Challenges and potential improvements of the sustainability in telco networks

Michael Düser | Berlin | September 2024

GROUP **TECHNOLOGY**

public

Telco networks facing multiple challenges to ensure climate neutrality & resilience

Managing a highly distributed infrastructure with mix of equipment for different services & requirements

- All sites providing floor space, energy, cooling, connectivity
- Continuously adapted to conversion from phone to IP based service company
- IT centricity – cloudification, virtualization, disaggregation as main drivers of change

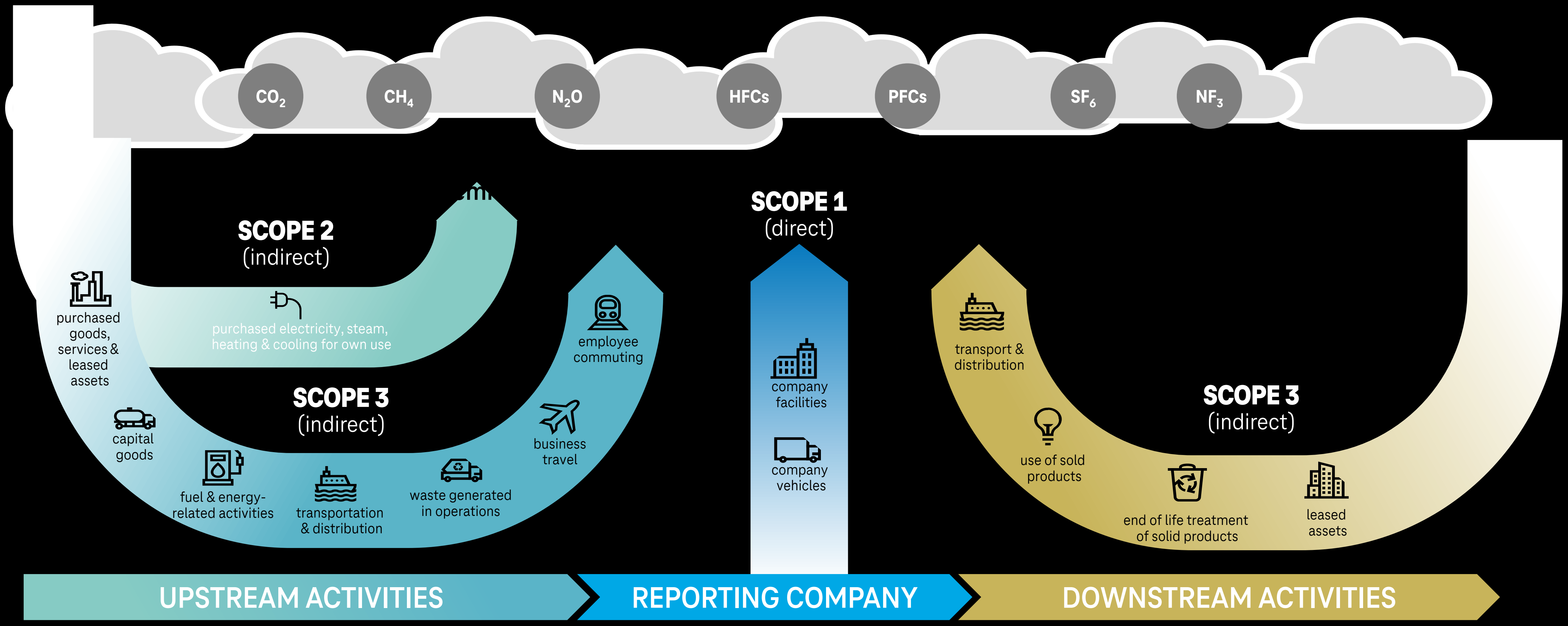
Climate change imposes new threats and risks

- Flooding, storms increase risk of service disruption
- Heat waves challenge established cooling models
- Not considered in network design

Turning from consumer to active participant in energy markets

- Energy → heat → reuse
- Decentralization of energy production, storage, consumption

Greenhouse Gas emissions segmented by scope – measured in CO_2e[1]



