Increased workers health and safety

Case overview: SSA Marine Terminal 5, Port of Seattle, USA

SSA Marine
A Carrix Enterprise

Background, challenges and drivers

- Seamless wireless connectivity required indoors and outdoors to across Terminal 5 operations
- Private wireless network based on LTE to enable major increases in efficiency, workers safety and terminal handling performance
- Following successful proof of concept at Oakland International Container Terminal (OICT) proving superior coverage and reliability of LTE over Wi-Fi

Solution

- Nokia DAC enabled private LTE network in B48 and B53 with seamless switching between bands and geo-redundant core on premise for secure, highly available and low-latency data connectivity
- Incorporation of ruggedized smartphones and tablets for terminal wide mobile voice communications and industry specific applications

"The Nokia DAC platform provided its worth in rigorous testing at OICT. [...] We look forward to securing and supporting the same kind of mobility, safety and productivity gains at Terminal 5 in Seattle."

Amanda Gress,
Vice President of IT at Tideworks Technology

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