



PANEL #3

Theme: Edge-Cloud Computing Continuum

Moderator: Prof. Dr. Rossitza Goleva, New Bulgarian University – Sofia, Bulgaria

Panelists:

Prof. Dr. Nuno Garcia, University of Lisbon, Portugal

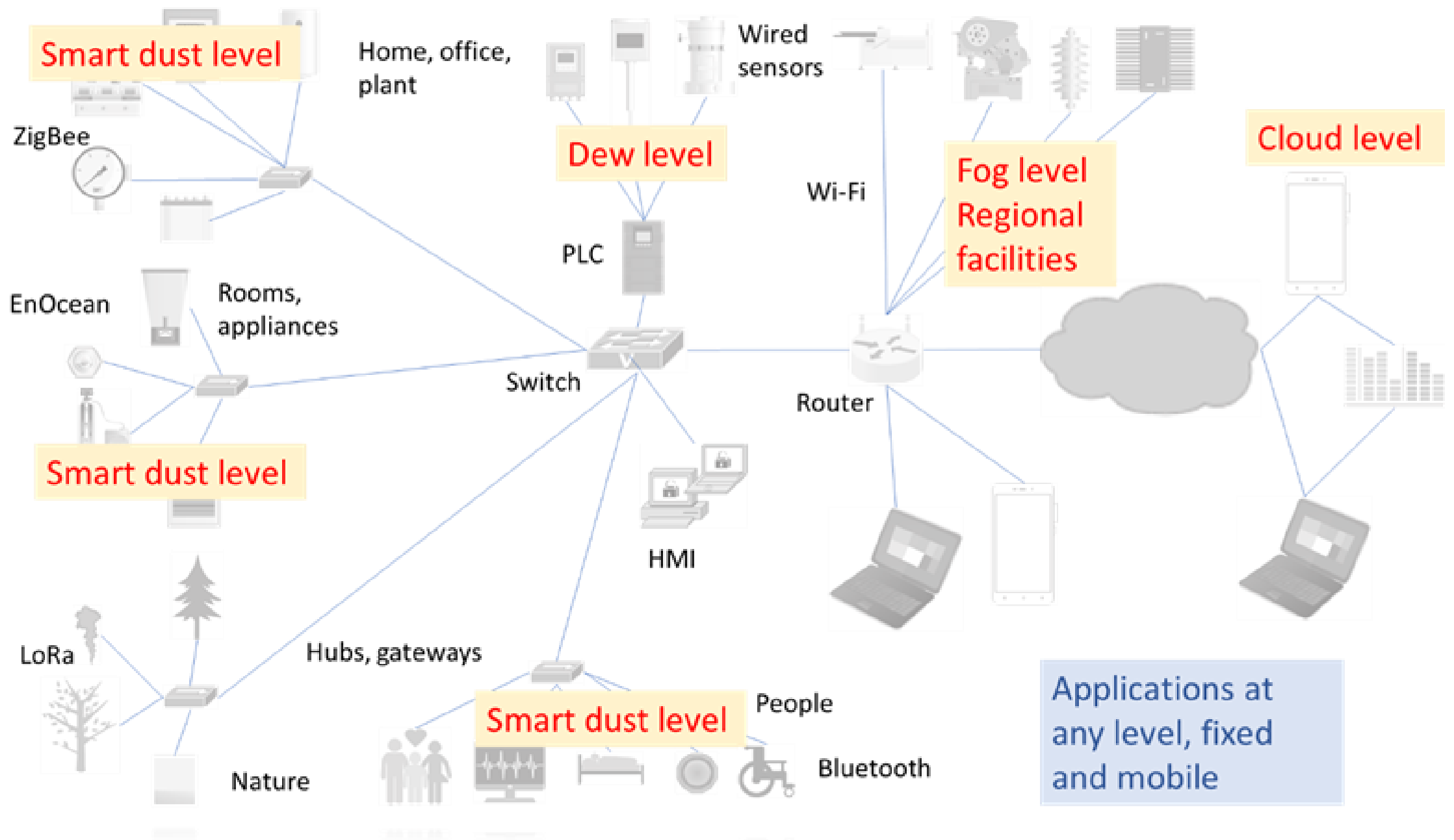
Prof. Dr. Erik Buchmann, ScaDS.AI Dresden/Leipzig, Germany