DT Carbon Footprint & Targets

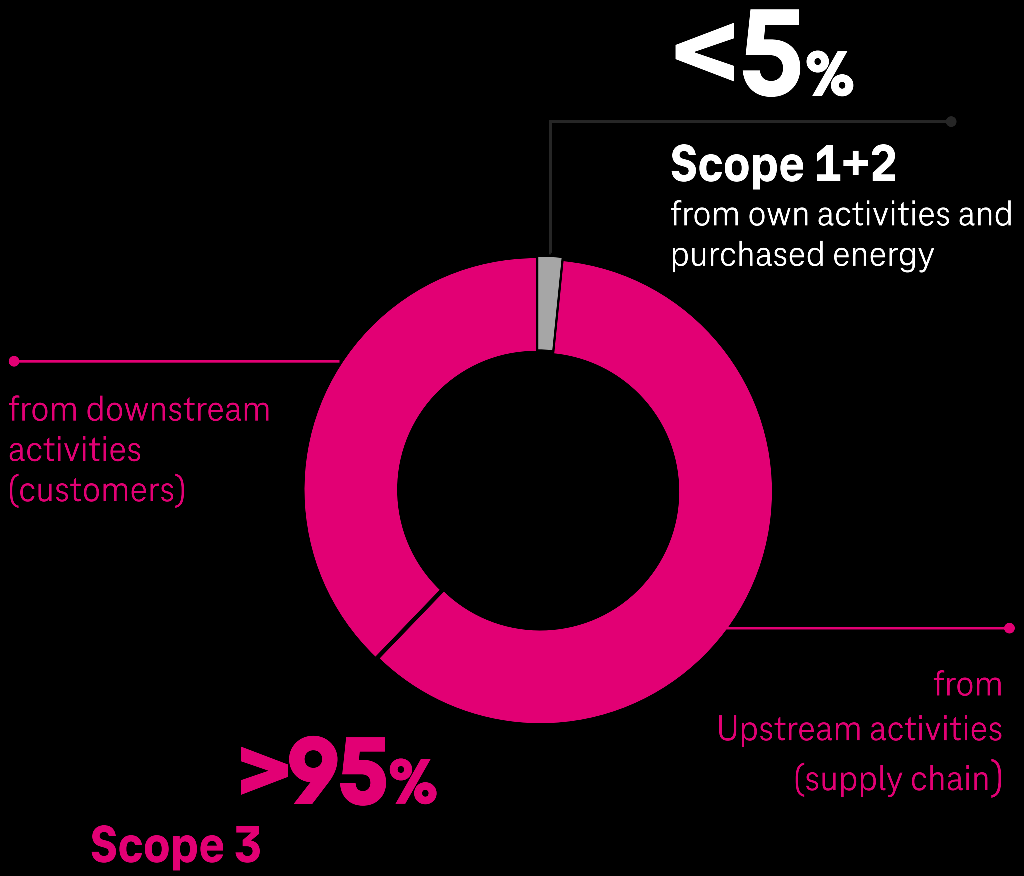
CLIMATE AMBITIONS

2021 **Renewable electricity** for DT Group as of 2021

2025 Reduction **direct and indirect emissions** from within our company to net-zero (Scope 1-2)

2040 **Climate-neutral company** Total elimination of DT's carbon footprint (Scope 1-3)

