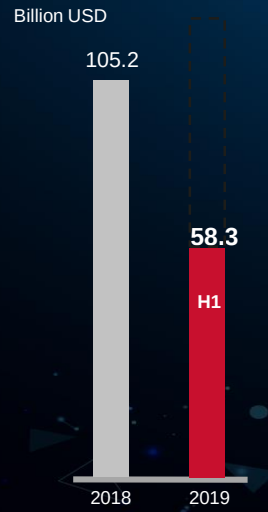
Energy @ 5G Era

Nicolas Driesen

Chief Technical Sales Expert

Sustainable, Robust Growth， 2019H1 Business Results

Sales Revenue



Revenue
23.2% ↑
the same period last year

Net Profit Margin
8.7% ↑
the same period last year

Total R&D investment2019
17.45B

Robust growth across all business segments, thanks to balanced global presence and strategic focus

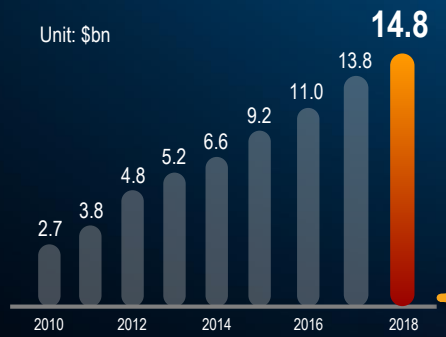
Carrier business: H1 sales revenue reached **USD 21.4 billion**，has secured 50 commercial 5G contracts and has shipped more than 150,000 base stations to markets around the world

Enterprise business: H1 sales revenue was **USD 4.7 billion**，continues to enhance its ICT portfolio across multiple domains, including cloud, artificial intelligence, campus networks, data centers, Internet of Things, and intelligent computing

Consumer business: H1 sales revenue hit **USD 32.2 billion**, Huawei's smartphone shipments (including Honor phones) reached 118 million units, up 24% YoY.

Remarks: [1]: The financial data disclosed here are unaudited figures compiled in compliance with the International Financial Reporting Standard. Converted into United States dollars ("USD") using the market rate at the end of June 2019,* ***USD1.00 = CNY6.8785.*

Persistent Investment in R&D Brings



- $70+ bn invested in R&D since 2009
- 10%~15% of annual revenue invested in R&D
- $100 bn R&D investment in next 5 years

Products & Solutions

ICT Infrastructure

Network | Cloud & AI | IAS

Smart Devices

Smart Phones | Other Products

Cutting Edge Technology Behind the Scenes

Chipset design

Materials science

Ceramics | Carbon Nanotubes

Mathematical algorithms

$$F(\omega) = \int_{-\infty}^{\infty} f(t) e^{-i\omega t} dt$$

$$f(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\omega) e^{i\omega t} d\omega$$

OS & DB

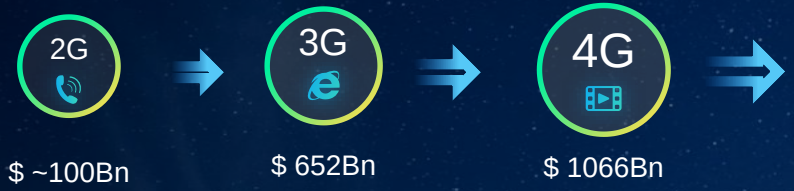
Euler OS
FusionSphere
Lite OS
Gauss DB
...

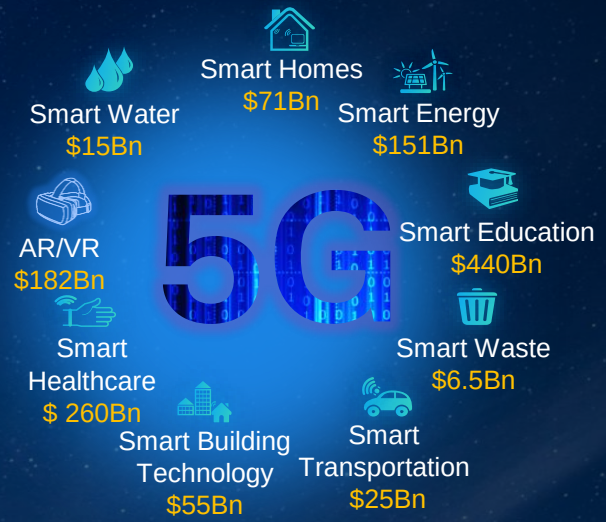
GSMA Outstanding Contribution for LTE Evolution to 5G

Award for Most Notable Partnership between an Operator and Solutions Provider for 5G Trials and Development

GSMA Outstanding Mobile Technology Award - 5G

5G, Full of Potential and Possibilities





Source：9 analytics agencies, e.g.. Ovum, IDC, Gartner, Forbes

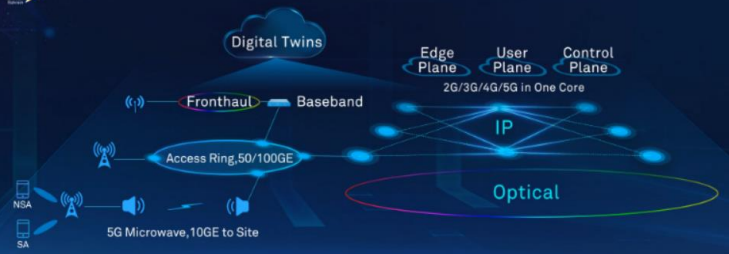
5G is ON, Inspiring the Future

70GB
5G Data of Usage

10%-20%
Operator Revenue Growth vs.2018

15M
Job Opportunities

2025 Forecasts
Source: Huawei MI



Simplified RAN
- Massive MIMO for All Scenarios
- NSA & SA in One Network

Converged Transport
- Optimal Cost per Bit
- Lifecycle Automation

One Core for All
- 2G/3G/4G/5G in One Core
- User Experience Monetization

Global Services
- Digital Engineering
- Intelligent Operations

Target Network: LTE + NR Long Term Co-existence, All Service @ 4G, All Bands Go to 5G

