A Network Architecture for Personal Networks

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IST Mobile Summit 2005 - Dresden

June 22, 2005

This work was sponsored by the IST-MAGNET project

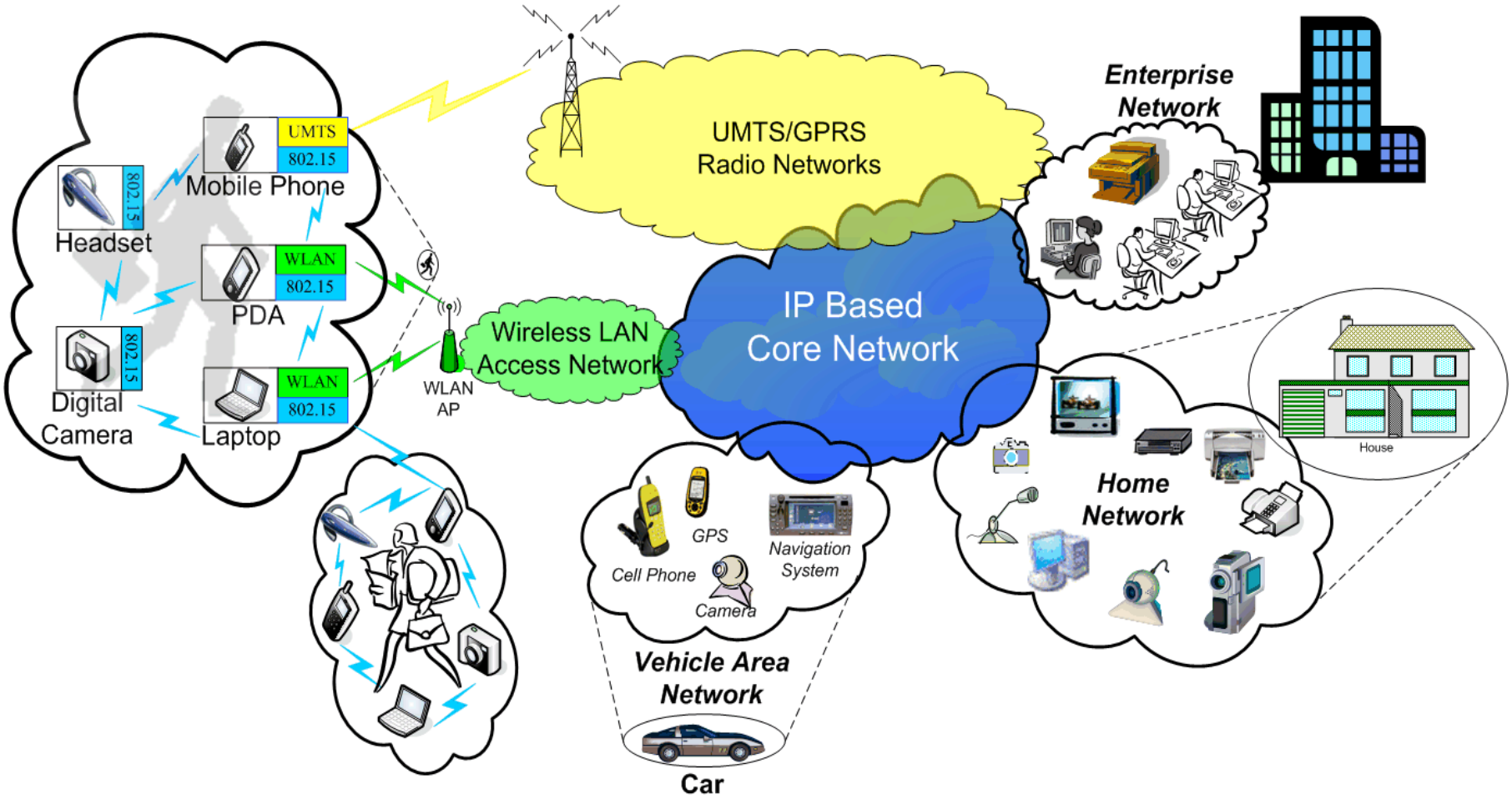
Outline

- Introduction to Personal Networks
- A Network Layer Architecture
- PN organisation, Addressing, Routing and Mobility Management
- Naming and Service Discovery in Personal Networks
- Conclusions