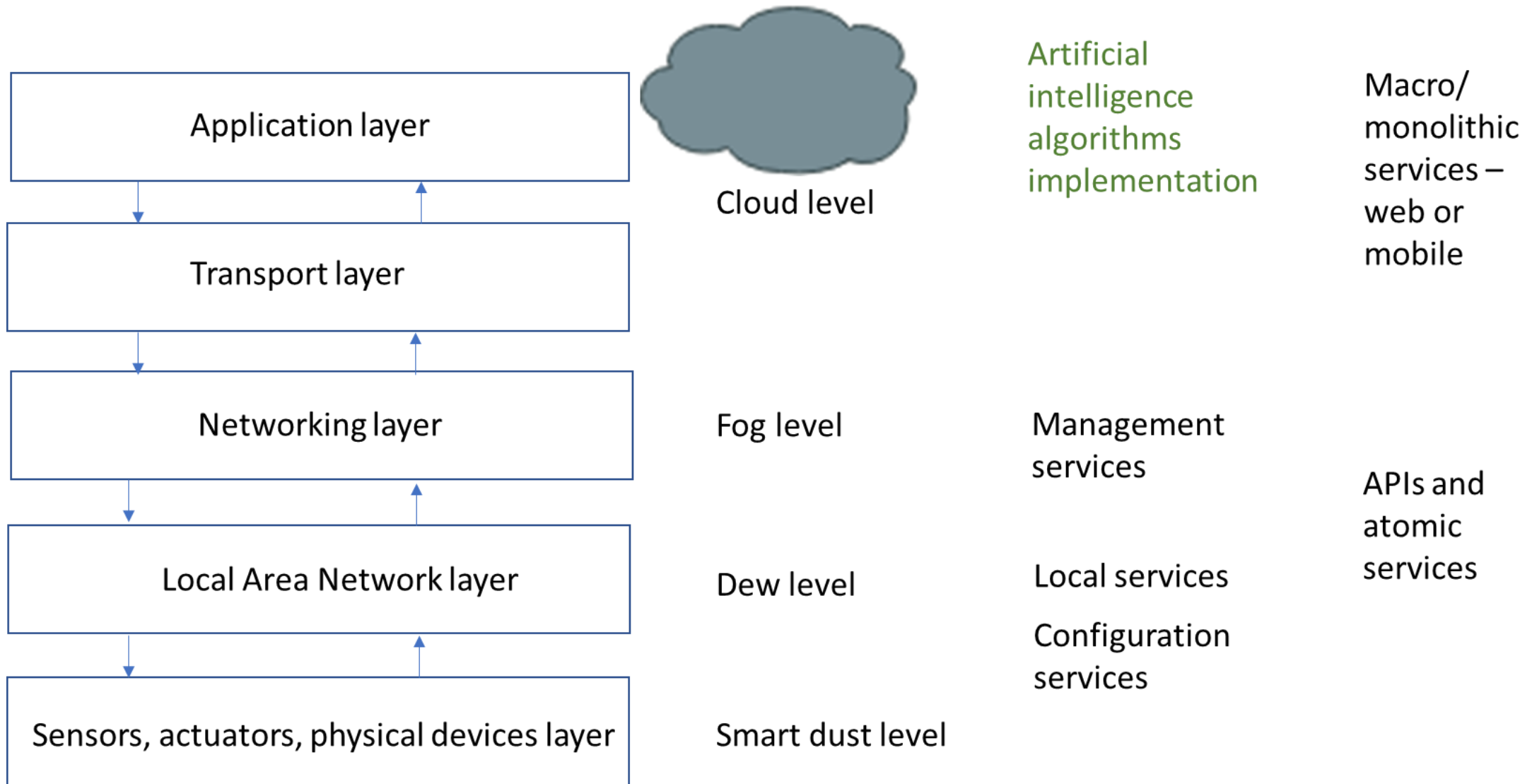
Prof. Dr. Ivan Ganchev, University of Limerick, Ireland & University of Plovdiv “Paisii Hilendarski”, Bulgaria

