ONF CONNECT 2018
DEUTSCHE TELEKOM KEYNOTE

LIFE IS FOR SHARING.

STRATEGY FOR INTEGRATED GIGABIT NETWORKS

DEUTSCHE TELEKOM
PROFILE

Customers & Markets

Customers

- **168 mn** mobile customers
  28 mn fixed-network lines/
  19 mn broadband lines
- Approx. **7.4 m** TV customers

Markets

- Present in > 50 countries
- **Germany, Europe and the USA:** with own infrastructure
- **T-Systems:** global presence & alliances via partners

Facts & Figures

Telekom in figures, 2017

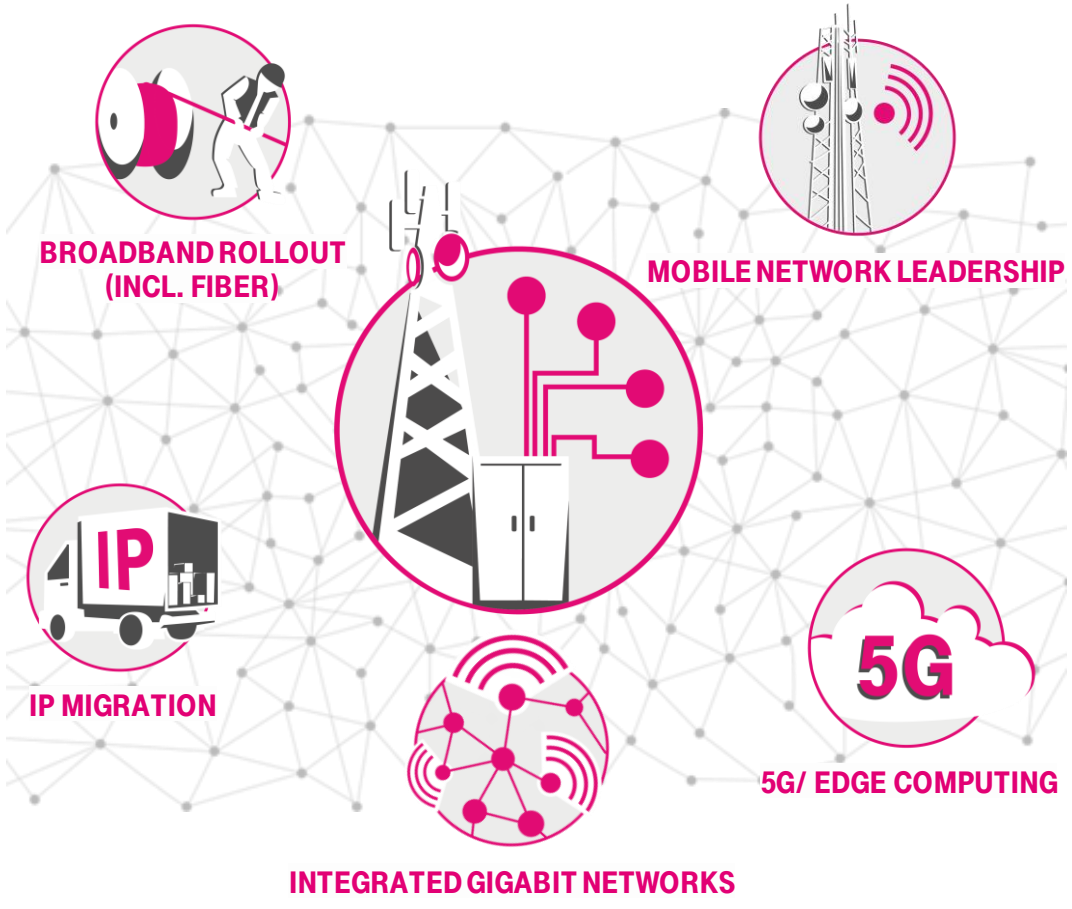
- Revenue **€ 74.9 bn**
- Adjusted EBITDA **€ 22.2 bn**
- Free Cash-Flow **€ 5.5 bn**

Employees & responsibility

- Employees worldwide: 217,349
- 6,559 trainees and cooperative degree students in Germany
- Pioneer of social issues (climate protection, data privacy, diversity, etc.)

