

Heterogeneous Networking in Automation

50th anniversary of IFAC at Heidelberg
Emerging Area Workshop, Group 6
Peter Neumann, ifak Magdeburg, Germany

Fields of Interest

- ❑ Uninterrupted end-to-end communication between distributed automation applications via heterogeneous digital networks. Main problems:
 - Various network transitions,
 - Quality of service (different metrics, performance, Security, Safety)
- ❑ Wireless communications
 - Local Area Networks, Fieldbus Systems
 - Metropolitan Area Networks
 - Wide Area Networks
- ❑ Computer-aided Engineering using formal description of device features
 - Ontologies
 - Business logics

Fields of Interest (cont'd)

- Location Awareness,
 - esp. for context-sensitive applications in distributed control systems

- Networked Control
 - Real-time classes
 - Algorithm design considering network performance

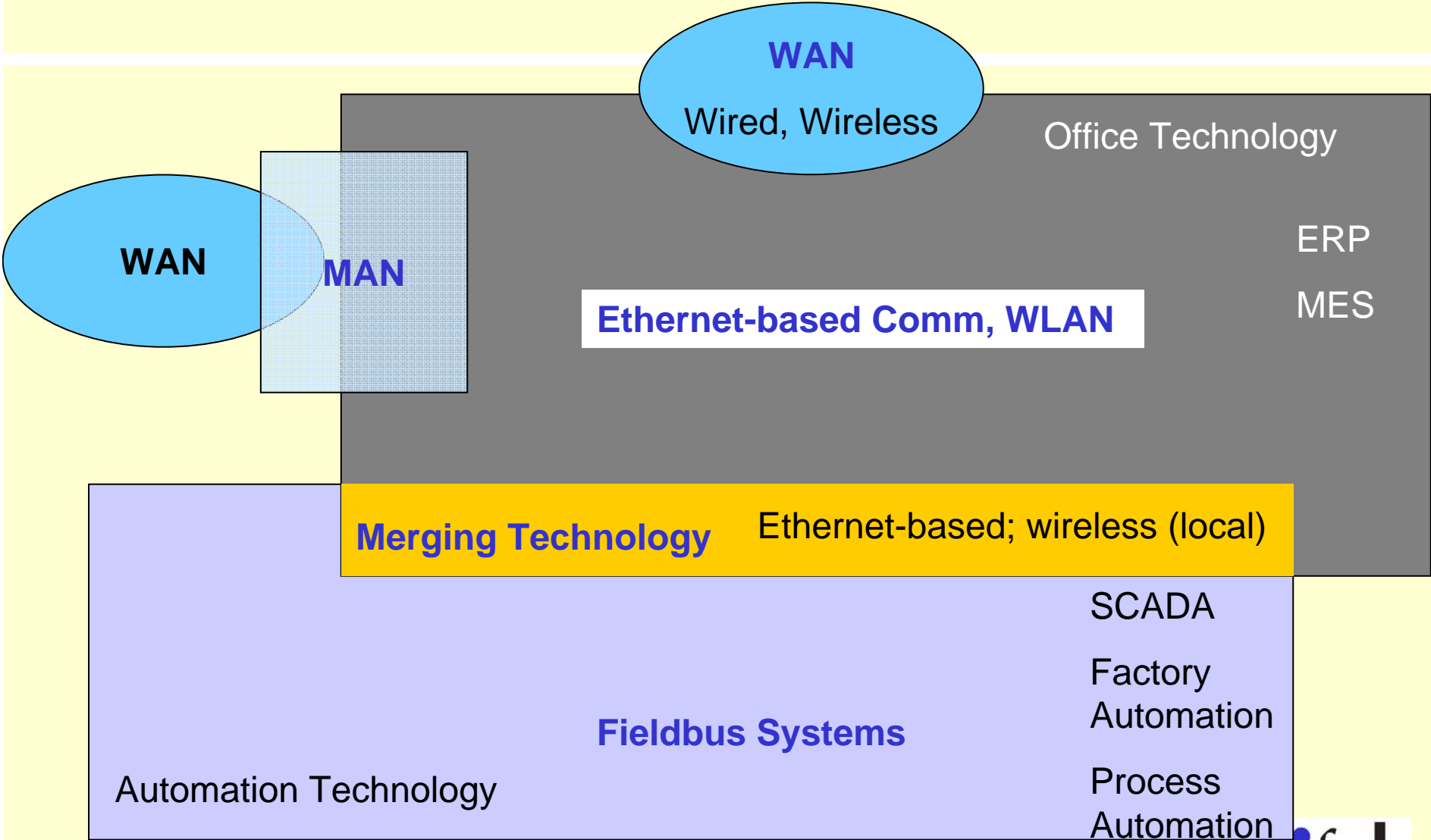
What has to be new?