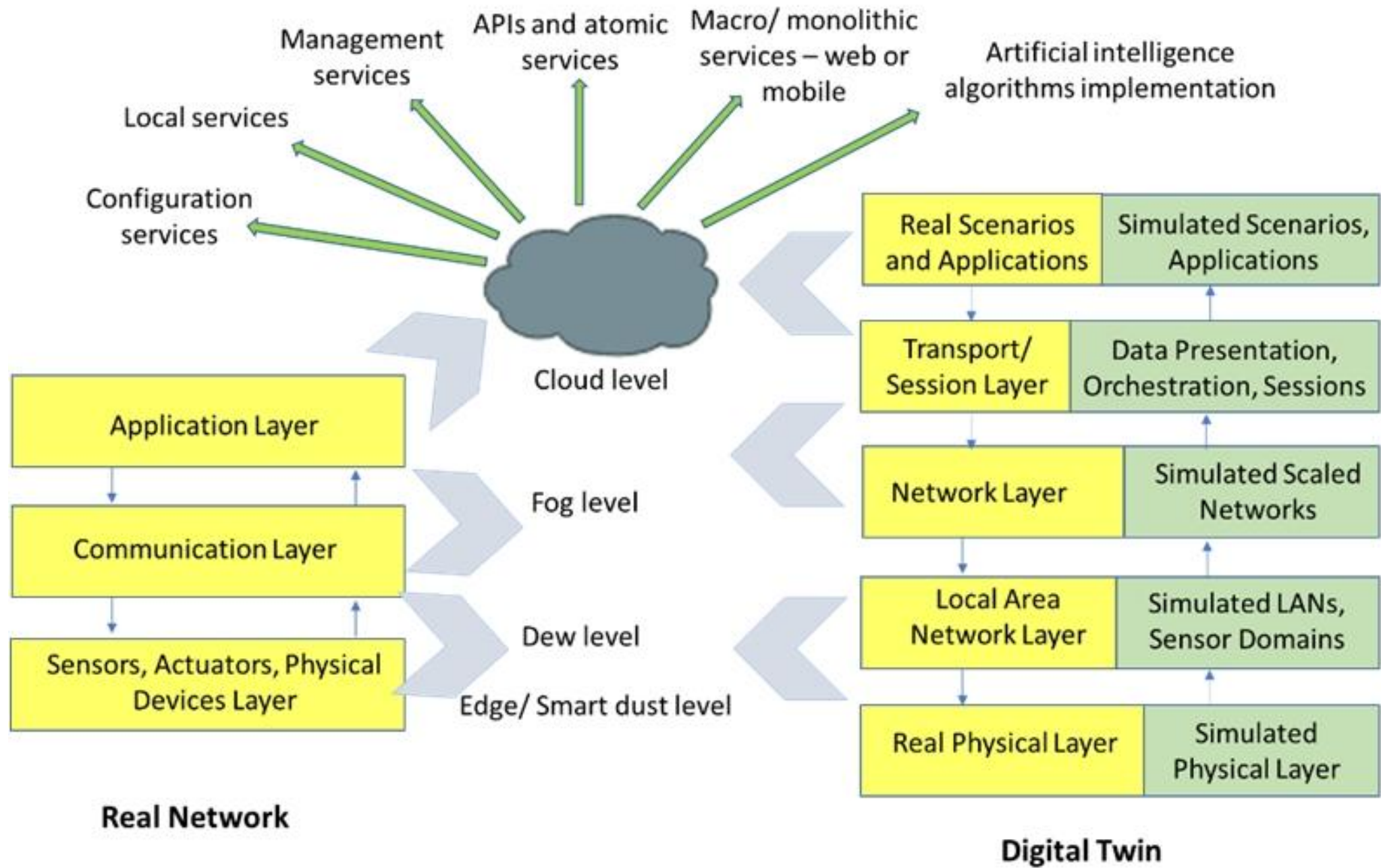
- **Edge-to-Fog-to-Cloud Computing Continuum or Just Cloud**
 - Resource orchestration of distributed architecture
 - Synchronization constrains of the access technologies
 - Smart contracts based on blockchain require resources and introduce delays
 - Role of 5G and 6G
 - Using AI to predict the quality and manage the services
 - AI in the cloud vs. tiny AI at the edge
 - Training vs. pretraining of the models – how to do it in a distributed and unstable systems?
 - Services orchestration



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- **Edge-to-Fog-to-Cloud Computing Continuum or Just Cloud**
 - How to form a swarm?
 - How big the swarm can be?
 - Data orchestration
 - Storing data
 - Processing data
 - Moving data
 - Sharing data
 - Security and privacy – many back doors are open in the cloud-to-fog-to-edge continuum
 - Efficiency of the systems
 - Is there any future of cloud-to-fog-to-edge continuum?
 - The role of the SMEs



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▪ Edge-Cloud computing continuum

- Is this the next step from Ubiquitous Computing (Mark Wieser)
- Collect what you can, process where you must
- Collect where you can, store what you must
- Is the Internet (and the networks) capable of this?
- Is “always-connected” an utopia?