Source: DT 2017 annual report/TMUS annual report to shareholders 2017

WE ARE “DEDICATED NETWORK INVESTORS”



[1] Bandwidth ≥ 50 Mbps, delayed due to regulatory decisions

Our proof points

- **We own extended fiber backbone in our European footprint:** Key asset for **integrated Gigabit networks**
- **We roll out broadband for the masses:** ≈ 80% HH coverage with vectoring in 2019 (≈ 62% in 2018)[1]
- **We push the fiber rollout:** Already more than 455,000 km fiber deployed in Germany, 240,000 km in our EU footprint
- **We enable real-time networks: IP migration** completed in 5 EU NatCos, 75 k BNG access nodes migrated in Germany in 2017
- **We provide leading mobile network quality:** Winner of all relevant network tests (e.g. Connect, P3, Opensignal)
- **We drive network innovation with 5G and Edge Computing:** 600 MHz rollout started in US, MobiledgeX launched

ACCESS 4.0 - AN ENABLER WITH FOCUS ON FTTH/B

BUILDING THE GIGABIT SOCIETY

WE DEVELOP A COST-EFFICIENT, LEAN-TO-OPERATE AND SCALABLE ACCESS PLATFORM TO DELIVER GIGABIT PRODUCTS

A 4.0 MISSIION

Access 4.0 Goals:

- Re-design Broadband Access leveraging data center concepts
- **Reduce lifecycle costs**
- **Increase feature agility**

Access 4.0 Focus:

- **Unit deployment cost (bill-of-materials)**
- **Automation to lower OPEX**
- **Broaden supplier spectrum (whitebox, COTS, x86)**

ACCESS 4.0 (A4)

ACHIEVEMENTS AND OUTLOOK

ACCESS4.0 - A SUCCESS STORY

Important Cornerstones

2016 Started first CORD Lab-Trial in Germany/Darmstadt

2017 ONF Membership on Partner level
Demonstrated a Multi-Access CORD Prototype at the MWC San Francisco together with Radisys

2018 Piloting VOLTHA and SEBA in the Frankfurt Area

A4 TURNED TWO IN SUMMER.

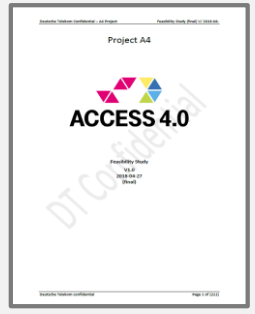
WHAT HAS BEEN ACHIEVED FOR FTTH/B?

1 REAL CODE RUNNING FTTH/B@A4

- Based on **bare metal + open source** (K8s, VOLTHA)
- Focus on **automation** (ONT bootstrapping, ZTP / capacity- and change mgmt. etc.)

2 FEASIBILITY STUDY FINALIZED AND COST MODEL DEVELOPED

- Assumptions and technology in **Cost Model** documented; Cost Case is green

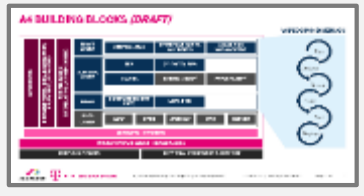


3 COLLABORATION / COMMUNITY

- **OCP spec** for OLT submitted
- **ONF-Community event** June 2018
- **Code** contributions to **VOLTHA/vSE**
- **Operator** Collaboration on RDs

4 RFQ FOR CO-DEV PARTNERSHIP FTTH/B@A4

- **RfQ issued** and finalized
- **Objective:** find a partner who **shares vision** and wants to **productize** the A4 design