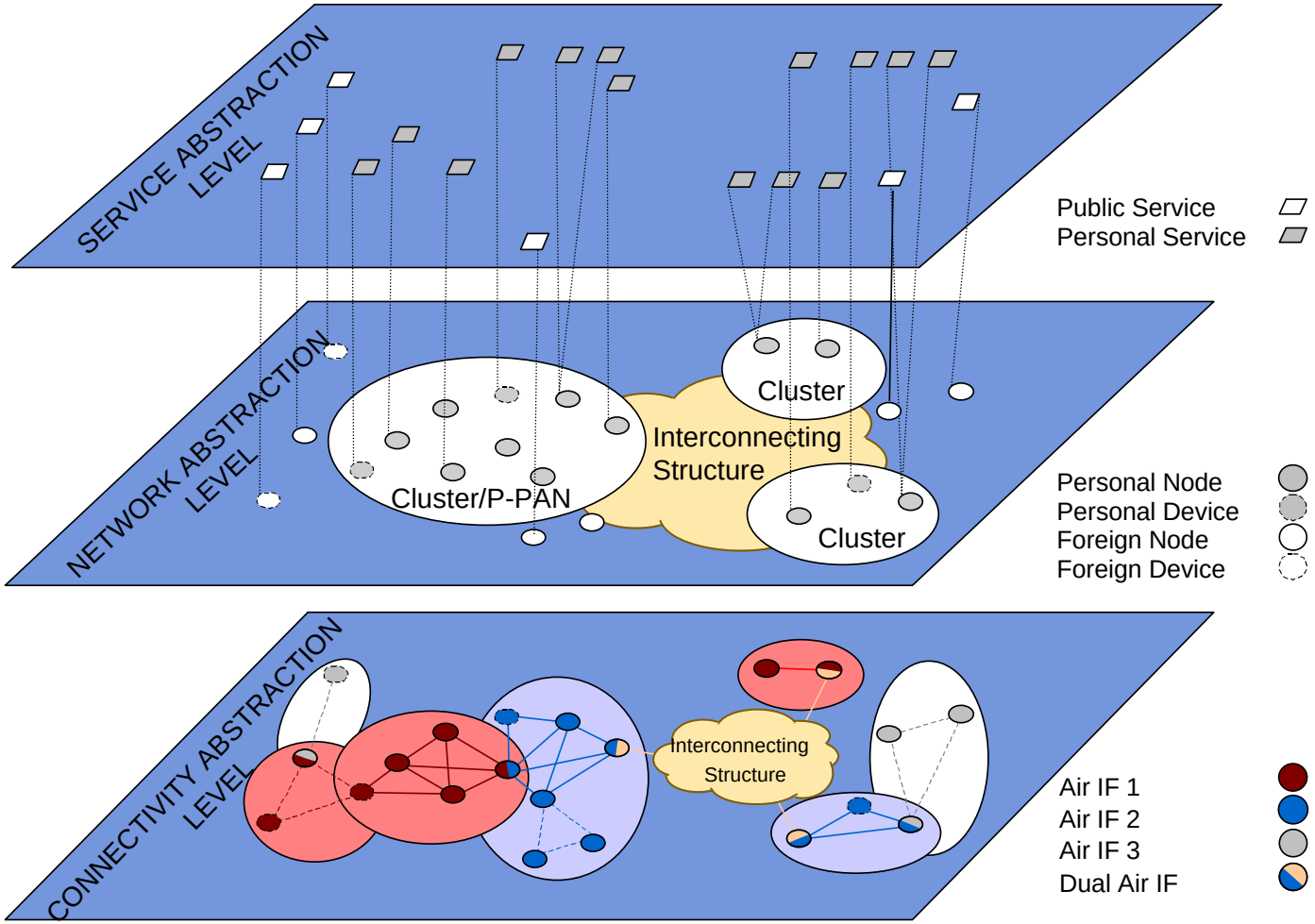
From PANs to Personal Networks

- Personal Area Network (PAN)
  - Network consisting of personal devices in the close vicinity of the person (Personal Operating Space or POS)
- Personal Network (PN)
  - Network centered around a person and his/her needs
  - Resources and devices are not necessarily in the close vicinity of the person
  - Dynamic in composition, configuration and connectivity depending on time, place and circumstances
  - Core consisting of a PAN extended with personal resources or resources belonging to others.