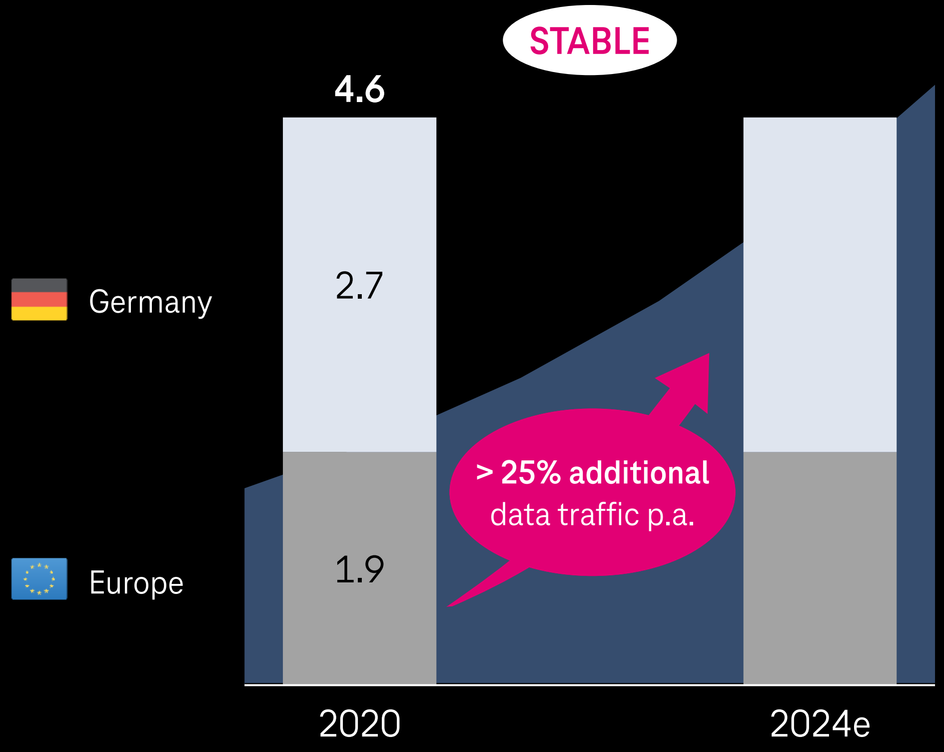
DRIVERS OF CO_2 EMISSIONS



Stable energy consumption across the entire infrastructure based on continuous optimization

Long-term stable energy consumption …

Energy* consumption per region, TWh



*here: electricity

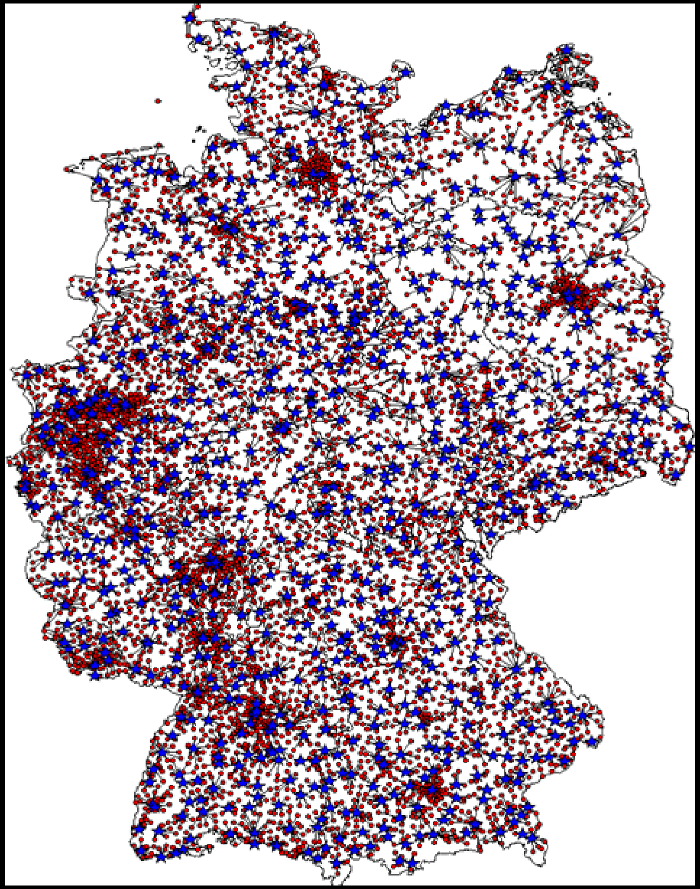
… with efficiency levers offsetting additional demands

- We will retire legacy platforms[1] to counterbalance other trends such as rise in data traffic, network densification & rollout of more active network components
- In addition, efficiency from …
  - Network measures & modernization
  - Introduction of FTTH and potential copper retirement
  - Energy efficient data centers
  - In addition, innovation in packaging, materials, and decentral energy production

Where do we spend our energy?

Telecommunications networks – highly distributed number of energy consumers with varying granularity

Site classification: Example Telekom Germany



	Type	No#	Power (in kW)	Energy (GWh/a)
Indoor - site	Core Nodes	20	~ 1000	~140
	Aggregation nodes	900	< 100	~620
	Access node	6982	< 10	~350
Outdoor -site	Outdoor cabinet	177000	< 0,5	~350*1
	Cellular base station	33000	< 5	~950*
Total				~2450

* estimation by author

Where and how to save energy?