- ❑ Data throughput between geographically distributed connection end points with guaranteed Quality of Service
- ❑ QoS contains *scalable* Real-time behaviour, Safety and Security over heterogeneous communication networks
- ❑ The metrics to describe the QoS are very different in the participating sub-networks within the local area as well as in the wide area. It is aimed to define the necessary *“overall” metric*
- ❑ There are (many) network transitions between the participating sub-networks. A method to describe the *“transition chain”* is necessary.

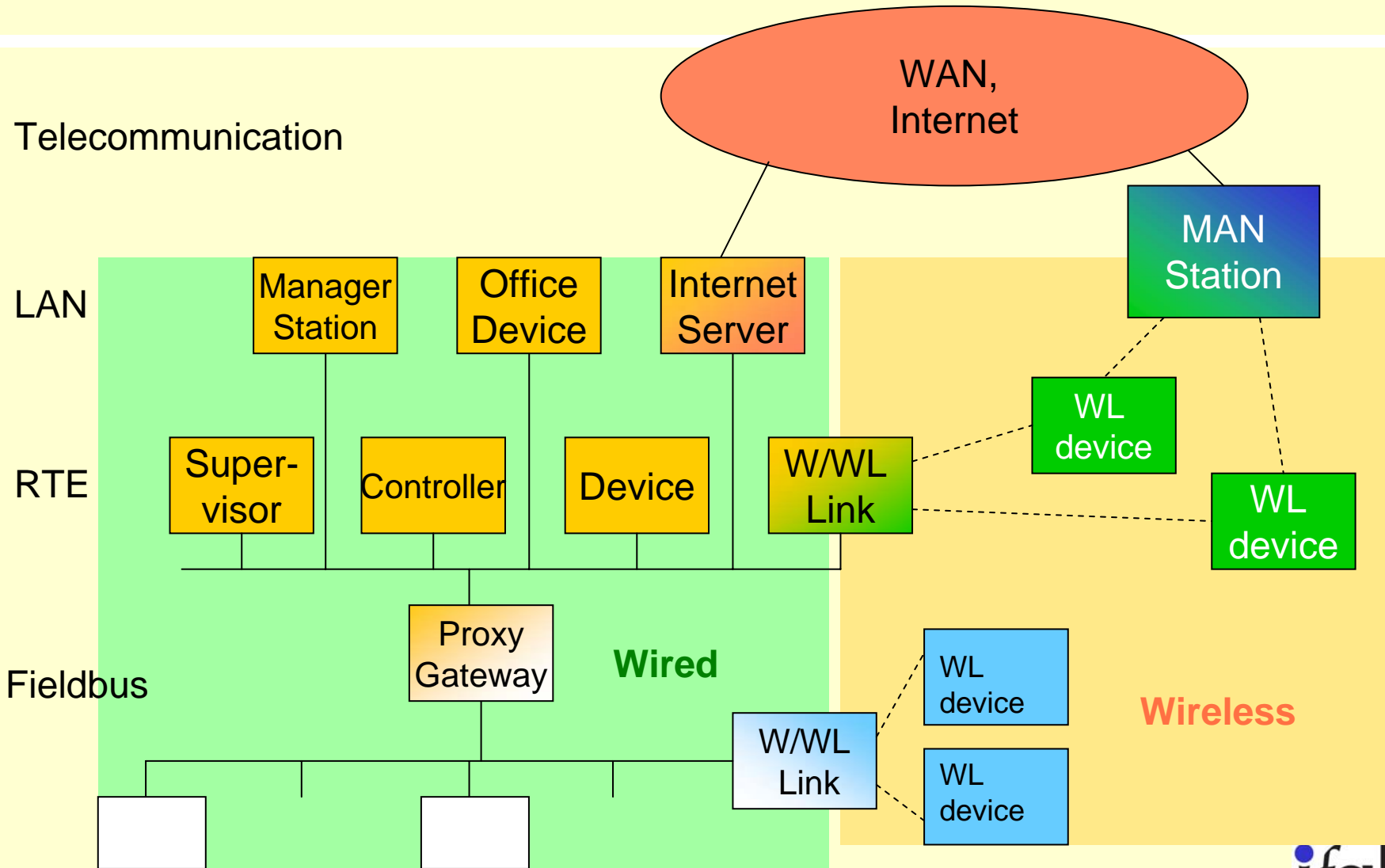
General Needs

- ❑ Concepts for guaranty of *desired end-to-end performance in heterogeneous LAN/WAN networks*
- ❑ Special mechanisms for *Security* with scalable security in different zones
- ❑ Special mechanisms for *functional Safety* in combined wired and wireless networks
- ❑ General *wireless communication concept* including local and wide area telecommunication networks

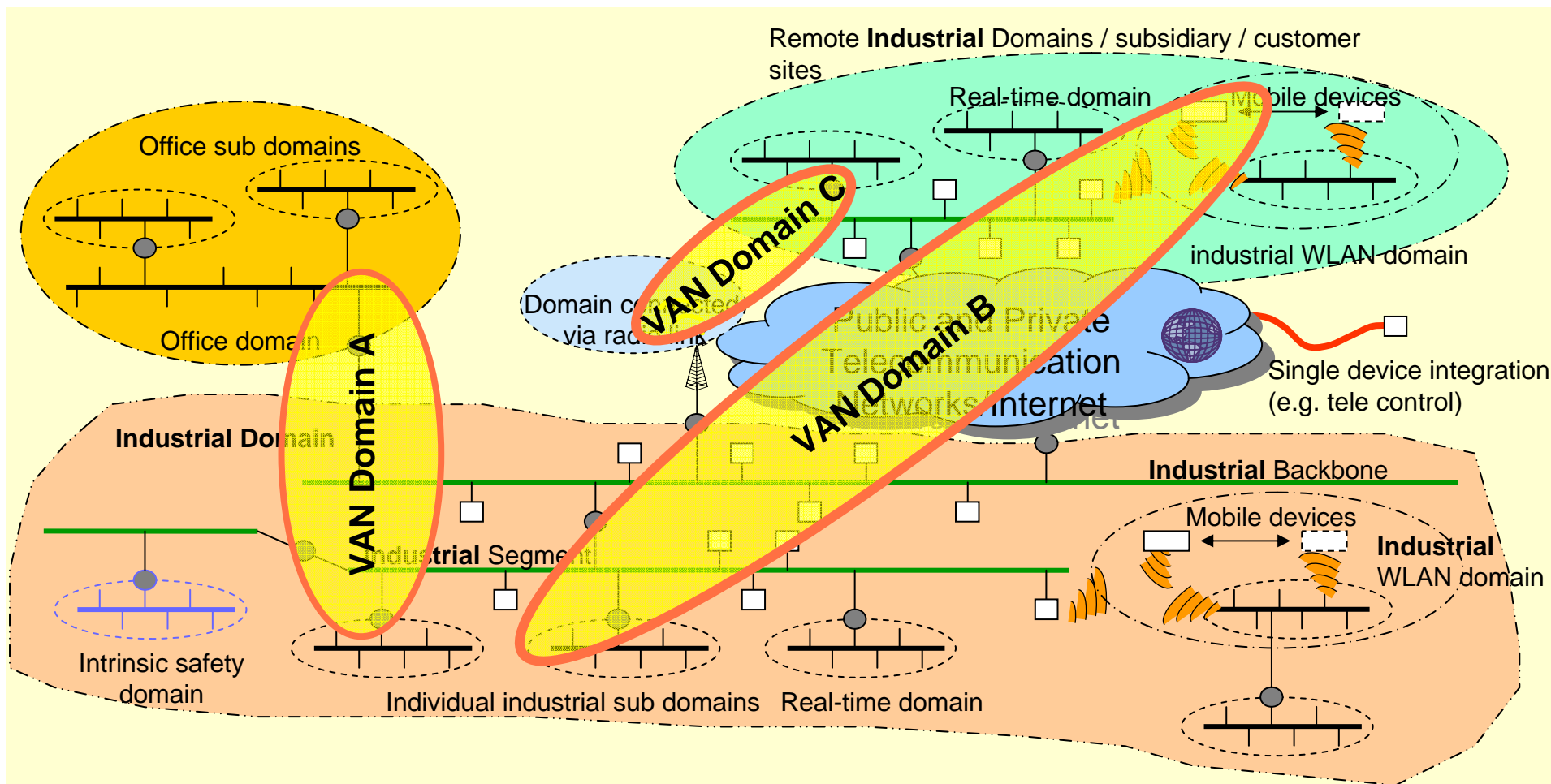
Office & Automation Technology are merging