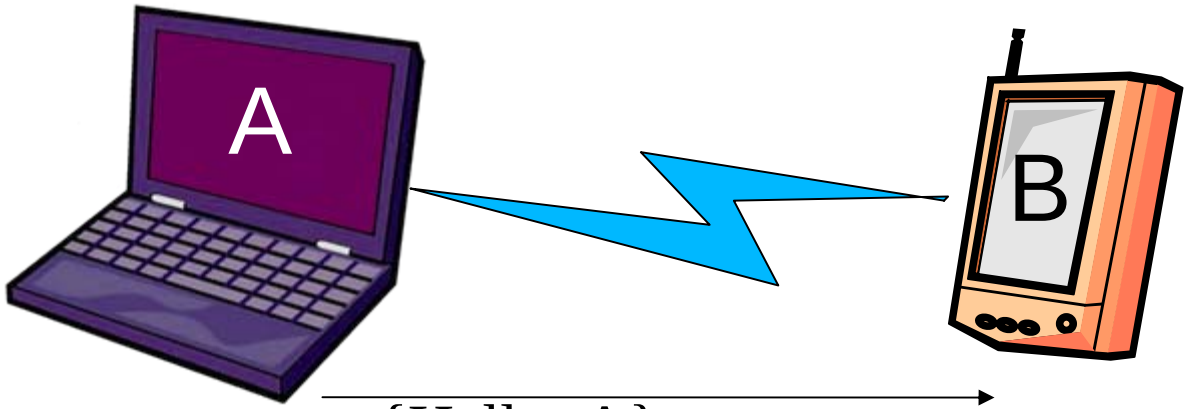
An Example of a Personal Network



The Three Level View of Personal Networks



When a Node Meets Another Node...