DT SELECTED A CO-DEVELOPMENT PARTNERSHIP TO PRODUCTIZE ACCESS 4.0

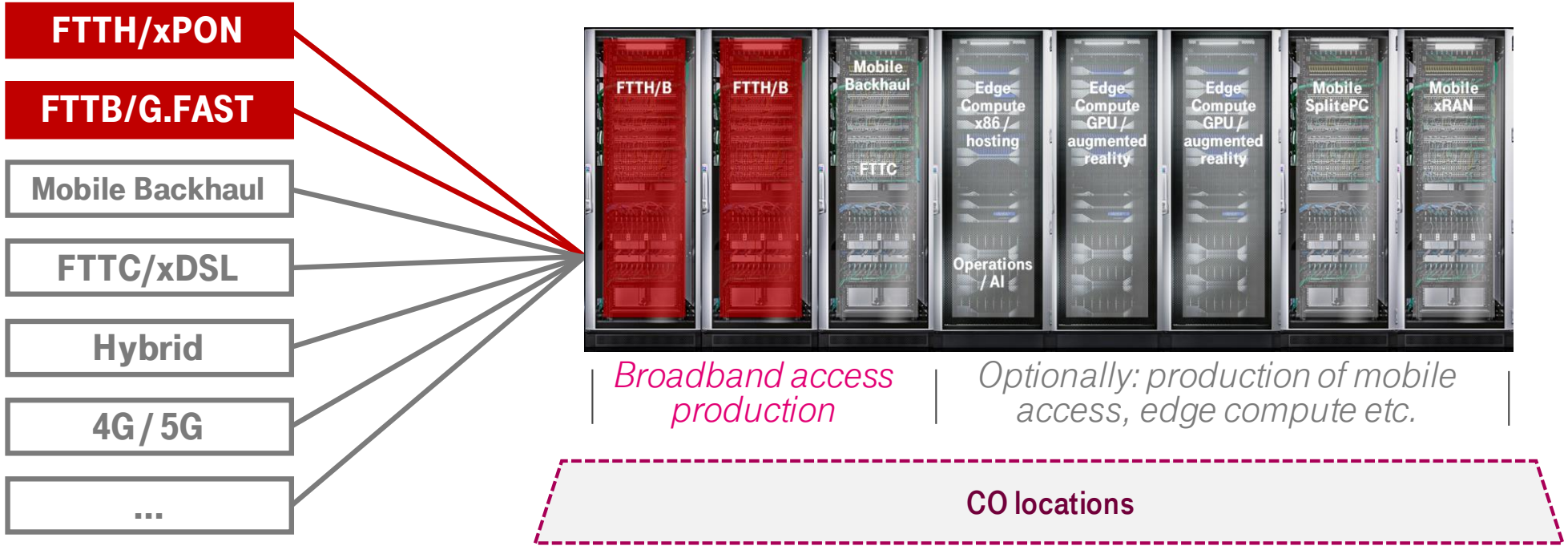
WHY A CO-DEVELOPMENT PARTNERSHIP?

- **Accelerate** the development
- Enable **delivery mode**
- **Bring in knowhow**
- Find an **integrator / supplier role for A4**
- **Learn / improve methodologies**
- Help to **mature the new interplay** between the various players incl. communities

OBJECTIVES FOR A CO-DEVELOPMENT PARTNERSHIP

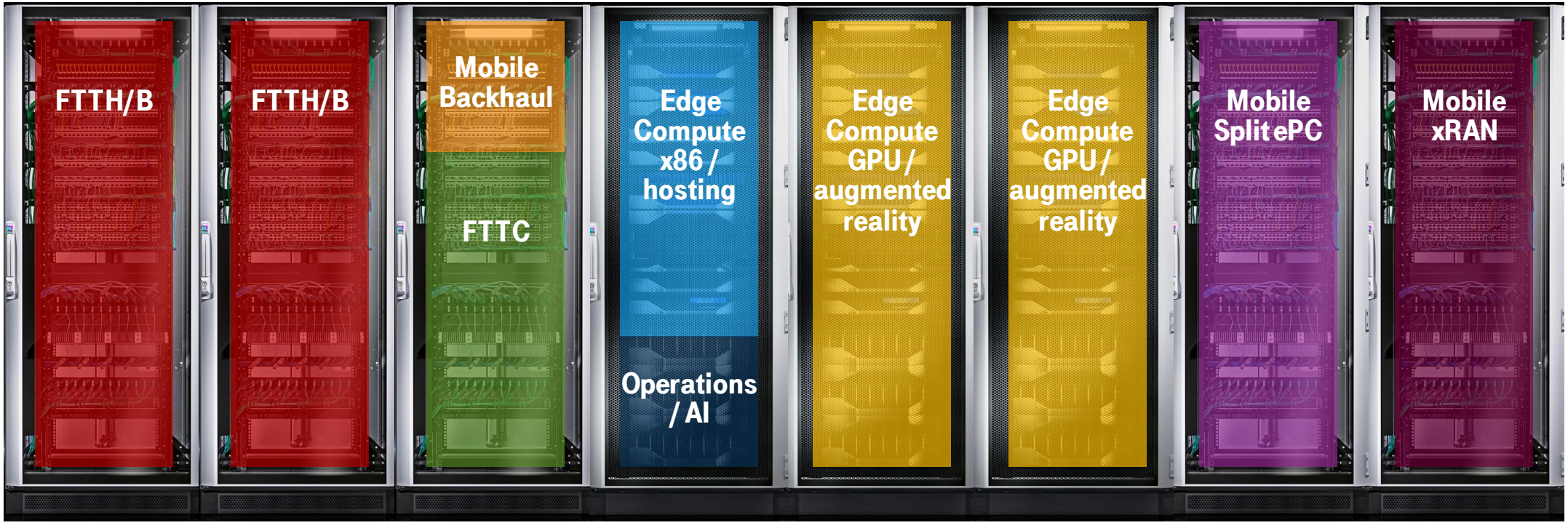
- **Develop, realize and test an FTTH/B@A4 solution**
- Run a **limited roll-out** by the end of 2018/beginning 2019
- Bring in a **GA-release OLT** (GPON, XGS-PON) **and DPU**
- Integrate **EdgeCore XGS-PON OLT and another white box OLT** (GPON)
- **Integrate the RtBrick software**
- Use **open source** wherever possible