Network Transitions

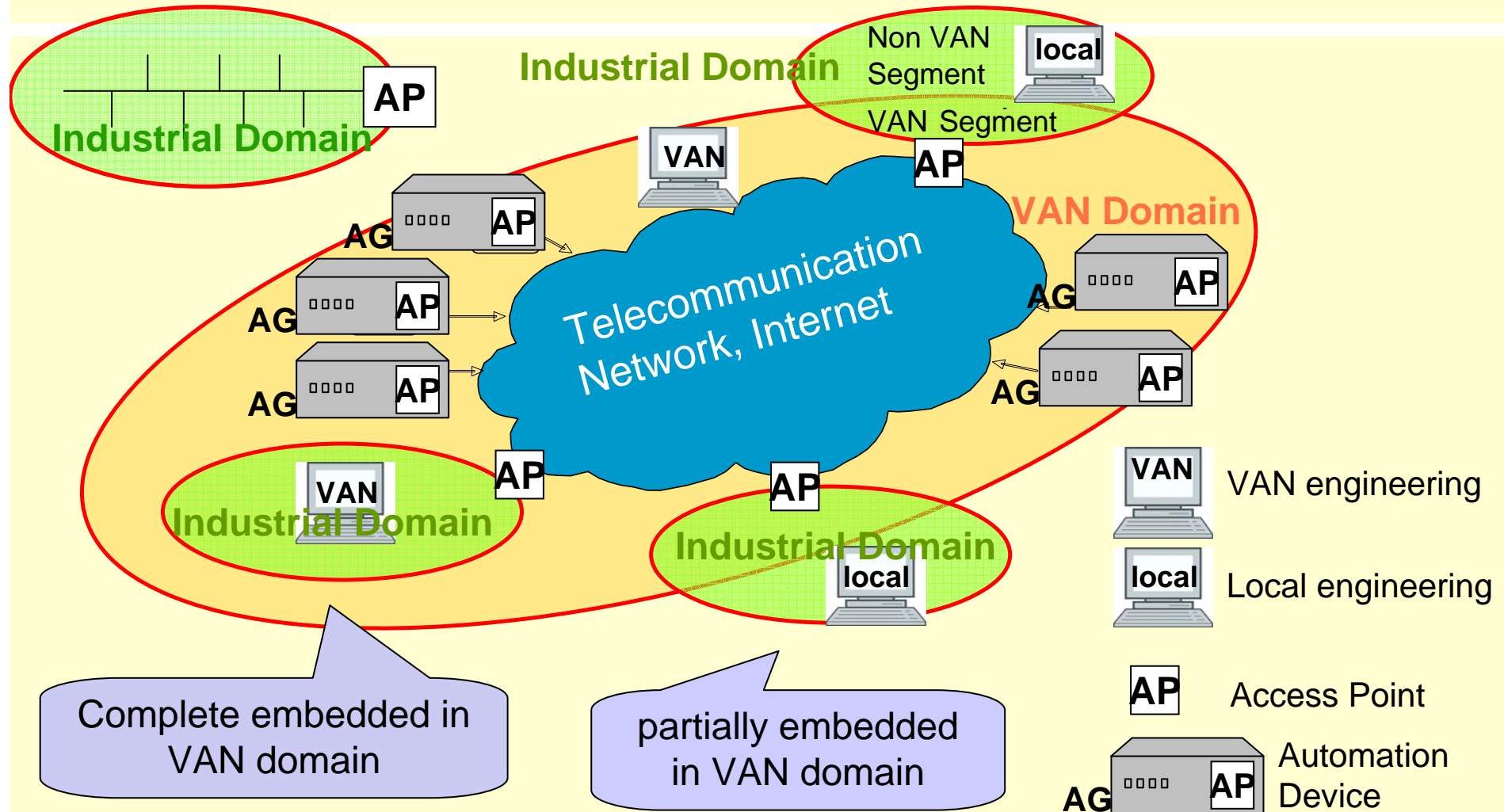


Virtual Automation Network Domains



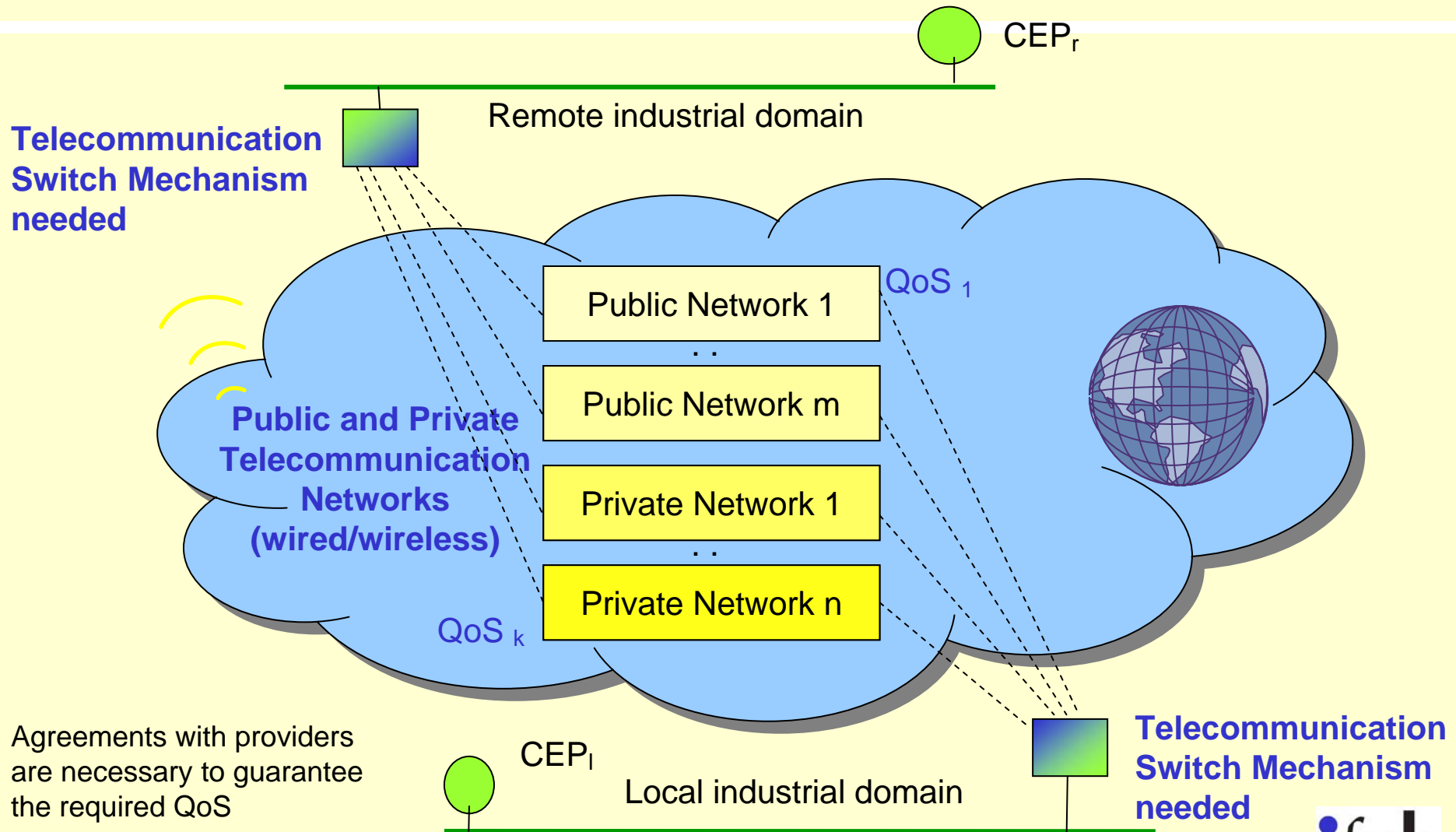
Source: VAN project

Virtual Automation Network Areas, participating in VAN Domains



Source: VAN project

Path Switching - General



QoS Requirements for Virtual Automation Networks

- Industrial environment of automation requires
 - Robustness against incorrect functions of automation devices
 - → *functional Safety* necessary
 - Not discussed in detail here

- Connection of legacy information islands (Fieldbus systems) to the open IT infrastructure requires
 - *Security* measures
 - Not discussed in detail here

- Scalable real-time behaviour (3 real-time classes)

Real-time Classes in Industrial Automation

There are three *real-time classes* guaranteeing response time:

- ❑ **Class 1:** soft real-time (scheduling on top of UDP/TCP): scalable cycle time; used in factory floor and process automation (local and wide area domain)