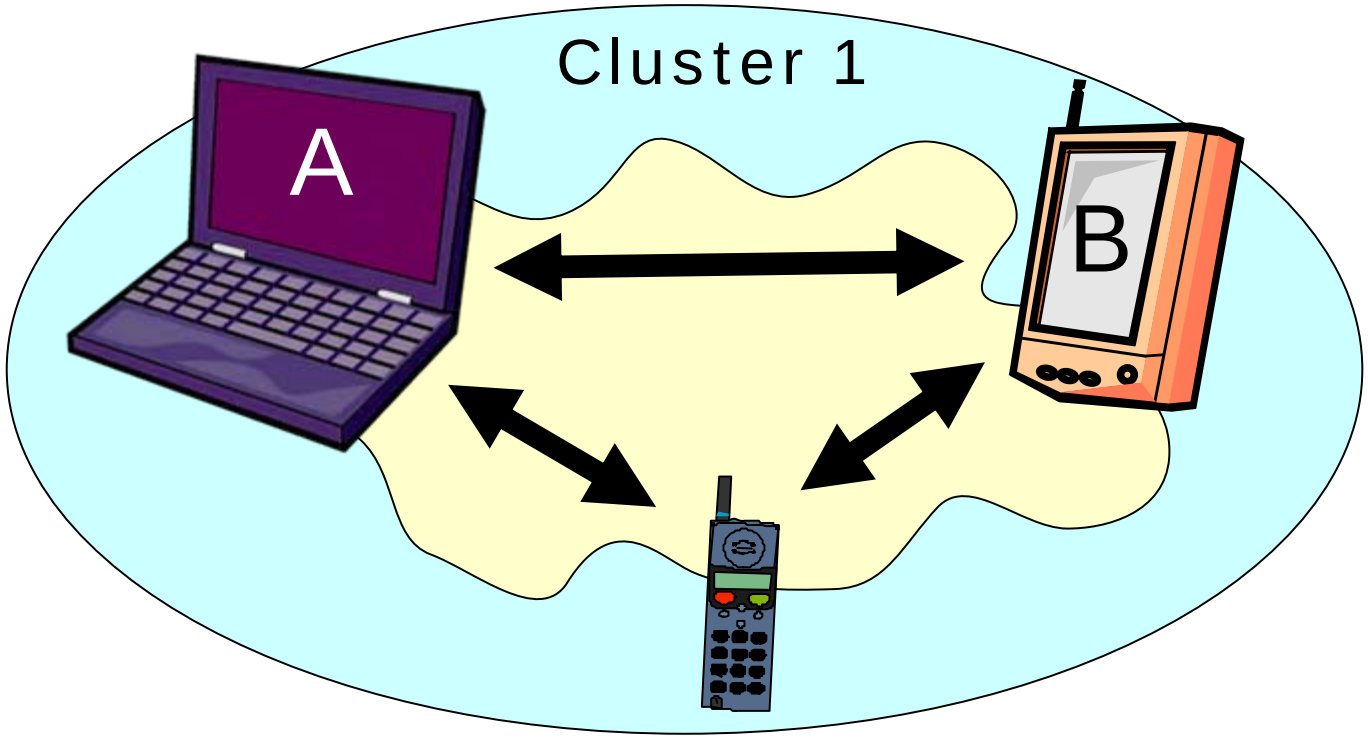
$\{Hello, A\}_{Shared\ PN\text{-}key}$

$\{Hello, B\}_{Shared\ PN\text{-}key}$

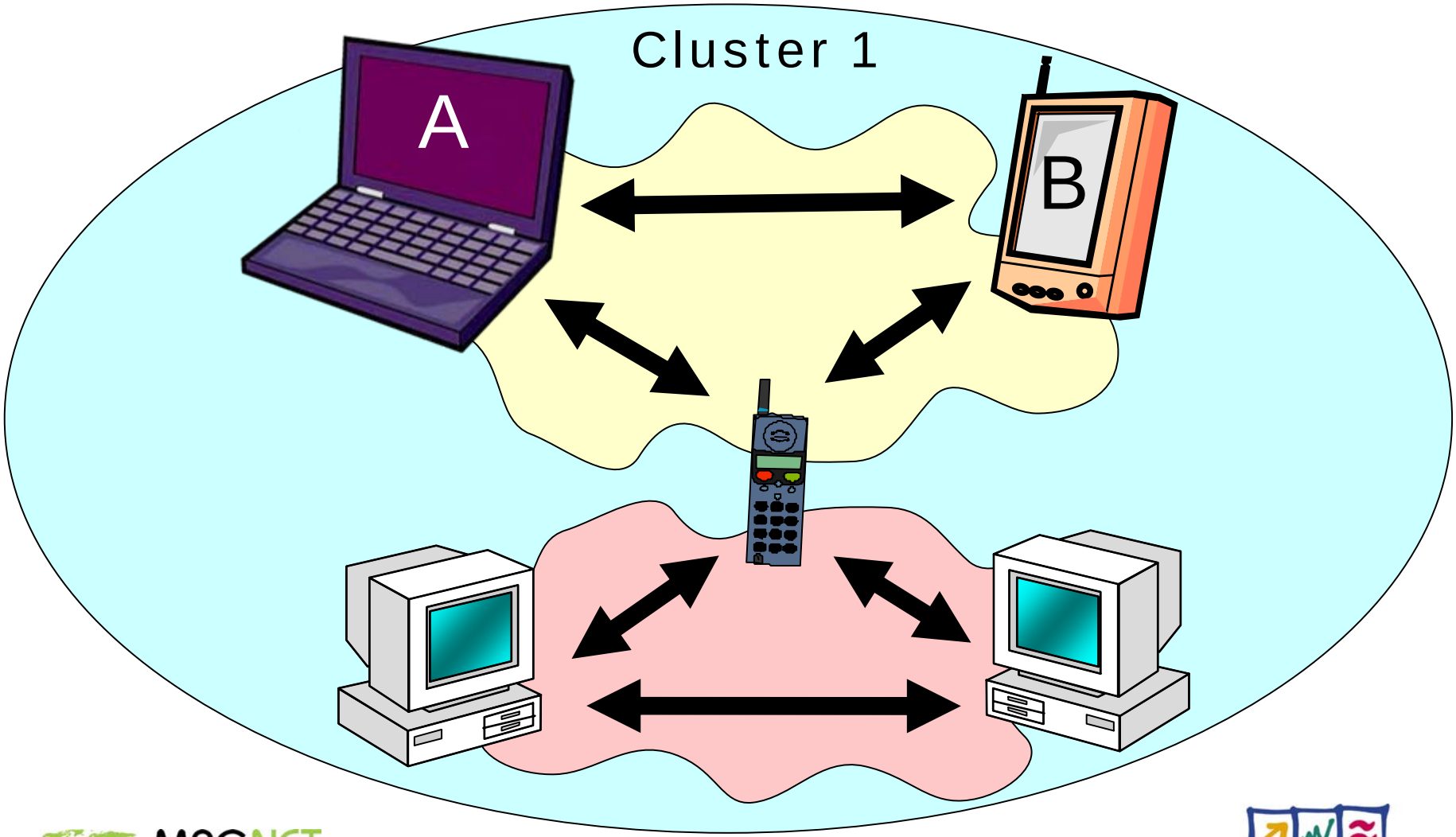
$\{Mgmt\ Data\}_{Shared\ PN\text{-}key}$