SingleRAN PRO Embracing Next Golden Decade

Powerful Capability by 10x

4G + 5G Co-existence, All Bands Go to 5G

- +10dB Coverage
- Zero Fallback
- 10x Capacity
- Zero Wait
- 10x Experience
- Zero Waste

Revenue Growth With Wireless First

All Services Wireless First

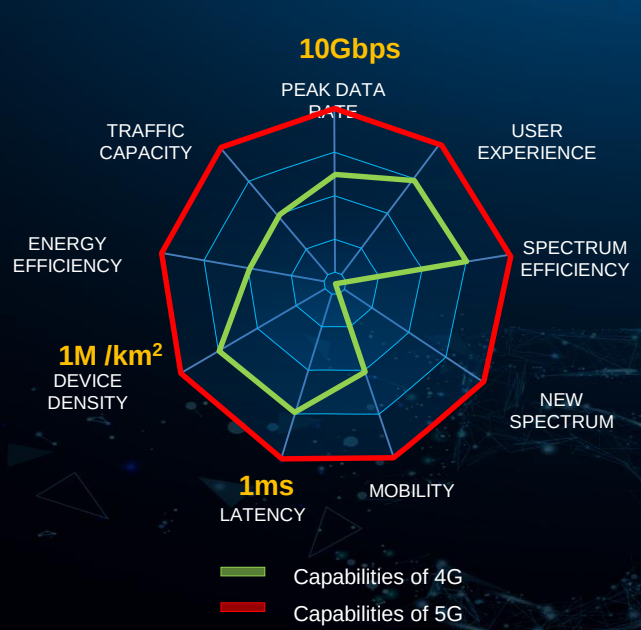
- Cloud X — All APPs, All Screen
- WTT X — Air Fiber
- Industry X — Digital Transformation

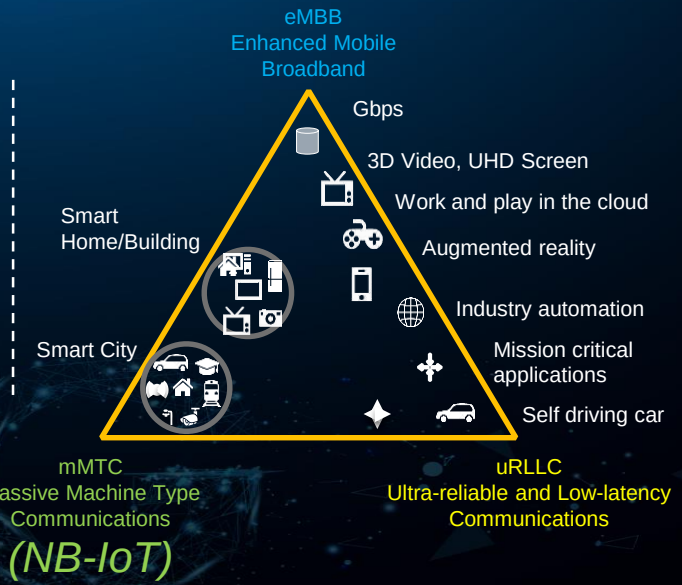
Opex Saving With AI

From CAPEX Saving to OPEX Saving

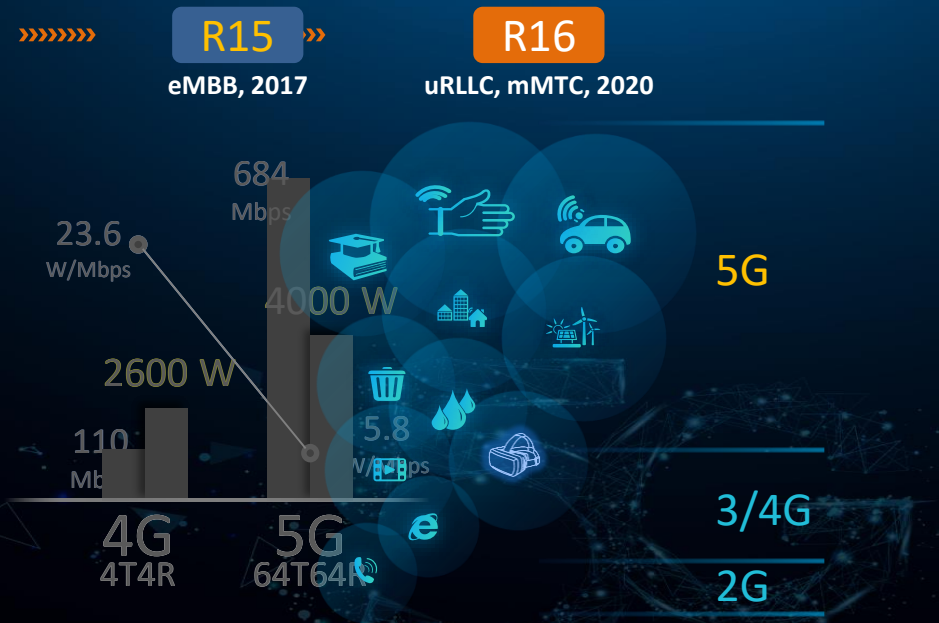
RAT	Site	O&M	Energy
Simplification	Simplification	Simplification	Simplification