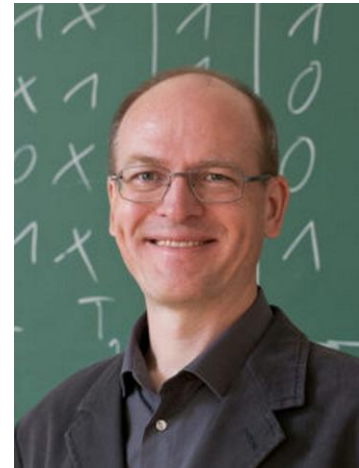
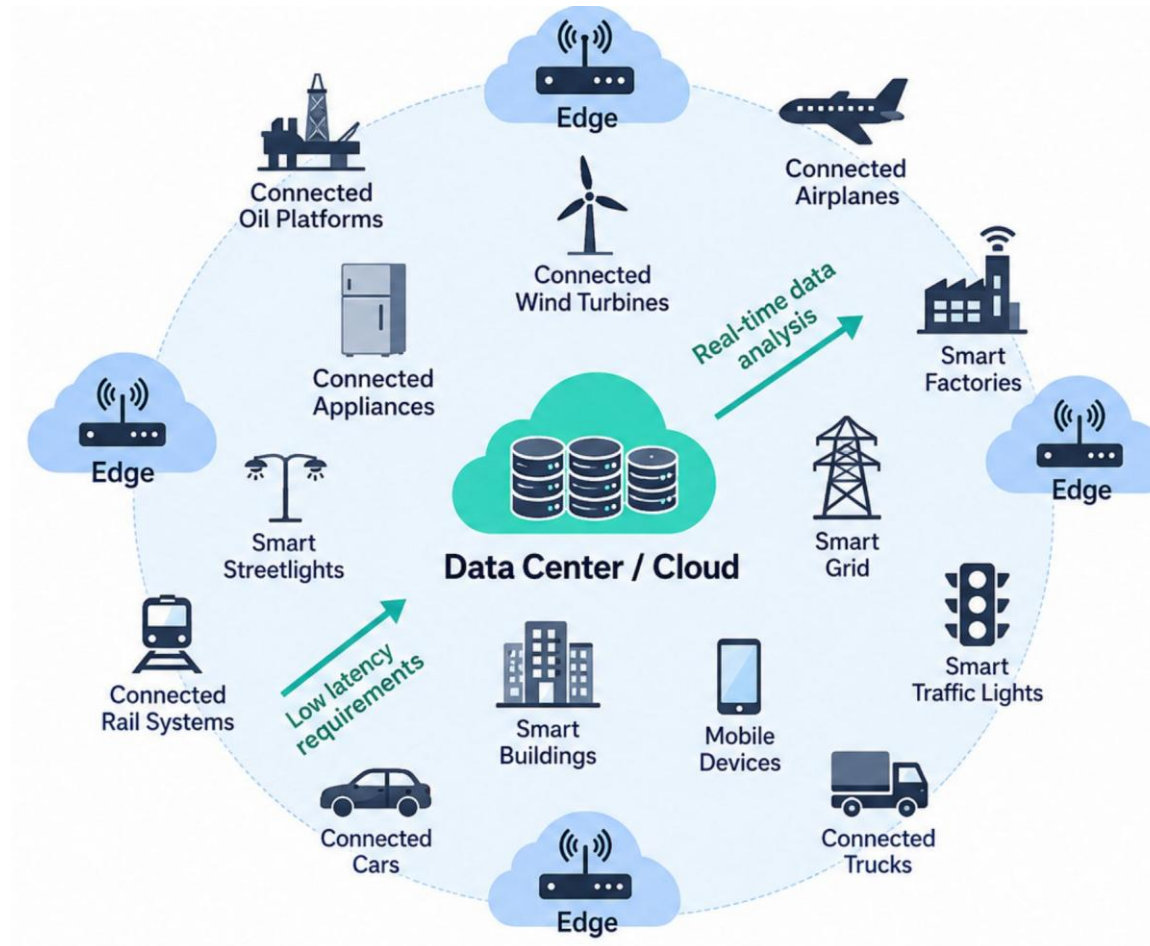


Nuno M. Garcia
FC ULisboa

Not having Edge-Cloud computing continuum is not good,
but it's not critical, we need to learn to work with what we can use

Edge-Cloud Continuum Opens Opportunities

- 10 years ago:
A Big-Data problem
(cannot be exactly solved)
- 5 years ago:
A problem for the cloud
(data needs to be centralized)
- Now:
Edge server can handle it locally

