

EVENT

## Rechenzentren für Kommunen und Städte

*Neue Chancen durch smarte  
Wärmeversorgung*

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# Data centers in the IoT-Edge-Cloud Continuum

Enabling Decentralized Digital and Energy Infrastructures for Smart  
Communities



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2026 - fortiss  
Landesforschungsinstitut des Freistaats Bayern  
für softwareintensive Systeme

# Industrial IoT @fortiss

-Enabling next generation IIoT Applications (since 2019) -

## GOALS

- Novel communication & computation architectures for IIoT  
*(OSI Layers 2–7)*
- Efficient, robust, predictive deployment of decentralized services
- Seamless computing for decentralized IIoT service pipelines

## Research Lines

- Decentralised Edge
- Real-time infrastructure adaptation
- In-network computing and adaptation

## Application Areas

Manufacturing

Smart Cities

Energy

### Keywords

IoT

Edge-Cloud

Edge AI

Wireless / Cellular





Networking Architectures

IIoT Protocols





# Datacenters and Smart Communities

## Relevance and Gaps

### Smart Communities rely on digital services

-  **Energy:** smart grids, distributed renewables, demand response, heat pumps
-  **Mobility:** EV charging networks, traffic optimization
-  **Public services:** digital gov., safety, infrastructure monitoring
-  **Industrial & farming:** IoT-enabled production

### The Infrastructure Gap

-  Smart regions operate through cyber-physical infrastructures & Internet
-  Datacenters provide computing, storage and AI capabilities
-  **But:** IoT-Edge-Cloud continuum is fundamentally changing
-  **Current design still focused on centralized cloud — not enough!**

Datacenters provide the computing, storage, AI capabilities to enable these services  
**Relying on Data source – Internet – Cloud/HPC**

# Smart Communities need a New Digital Infrastructure

## IoT-Edge-Cloud infrastructure and Challenges

### Data Volumes & Compute Demands

- IoT everywhere, always-on
- AI-enabled city services
- Increasing data generation
- Real-time infrastructure management requirements

↑ 10× growth by 2030

### Real-time Coordination is Missing

- Distributed renewable energy
- EV charging coordination
- Smart buildings & microgrids
- Local energy generation management