BY END 2020 WE ARE READY TO PRODUCE FTTH/B WITH OUR EDGE DATA CENTERS



VISION: EDGE DATA CENTERS ARE USED TO POWER BROADBAND ACCESS AND OTHER TECHNOLOGIES FOR DT

Same operational principals across all use cases with full automation
Same software, same formfactor for hardware; all **highly scalable**



COMMUNITY WORK

ACHIEVEMENTS AND EXPECTATIONS

KEY AREAS OF OUR COMMUNITY ENGAGEMENT

Device Drivers and Edge APIs

System Design

Community

Hardware Specifications

Reference Implementations

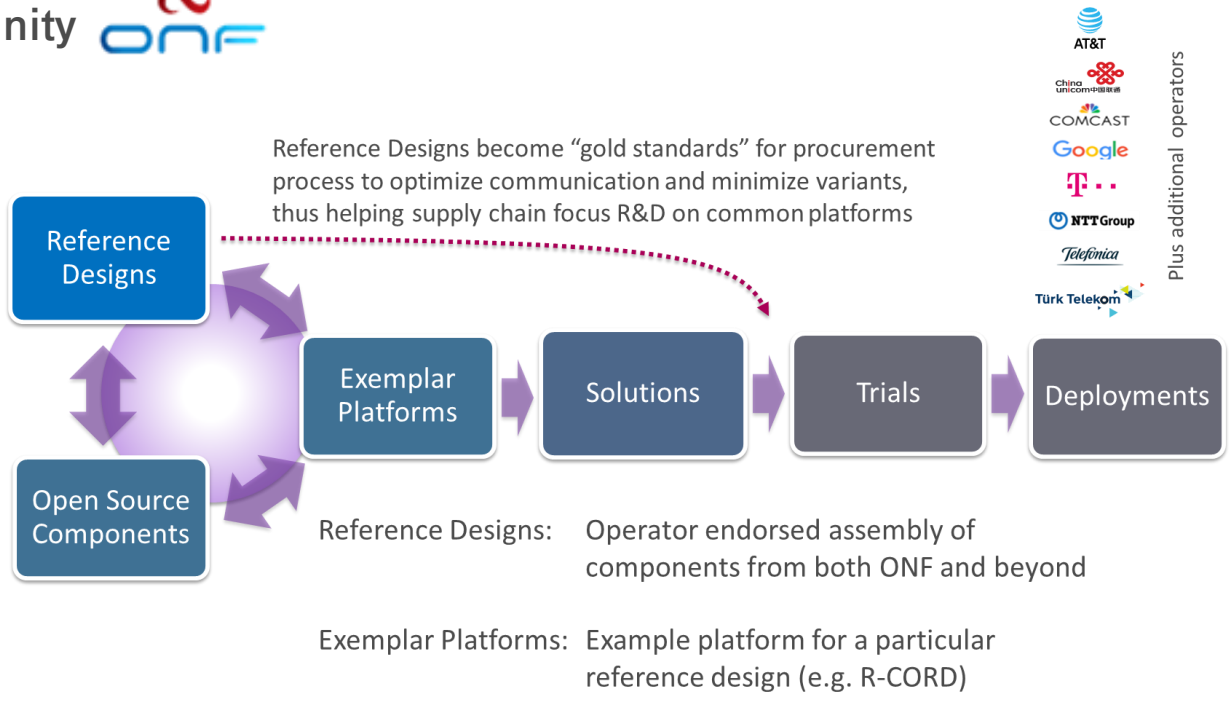
*logos are courtesy of the respective organizations