5G: Key Capabilities





Coming 5G Brings New Requirements for the Pioneers



REQUIREMENT

Higher Reliability

- Higher SLA of Service
- O&M on much Denser Network

Higher Capability

- Capacity (cooling, power, backup)
- Available Powering (to AAU)
- Higher Efficiency


5G is ON with Pioneers
Performance
Proven
1.33
Gbps
80 MHz
Korea Achieved
Peak User Speed
in a Commercial Network
Performance
Proven
Peak Cell THP
40+
Global 5G Contracts
Fish Farm
Digitalization
UHD Live
with 5G
CCTV
Spring Festival Gala
4K
Smart
cytc
zain
FASTWEB
Omantel
O2
rain
TIM

Pioneering the Largest 5G Comercial Networks

U+5G

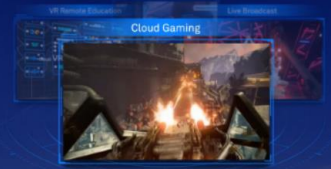
xGbps Experience

32T MIMO 4G&5G 1:1 Co-site 80MHz@C-band

Ultra-Lean Site

1-person manual lifting 2*2 man-hours installation

Empowering Cloud X

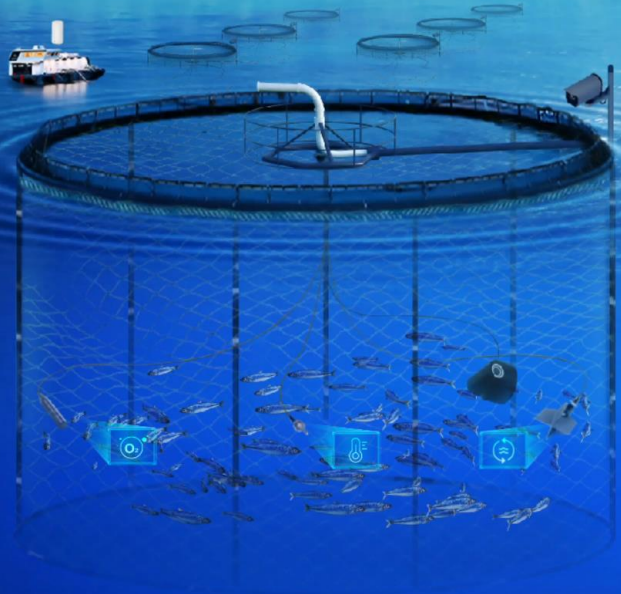


18 000

Sites Deployed in 5 months


5G Air Fiber to Home
VIVA Kuwait
5G
Air Fiber
100MHz@C-Band
64T64R Massive MIMO
25x Capacity
100Mbps Everywhere
To Achieve Growth
Revenue
12% Growth
Home Connection
ARPU
Revenue
High DOU Challenge
DOU
83GB
10Mbps
User Speed Experience
30USD
1TB data
20Mbps
60USD
50Mbps
120USD
1/10 E2E Cost per GB
1/10
Legacy
5G
Cost
5G

Fish Farm Digitalization with 5G



Ocean-farmed salmon is cooked and enjoyed in over 100 countries

Challenges

Labor Shortage
3x Fish Farms

Ocean Pollution
20% Food Residue

Fish Loss
5% Disease Rate

Background

Digitalization

Network Requirements

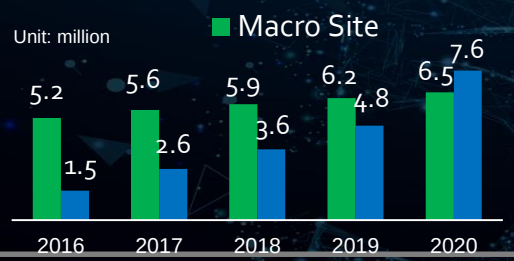
Legacy Energy Solution Cannot Support 5G Network

60% legacy sites cannot evolve to support 5G network

- AC/DC distribution
- Rectifier capacity
- AAU(antenna+RRU) cable power lose
- Battery capacity
- User space
- Cooling capacity

** Data source: Huawei research in CMCC network*

+2x sites quantity brings high OPEX

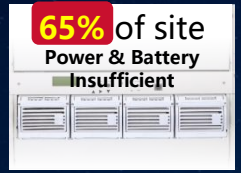


Hard Acquisition
Resident

Long Deployment
6~12 Dept.
12+ Months

High OPEX
On site maintenance

High CAPEX & Long TTM if 5G Deployed in Traditional Way



Grid Modernization

- **TTM > 3 months**
- **€5,000** per site

(Germany)

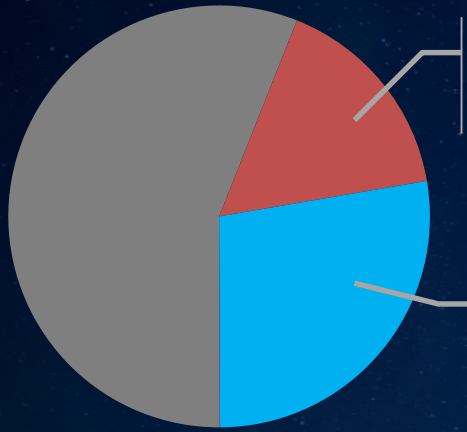
Add New Cabinet on Site

~€1,000
Crane Rental

~€300
Concrete work

~6 Months
Re-approval by Gov.