Latency gap: > 50 ms today

### Data Infrastructure Must Evolve

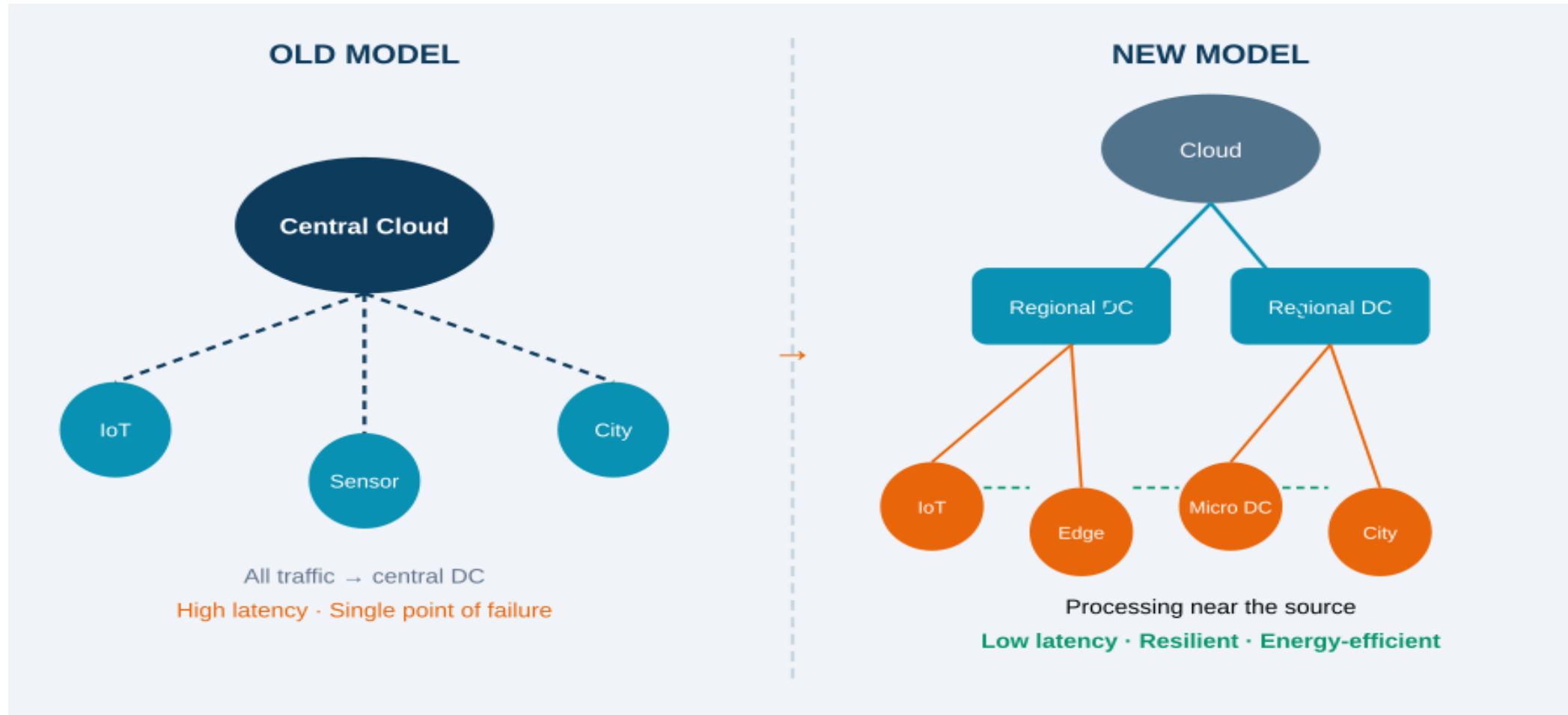
- Cloud-centric only insufficient
- Limited edge infrastructure
- Weak integration with energy
- No coordination framework between digital & energy