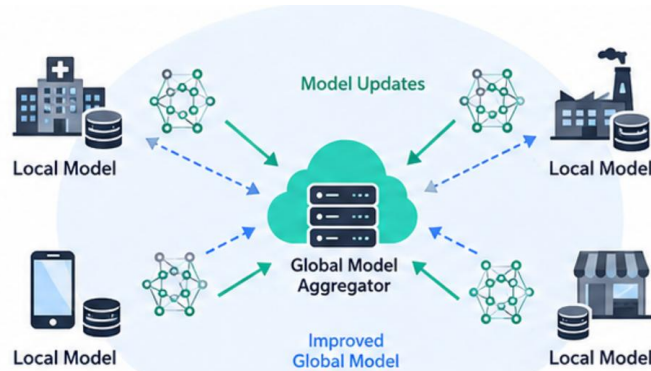


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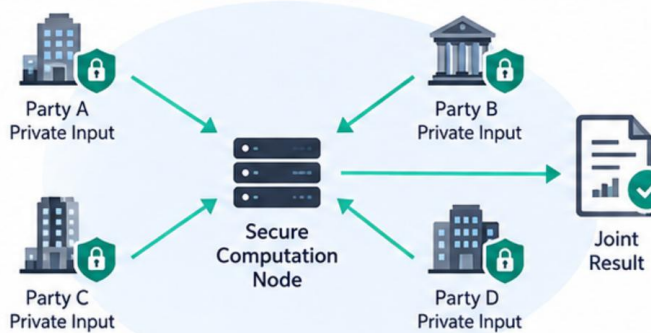
Edge-Cloud Continuum Opens Opportunities

- For important topics:
 - Data Privacy
 - Cybersecurity



Federated Learning

Local training, shared model updates.



Secure Multiparty Computation

Joint results without revealing inputs.



Fully Homomorphic Encryption

Compute on encrypted data.



Searchable Encryption

Parallel search on local encrypted data.

▪ Edge-to-Fog-to-Cloud Computing Continuum

- Balances **speed, efficiency, and scalability**
- Enable **next-generation distributed systems**
- **Edge** handles real-time tasks with ultra-low latency, local decision-making, limited compute/storage, and computation performed directly on or near data-generating devices.
 - ✓ Applications: IoT sensors, smart cameras, autonomous vehicles, wearables
 - ✓ Example: IoT sensor detects anomaly → Edge performs quick inference
- **Fog** aggregates data from multiple edge nodes, performs near-real-time analytics, and reduces cloud dependency.
 - ✓ Applications: local communication gateways, micro-data centers, industrial controllers
 - ✓ Example: Gateway aggregates data → Fog runs local analytics
- **Cloud** provides global intelligence with high compute/storage capacity, long-term analytics and machine learning, and global accessibility.
 - ✓ Application scenario: Cloud stores historical data → trains ML models → sends updated models back to fog
 - ✓ Examples: AWS, Azure, Google Cloud, private cloud clusters



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■ Why Edge-to-Fog-to-Cloud Computing Continuum matters (1)

- Provides balance between **speed, intelligence, scalability, and efficiency** for modern applications across distributed systems
- **Reduces latency** for time-critical applications
 - ✓ Applications like autonomous vehicles, industrial automation, AR/VR, and smart healthcare cannot wait for distant cloud responses. Edge and fog layers process data closer to devices for near real-time actions.
- **Optimizes bandwidth** by filtering data before cloud upload
 - ✓ Billions of IoT devices generate enormous data volumes. Sending everything directly to the cloud is expensive and inefficient. Fog nodes filter, aggregate, and preprocess data before transmission.
- Provides **scalability** for massive IoT
 - ✓ The continuum distributes workloads intelligently across edge, fog, and cloud layers, enabling systems to scale efficiently without overloading centralized infrastructure.
- **Enhances reliability and resilience** through distributed processing
 - ✓ Local edge/fog processing allows systems to continue operating even during intermittent cloud or network outages.



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■ Why Edge-to-Fog-to-Cloud Computing Continuum matters (2)

- **Enhanced Security & Privacy**

- ✓ Sensitive data can remain closer to its source instead of always traveling to centralized clouds, reducing exposure risks and supporting regulatory compliance.

- **AI Everywhere**

- ✓ AI inference increasingly happens at the edge for fast decisions, while fog coordinates regional intelligence and cloud performs large-scale AI training and orchestration.
- ✓ Enables hybrid AI (edge inference + cloud training)

- **Energy & Cost Efficiency**

- ✓ Processing data at the appropriate layer reduces unnecessary communication and cloud resource usage, lowering operational costs and energy consumption.



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