OPEX Soars, Both Energy Cost and O&M



28 Bn. USD

Energy cost takes **16%** of total OPEX

47 Bn. USD

total O&M cost, Passive O&M takes 50%

170 Bn. USD

Total OPEX of worldwide operators annually

2 times

Electricity Cost

1.8 times power consumption
(L800+G/U900+L1800+L2100+L2600**+N3500)**

Highly Dense

Network Elements

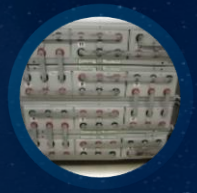
High frequency (mm wave) requires more sites

Low Satisfaction Rate of Existing Site, Swap All?

Grid

Power

Battery

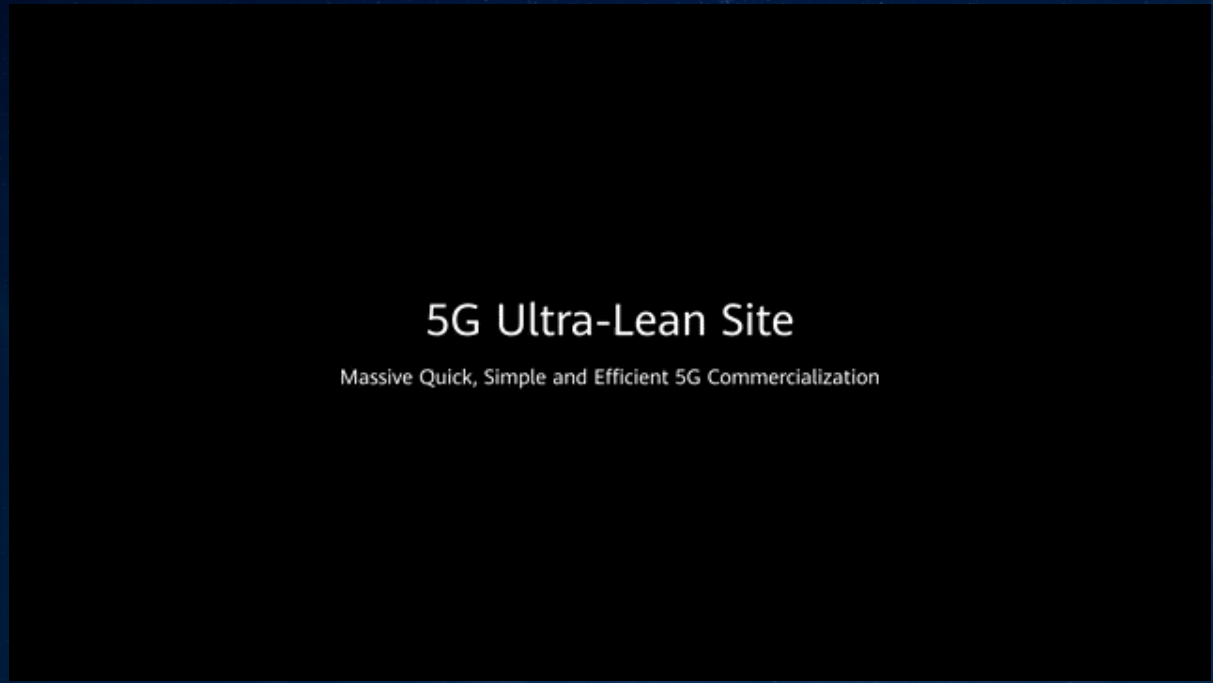


Distribution

Footprint

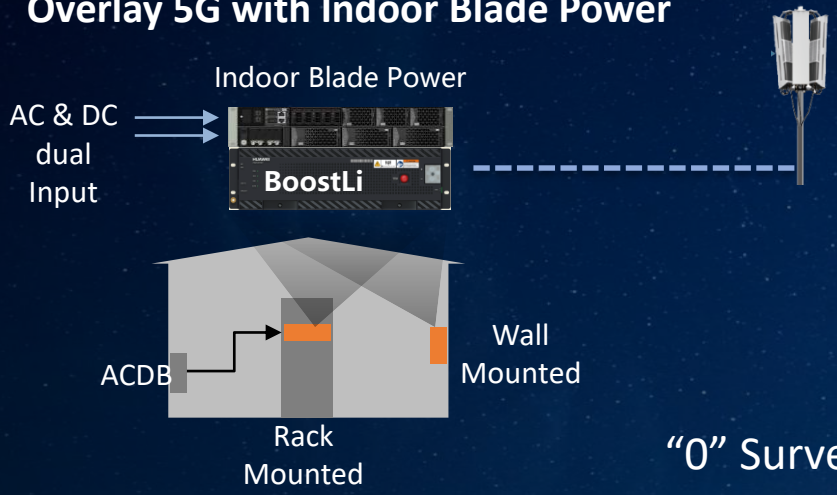
Insufficient capacity, backup time, space and etc.