New paradigm needed:  
IoT-Edge-Cloud

*Smart communities will operate through integrated cyber-physical infrastructures*

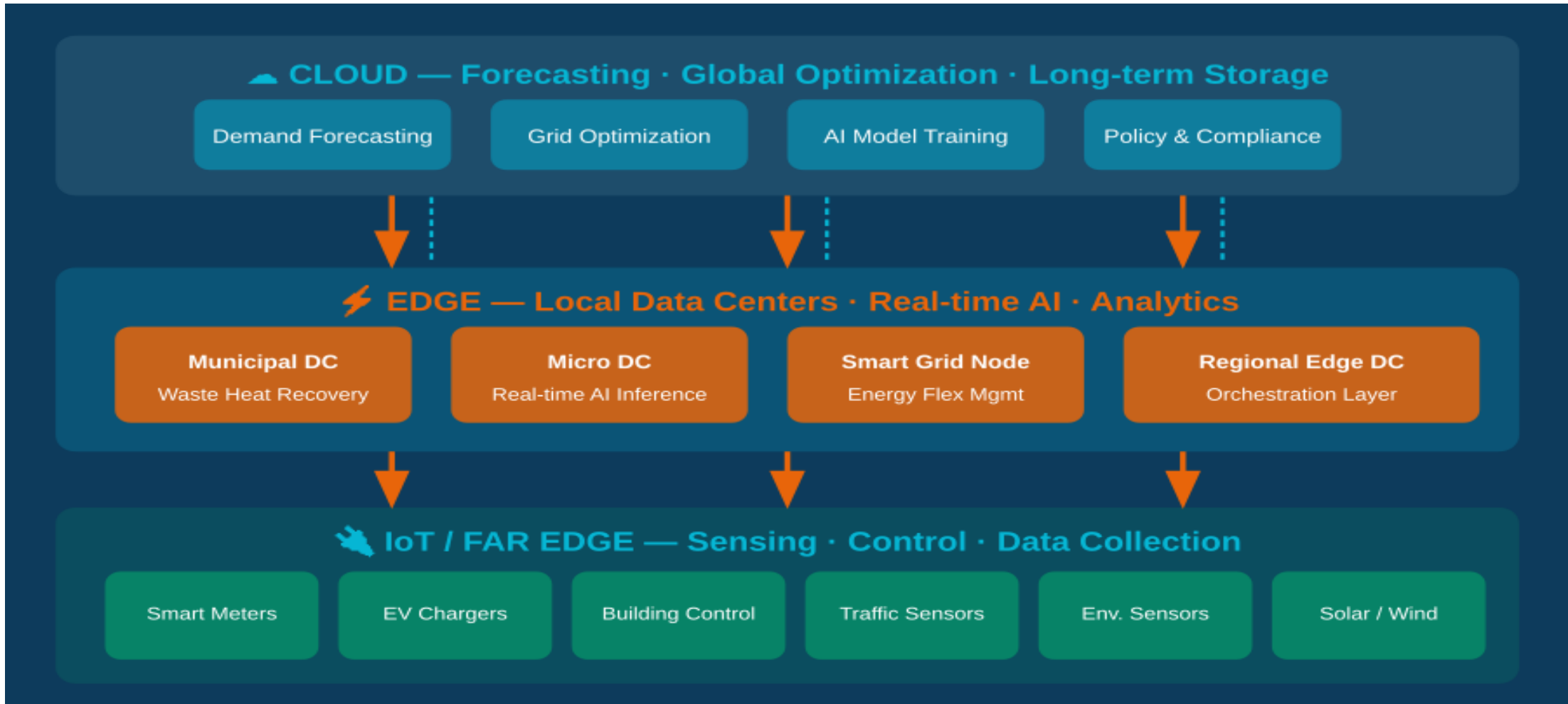
# From Centralized to Decentralized infrastructures