Different measures how to save energy

We identified three clusters of efficiency levers to address energy efficiency

RETIRE

Recently legacy voice (PSTN), near-term future legacy transport (SDH), long-term switch to fixed access disaggregation and potential copper platform retirement

MODERNIZE

...after accelerated Fiber rollout and Technology updates, e.g., rectifiers, 3G frequency re-use for 4G/5G or Cloud transformation in NT/IT

INNOVATE

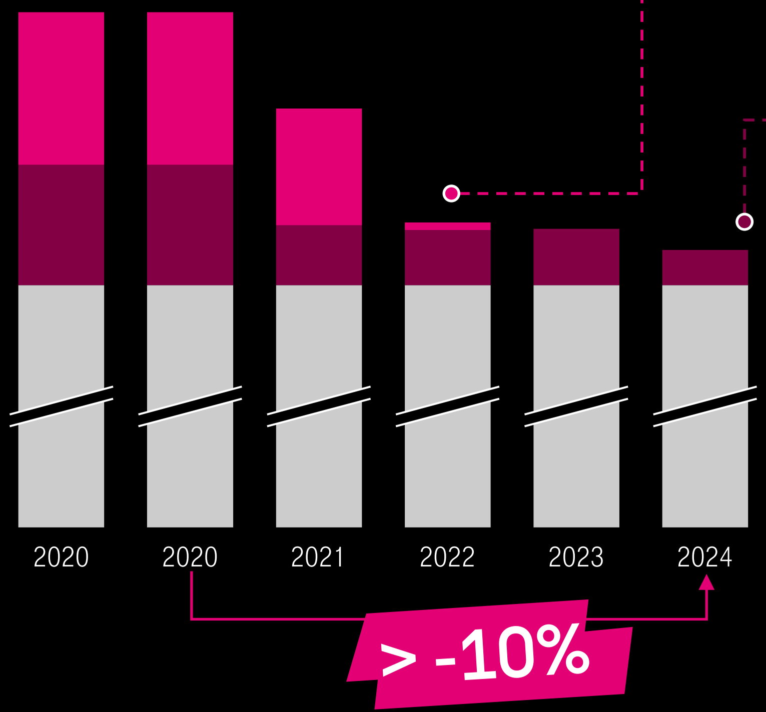
Network measures, including site sharing & AI steering

ORAN based approaches

Significant reduction achieved via legacy retirement but one-off effect

RETIRE

Retirement boosts electricity savings...



...no short-term lever

PSTN Retirement
Completed in **2022**

SDH Retirement
To be completed in **2025**

Potential future levers include...

Copper to fiber migration (Cu2F)
Long term chance but focus currently on FTTH rollout to build proper coverage

Access disaggregation
Long term effect to be evaluated

So what:

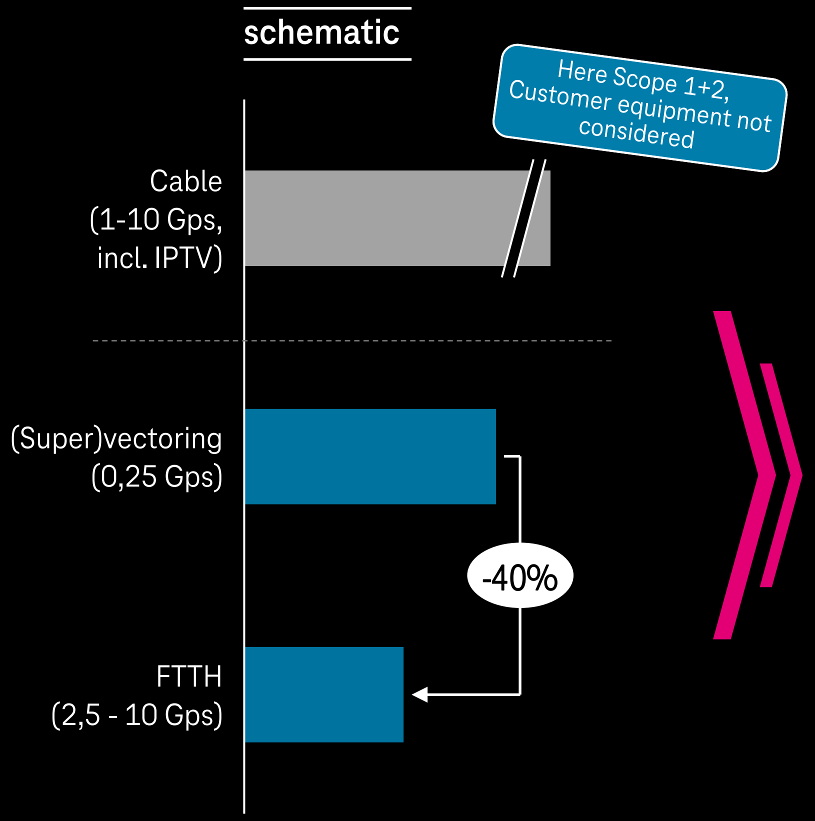
» 'One-off' effect
» Needs strategic decision and significant lead time (~10years)
» Operationalization challenging and requires migration