5G Ultra-Lean Site

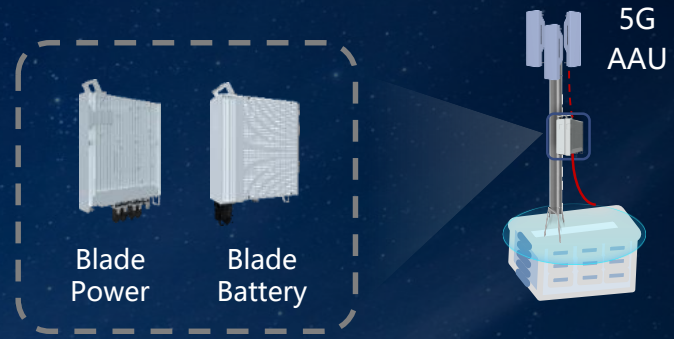


One Band One Blade, 5G Network Overlaid Fast

Overlay 5G with Indoor Blade Power



Overlay 5G with Outdoor Blade Power



"0" Survey, Short TTM

SCALABLE

One Site One Cabinet, Evolves to 5G Smoothly

One Site, One Cabinet

- Dynamic Voltage (42v~72V)
- 1.5kW + 1kW Cooling Capacity
- 300A +150A Rectifier Capacity

Cooling expansion reserved
Cooling module: 1kW

Power and Monitoring reserved
Expand rectifier and power smoothly

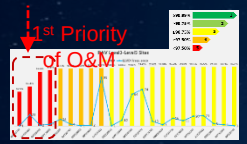
- **Smooth Expansion**
- **High-efficiency Power**
- **Investment Protection**

SCALABLE

SmartSite is A Must Way for 5G O&M

Smart CAPEX, Smart OPEX

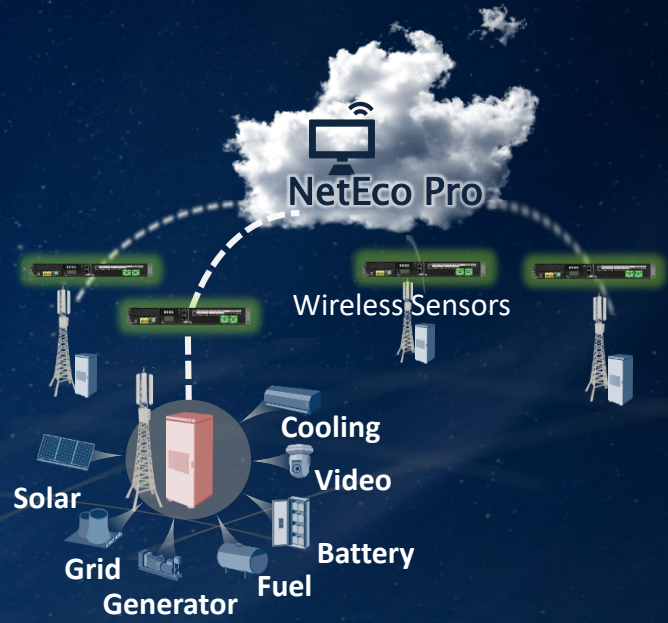
PAV Management



SEE Management

O&M Management

Security Management



Digitalization	Networking	Inteligent
Dump device visible	Reliable Connecting	Smart O&M

Ultra-broadband Network in 5G Era

2.8x Traffic
(2017 to 2022)

- 100M+ broadband users: over 34% of the total
- More than 250 million VR users

2.6x Traffic
(2017 to 2022)

- GE+ private lines account for 85%+ share
- Cloud adoption by millions of enterprises

6.7x Traffic
(2017 to 2022)

- 12G monthly data usage by 2022
- Video will account for >75% of mobile data

DCN	400GE Aggregation + 100GE Access
Backbone Metro	End to End 400GE 200G OTN to Backbone 400G OTN in Metro
Access	50GE/100GE IP-RAN Symmetric 10G PON

DCN	100GE Aggregation + 25GE Access
Backbone Metro	100GE Router, 10/100G OTN
Access	GE/10GE IP-RAN, GPON


QuickODN Improves 10x FTTH Onsite Operation Efficiency
Image Recognition
Past
Now
MPO: One Fiber for All
(Multiple-fiber Push-on/Push-off)
4G/5G
Wireless Site
E2E Plug&Play Solution
SME/SOHO
Safe City
QuickEntry
End-User DIY
Past
Now
MiniDP

Solution to overcome deployment challenges

Telco and Utility collaboration

Joint venture company of ESB and Vodafone unveiled in 2015

ESB and Vodafone are splitting the deal on a 50:50 basis with Vodafone chosen as ESB's partner following a tendering process.