Evolving the IoT-Edge-Cloud continuum for Sovereign Data Centers



# IoT-Edge-Cloud Continuum

Towards decentralized support for smart communities



# Why Edge & Decentralisation?

## Low Latency

Process data near the source: < 5 ms response for real-time control

**Critical for smart grids**



## Resilience

Local processing survives connectivity loss.  
No single point of failure

**Essential for public safety**



## Data Sovereignty

Data stays in the region.  
GDPR compliance built-in.  
Municipal control over data

**Key for city authorities**



## Energy Integration

Waste heat feeds district heating networks (DHN)

**New revenue for cities**



## Cost Efficiency

Reduce backhaul costs.  
Lower bandwidth needs

**Better ROI for communes**



## Scalability

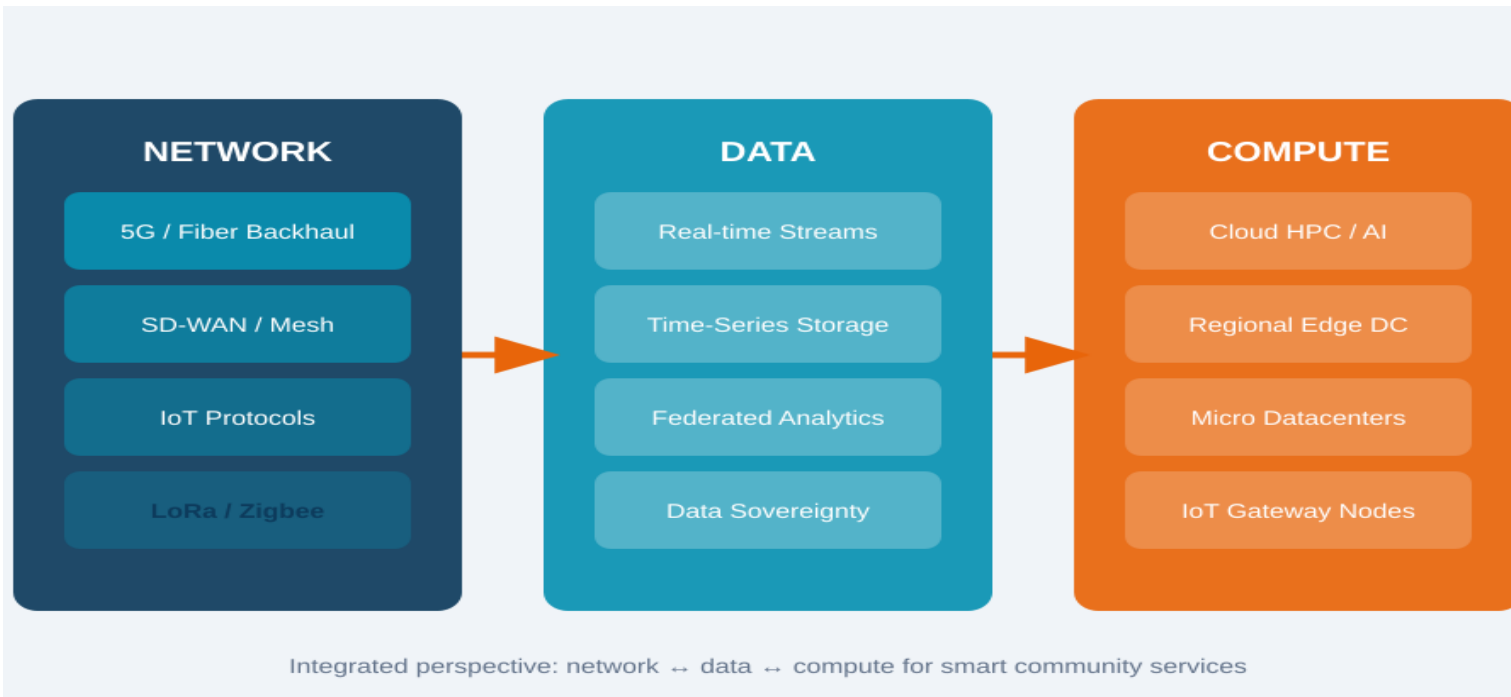
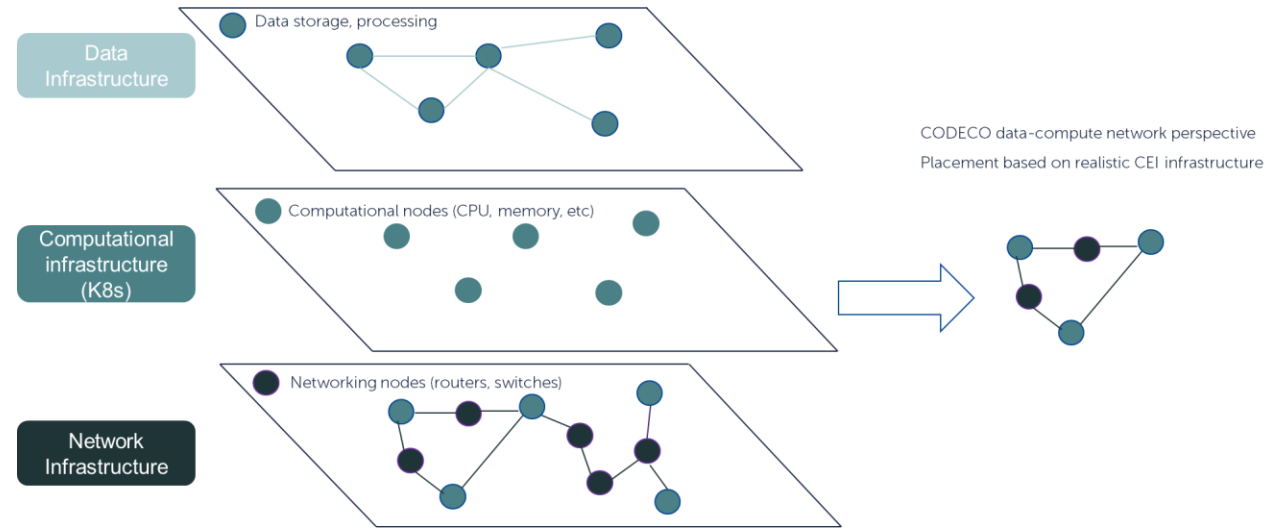
Add capacity organically.  
Distributed by design