- ❑ **Class 2:** hard real-time (scheduling on top of MAC): cycle time 1...10ms. Used for control (local domain)
- ❑ **Class 3:** isochronous real-time (with time/clock synchronisation and routing with time schedule): cycle time 250 μ s...1ms; jitter less than 1 μ s. Used for motion control (local domain).

- ❑ Additionally, there is a class “non real-time”

Location Awareness

- ❑ The usage of Information Technologies within the life cycle of an automation system is becoming broader.
- ❑ The Engineering in the various phases (design, development, manufacturing and commissioning of automation devices and systems, maintenance of the system) is becoming more efficient using formal methods to develop information models and description languages (describing the features of the components for all the mentioned phases) and computer aided wireless tools to handle these features.
- ❑ An important requirement is a context-sensitive offer of the needed information at these tools.
- ❑ Since the needed database is distributed through the decentralised automation system (connected by the heterogeneous network) it also requires location- based services.

Intergration of wireless technologies into automation devices

- ❑ Subject of these activities is the development of a unified communication software for different radio communication technologies and its integration into the lifecycle of Distributed Automation software systems. This unified communication software (allocated to a specific “Convergence Layer”) will enable the integration of different radio communication components into automation components running in a Distributed Automation software system
- ❑ The integration has to take under consideration the various influences as there are propagation conditions, specific industrial communication requirements (real- time, safety, security), implementation conditions (i.e. limited resources), and engineering aspects