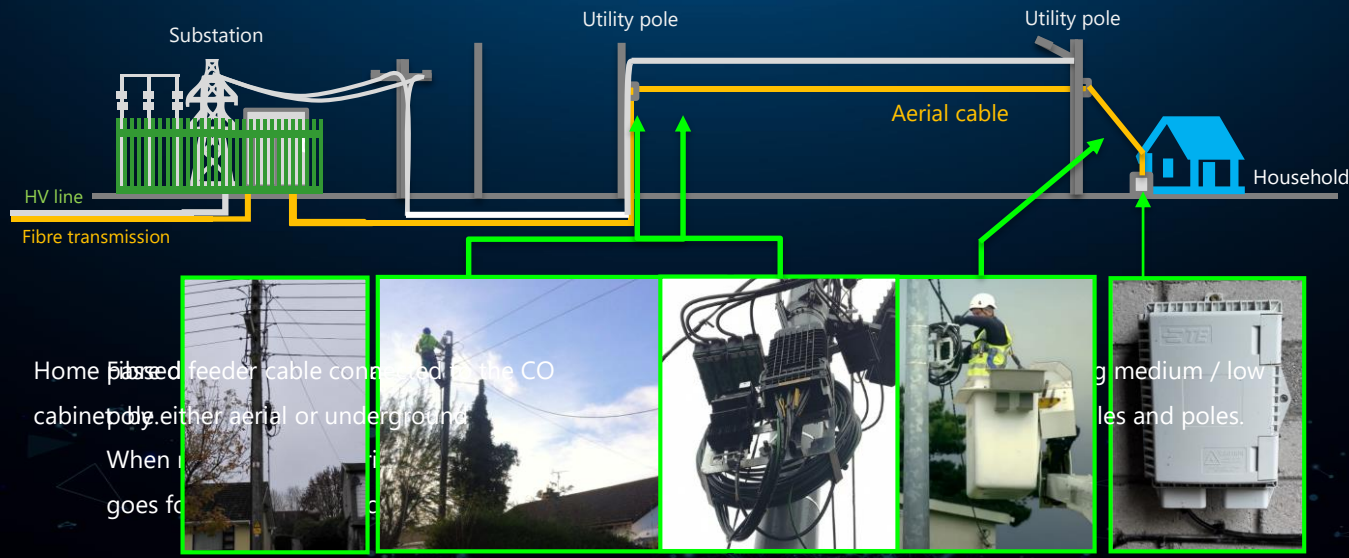
ESB Share existing infrastructure

vodafone Inject capital and share Telecom knowledge

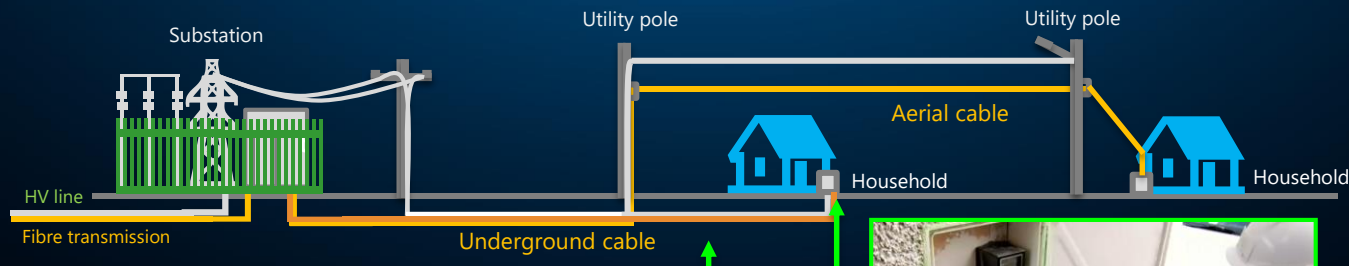
Objective: FTTB network wholesale to broadband service providers

In line with Irish National Broadband Plan (NBP)

Pole and duct sharing to reduces deployment costs

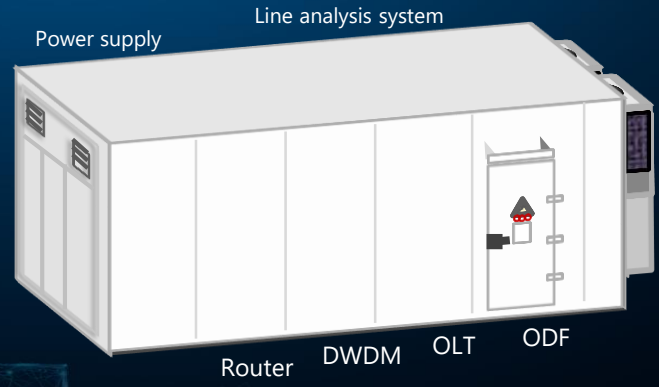


Pole and duct sharing to reduces deployment costs



Home passed feeder cable can lay along existing ducts, to minimize the excavation

CO Cabinet deployed at power substation

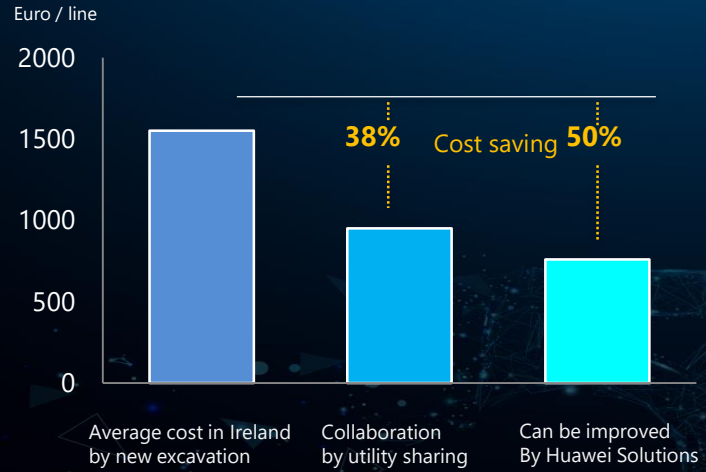


Advantages of deploying CO cabinet at Substation

- ✓ Site acquisition
- ✓ Efficient deployment
- ✓ Electricity availability
- ✓ Easy maintenance
- ✓ High safety and security
- ✓ Minimum disruption