JOINING FORCES WITH LIKE-MINDED OPERATORS ALLOWS US TO REACH THE CRITICAL MASS TO TRANSFORM THE INDUSTRY & PRODUCTIZE ACCESS4.0.

Deutsche Telekom's Engagement in the ONF Community

Driving **operator-led reference designs & open source software implementations** for Access Network hardware abstraction, enabling deployments with bare-metal/ white-box supply models, removing vendor locks in hardware and software.

Deutsche Telekom is a founding member and **ONF partner**.



* Source of figures: ONF

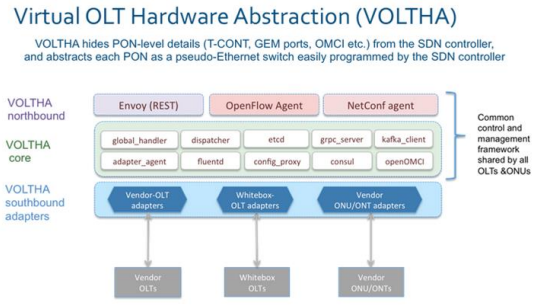
OUR ONF ENGAGEMENT AND THE EXPECTED OUTCOME.

ONF's Operator-led, joint Reference Design & open implementation work is essential for Deutsche Telekom/Access4.0

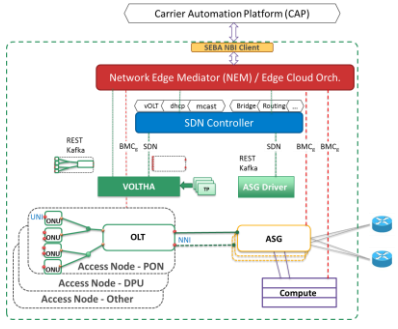
VOLTHA, SEBA and UPAN progress to fully cover our use cases and workflows - for trials in 2019Q2 and production-ready by 2020

Expect new reference designs to address use cases (first priority: lightweight converged Packet Core) with M-CORD

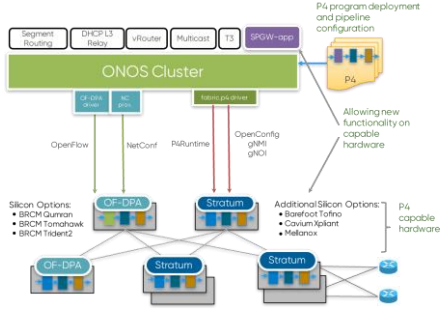
VOLTHA



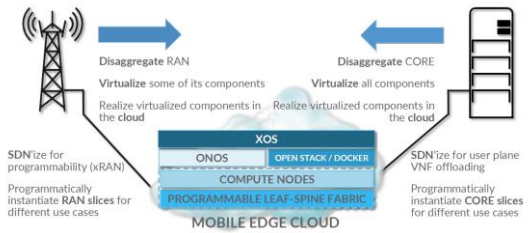
SEBA



UPAN



M-CORD



We are actively engaged on leadership and technical levels and are looking forward to deepening the community collaboration.

* Source of figures ONF

CONCLUSION

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Challenges ahead motivate collaboration	▪ Traffic growth in the net ▪ Huge investments with 5G and FTTH - require cost-efficient deployments, convergence of network functions and processes

Open Source community work - key part of DT‘s standardization strategy	▪ Open source technologies coupled with agile software development build a basis to meet our strategic goals:
	  ▪ Improve cost-efficiency /ability to manage the technology lifecycle
	  ▪ Full automation (CI-/CD)

A4.0 enbabler pioneering work of ONF	▪ First priority FTTH/B, other broadband services are lined up ▪ Co-Development partner selected, production roadmap ready ▪ Next is Converged Packet Core, ORAN - foundations for 5G, Potential enabler for Edge Compute

THANK YOU