Migration from copper to more efficient fiber potential long-term lever

RETIRE

MODERNIZE

FTTH most efficient fixed access technology...



...but migration requires fiber coverage

Increase of FTTH adoption

- Significantly adding FTTH homes passed
  - c. 2.5...3.0 mn p.a. in GER
- Increase take-up rates in FTTH areas (from “homes passed” to “subscriber”
  - Requires additional effort and resources
- Government claims to offer FTTH to every customer in GER by 2030

Develop concepts to retire copper

- Requires full FTTH availability in envisaged retirement areas
- Customer migration strategies ranging from natural to forced migration
- Lead time typically ranging from few up to 10+ years to complete migration

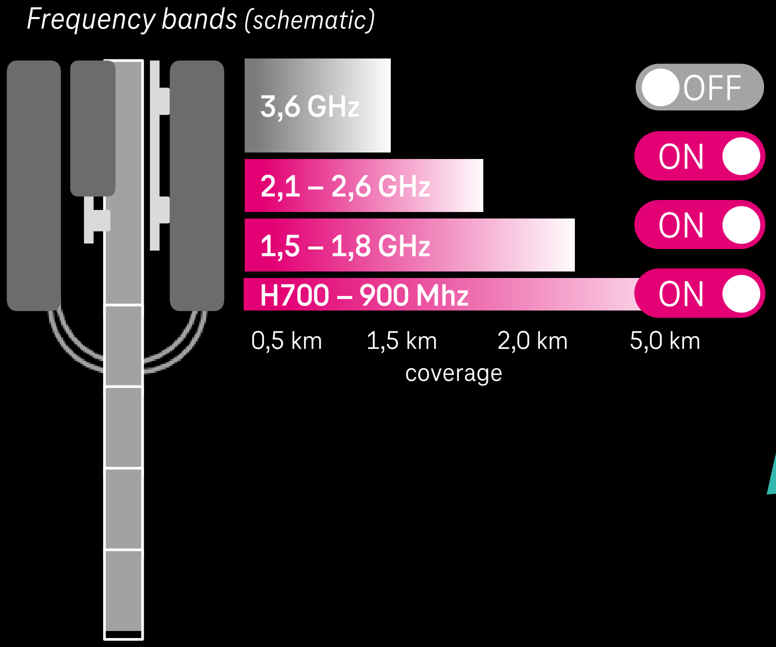
So what:

- Needs migration of customers in FTTH areas (incl. Wholesale)
- Gradual savings starting with customer migration ending with full dismantling of cabinetd etc. (‘Parallelbetrieb’ until then)
- Maximum energy saving potential requires full swap (DE earliest 203x)

Innovative saving features based on dynamic AI steering soon ready for implementation

INNOVATE

Innovative features increase saving potential…



Facts:

- Typical power consumption of a mobile site is 1-4 kW
- More active frequencies = the more energy consumption

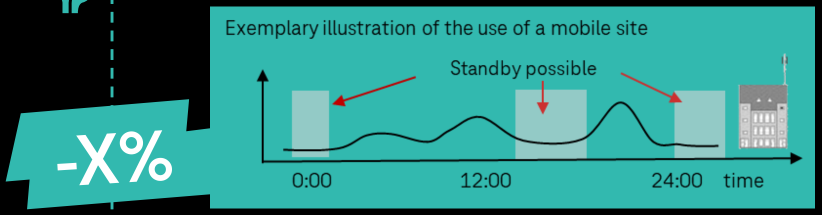
…but need implementation push

Static capacity-layer switch-off

» Live in all EU NatCos and GER

» Saving: up to 10% of mobile access network consumption

» Site-individual



Dynamic AI steering*

» Novel dynamic forecast and temporary reduction schemes

Requirements for operationalization:

» **Scale** field trials and MVPs to country-wide solutions

» **Balance** customer experience vs energy savings

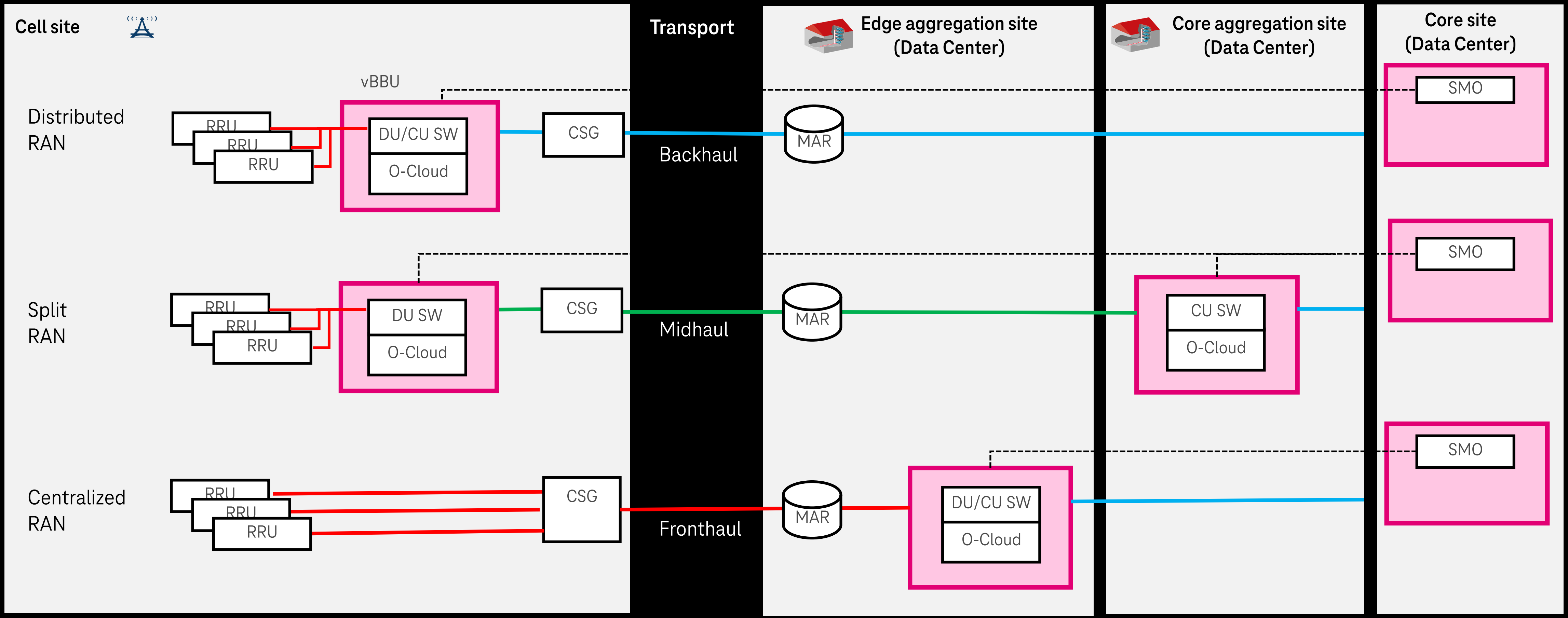
» **Ensure** legal/regulatory obligations