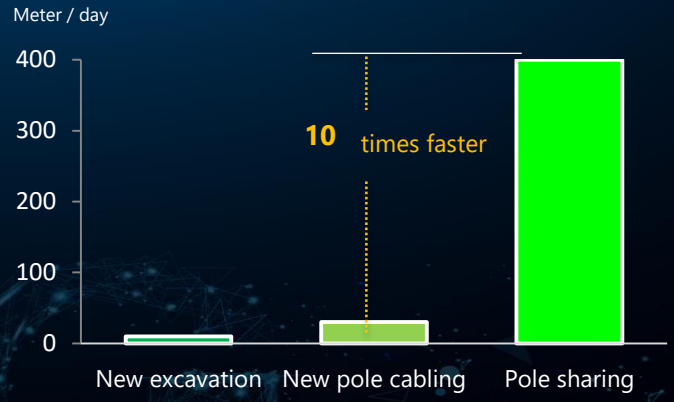
Cost reduction by Telco & Utility collaboration

FTTB/H End-to-End construction cost
Under underground cabling scenario



Source: Estimated data of Ireland by NBN working group, Huawei

Optical cable deployment efficiency
faster deployment, sooner subscribers will be up



Source: Estimated data of Kenya by NBN WG, Huawei

Summary of SIRO case study

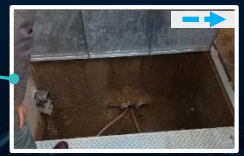
Case2: Outdoor CO shelter placed in Substation. Uplink Operators' CO via existing fibre transmission networks. ODN goes with power infrastructure

ENEL existing container
- Transmission uplink
- Microwave redundant

EOF new built 2 shelters
- One for active element
- The other for passive

POP site in Perugia
- 3 Uplink fibre，24 cores
- 3 Downlink fibre，192 cores，**96 for Enterprise P2P，96 for household PON**

Uplink fibre (buried，20cm depth，10cm wide，est. cost €30 /meter)
- To VDF CO: 1200m, est. cost **€30K**
- To WIND CO: 700m, est. cost **€18K**
- To ENEL container: 20m, est. cost **€600**



Downlink fibre go through power manhole (less than 8 meters)
- **Prior to use existing UG duct.** From POP to transformer box, if there is no space to install fibre, direct bury it by micro trenching (average length is 400m)

FDT
- **Prior to install into distribution box.** Lower the cost and shorten TTM.
- FDT with splitter: first level 1:4; second 1:16

EOF sales opportunity: 450 * outdoor CO €500m; 300 * indoor CO €210m; Transmission €150m. €860m upside in total

750
POP / CO

450
Outdoor CO

1.New CO site

€ 800K
€ 660k
€ ?k
€ 220k

OLT | N2510 | Passive | O&M outsource

€1.68M
Grant total / CO
X
450 site

€500M
Upside
66% of grant total opportunity

2.Transmission network

ENEL is now using **SDH, bandwidth need to enlarge**

- **WDM for transmission and interconnection:**
  750 * 0SN1800 (Edge POP),
  40 * OSN 9800(Regional POP)

€150M
Upside
Based on HW calculation

300
Indoor CO

3.Indoor site re-use

- In some area, coverage of EOF site is not sufficient
- Plan to re-use operator indoor site