**Grow with the city**

# Datacenters & Infrastructure

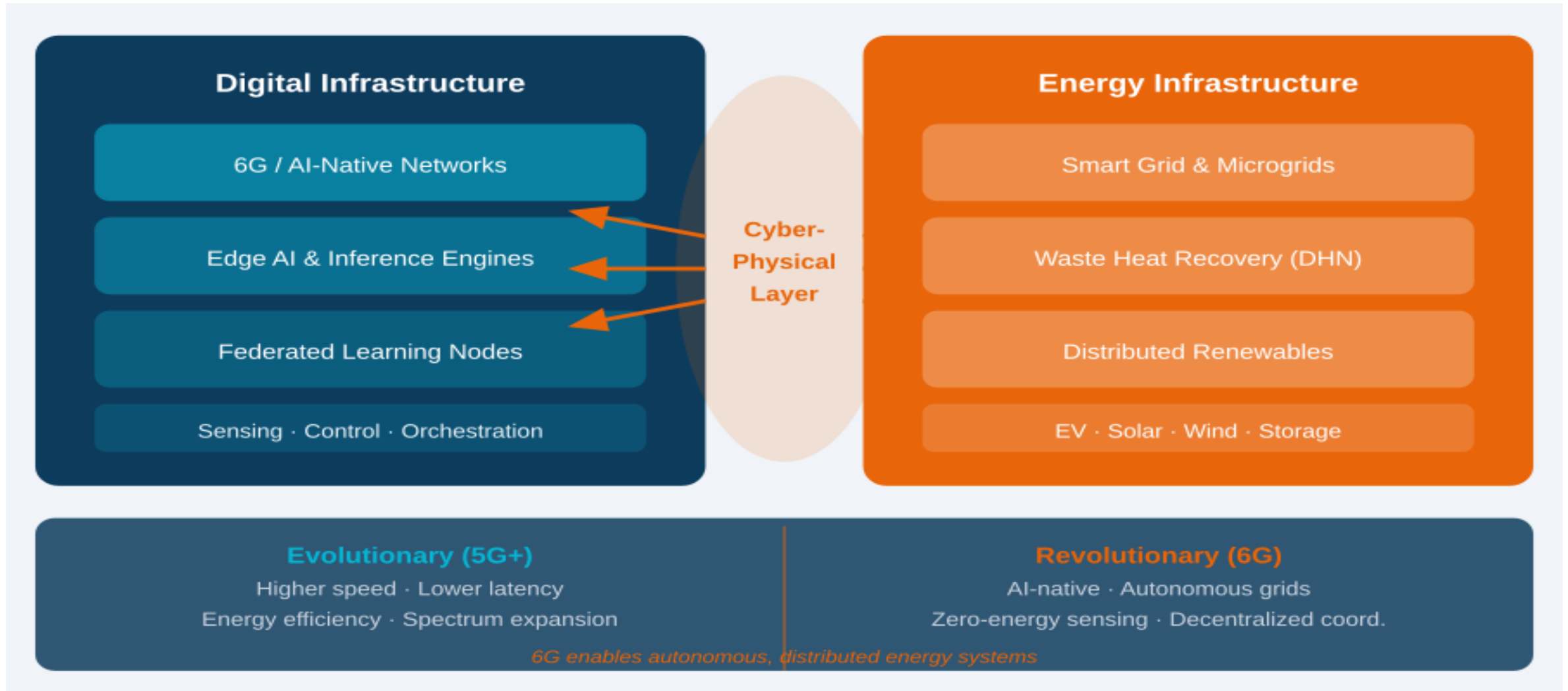
## A network-data-compute perspective

### Network-data-compute orchestration: the CODECO approach



# Digital infrastructure meets Energy Infrastructure

Data Communications evolution and convergence



## 5 Key Takeaways

1

### Smart communities need decentralized, edge-rich data center infrastructure

Central cloud alone cannot meet latency, resilience and energy integration requirements

2

### Data centers are energy assets — not only consumers

Waste heat recovery via district heating networks creates new value for cities and communes

3

### The IoT–Edge–Cloud continuum is the right architecture for regions

Layered computing from sensors to cloud enables flexible, scalable service delivery

4

### 6G will be a game-changer for autonomous energy systems

AI-native networks enable zero-energy sensing and decentralized coordination

5

### fortiss is developing the next-generation IIoT stack

Bridging AI, edge computing and energy infrastructure for Bavaria's digital future

# Thanks! Questions?

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