» **Assess** impact on benchmark results and network tests

Architectural options for ORAN enabled vBBU

INNOVATE

schematic

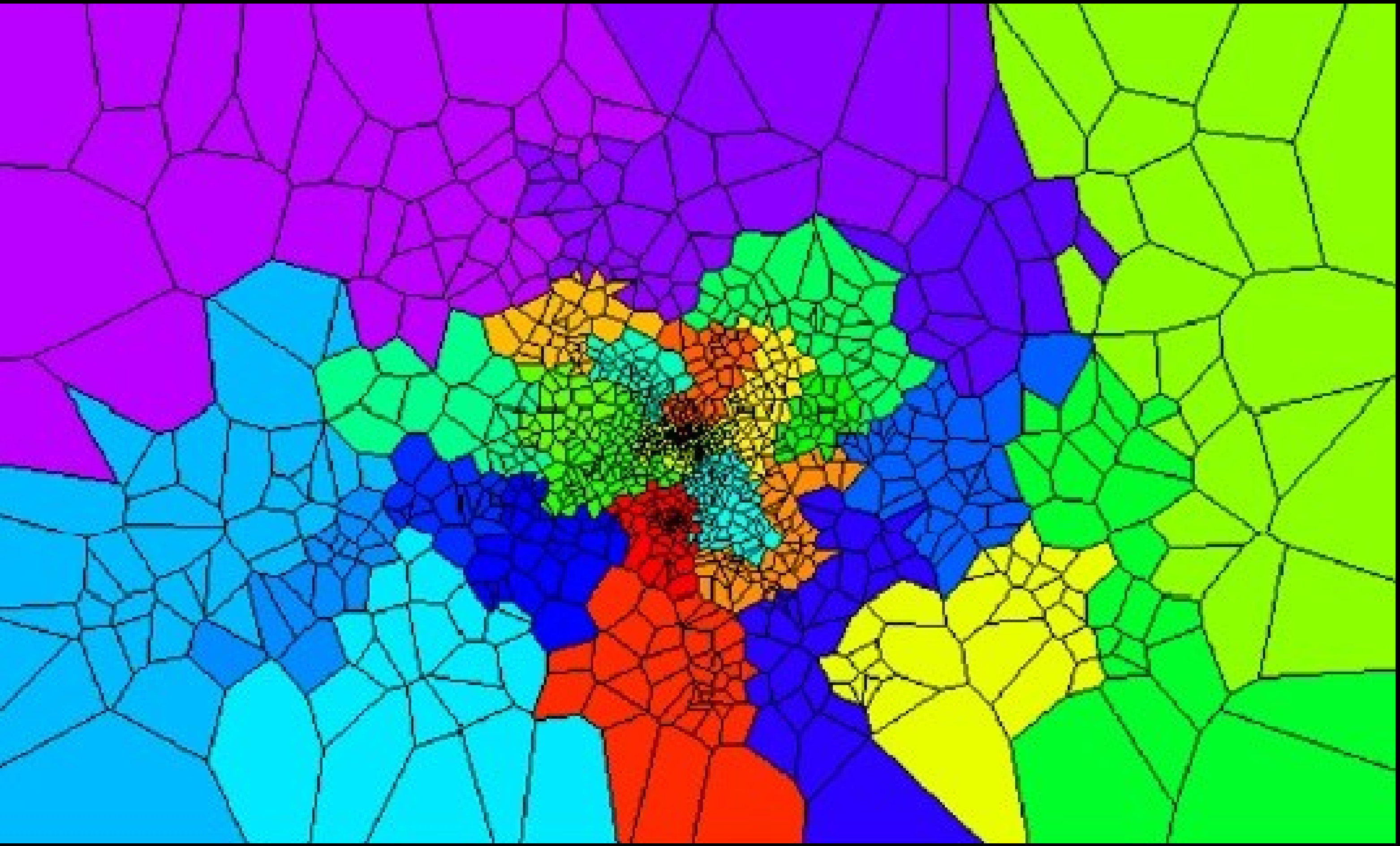


BBU: Base band unit
CSG: Cell site gateway
CU: Centralized Unit
DU: Distributed Unit
MAR: Mobile aggregation router

O-Cloud: Open RAN cloud
RAN: Radio access network
RRU: Radio remote unit
SMO: Service mgmt. & orchestration
SW: Software

ORAN based optimization of radio network architecture & topology at scale

INNOVATE



Real based optimization exercise to minimize cost by clustering of CU/DU and exploiting pooling gains

- **Scale** from single base station to >1000 base stations
- **Balance** pooling gains against transport cost
- **Assess** impact of different cluster sizes, cost variations etc.

Thank you!

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Contact

Michael Düser

Functional Strategy Manager

+49 171 564 3339
michael.dueser@telekom.de