€ 700K per CO

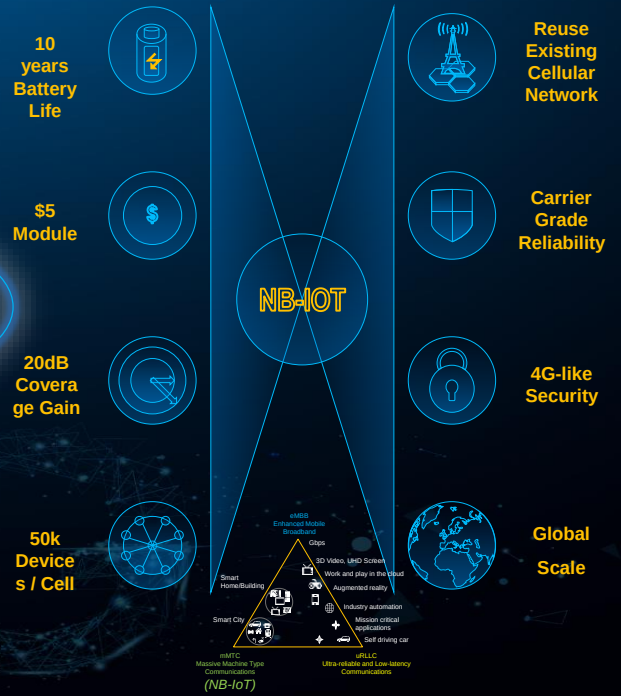
X **300 site**

Lease VDF, WIND etc. existing sit to build up CO

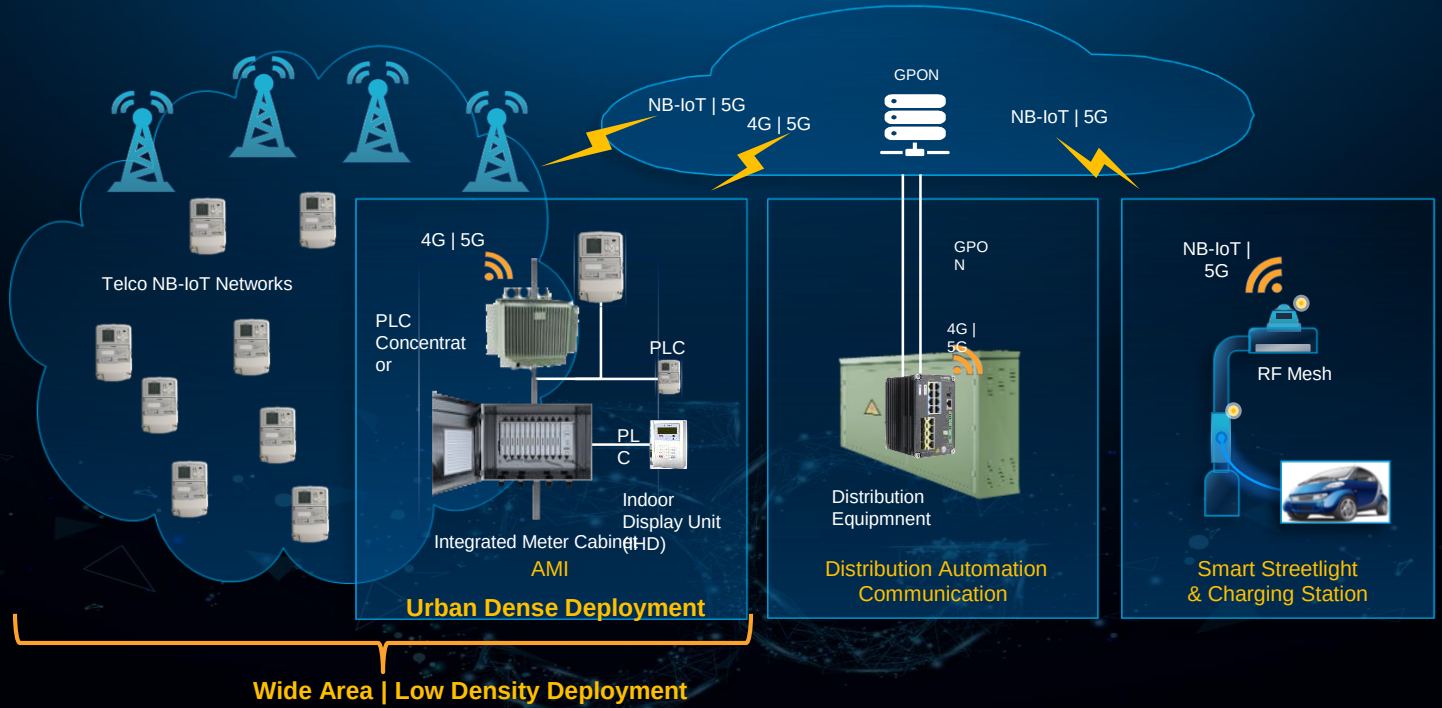
€210M
Upside
CO Capacity is considered

Key Benefits of NB-IoT for LPWA

- Water Metering
- Gas Metering
- Electric Metering
- Site Access / Door Locks
- Smart Parking
- Smart Waste Bins
- Smart Asset Tracking

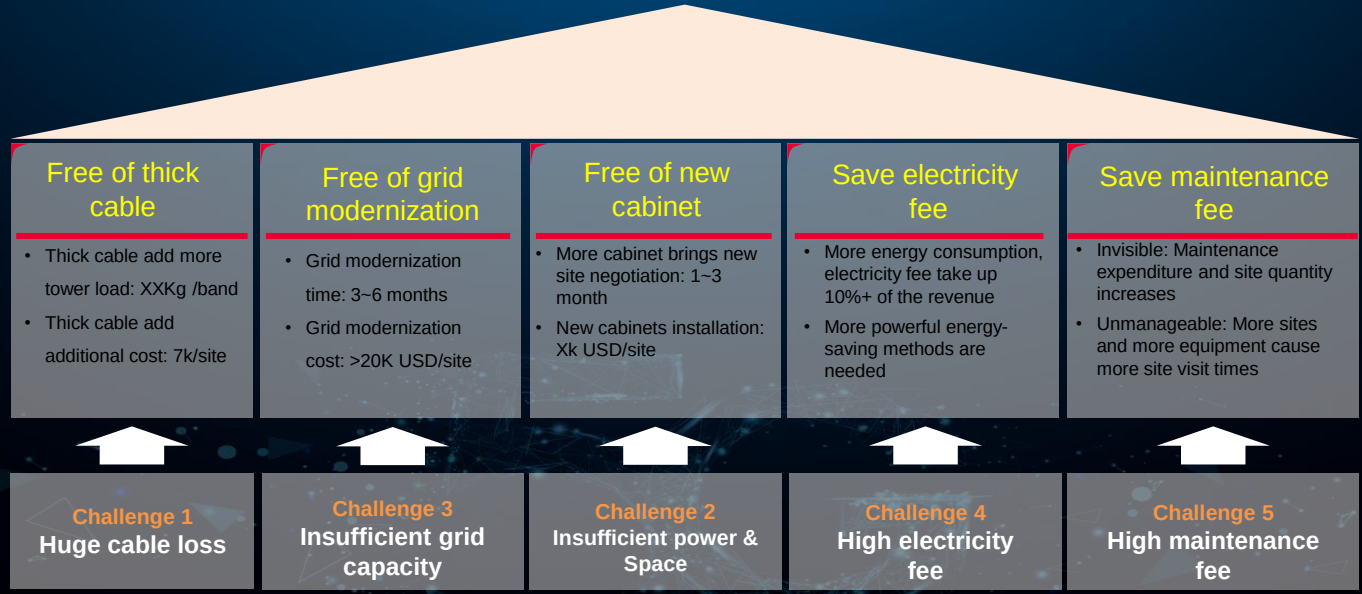


NB-IoT-based Power Solutions



Summary: the Key Requirements for Next-generation 5G

“3 Free & 2 Save”



Thank you

Nicolas Driesen