$\{Data\}_{Shared\ PN\text{-}key}$

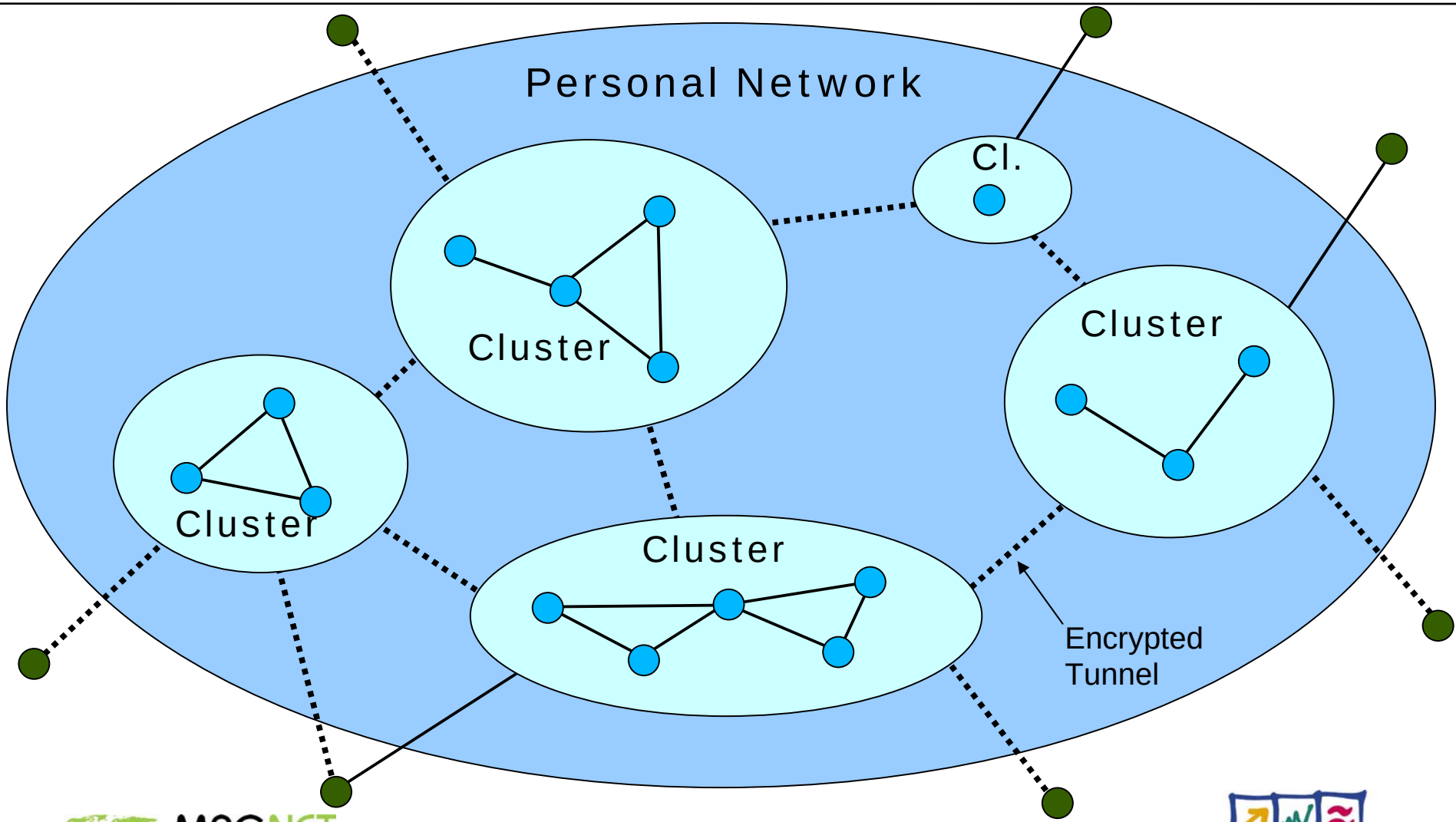
...And a Cluster is Formed



A Cluster can also be Multi-Hop



A Network Layer Architecture



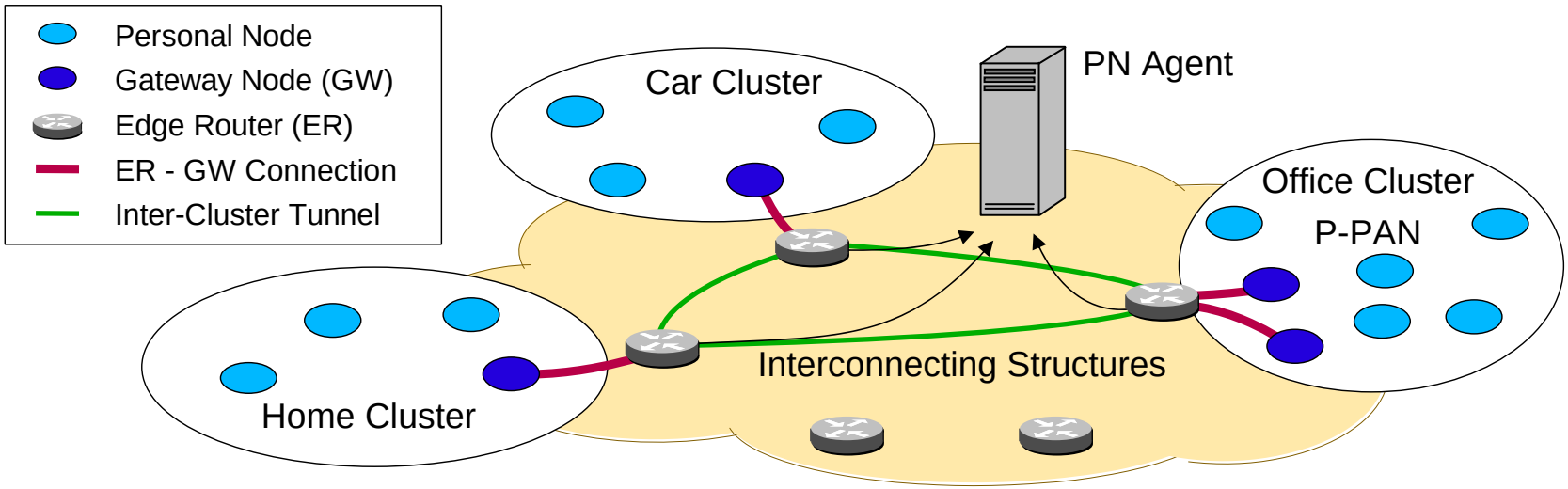
Network Functionality of a Cluster

- Secure packet forwarding
  - Offering data integrity and encryption
- Intra-Cluster routing and addressing
  - Mobile ad-hoc routing, automatic addressing
- Intra-Cluster Broadcasting/flooding capabilities
  - For service discovery, context information, routing, …
- Gateway Node identification
  - To establish connections with Foreign Nodes and other Clusters. Gateway Nodes enforce security.

Network Functionality of a PN

- Establishment and maintenance of encrypted tunnels between all Clusters
- Inclusion of new Nodes and exclusion of compromised Nodes
- Secure setup and maintenance of communication with Foreign Nodes.

PN Agent, Edge Routers and Tunnels



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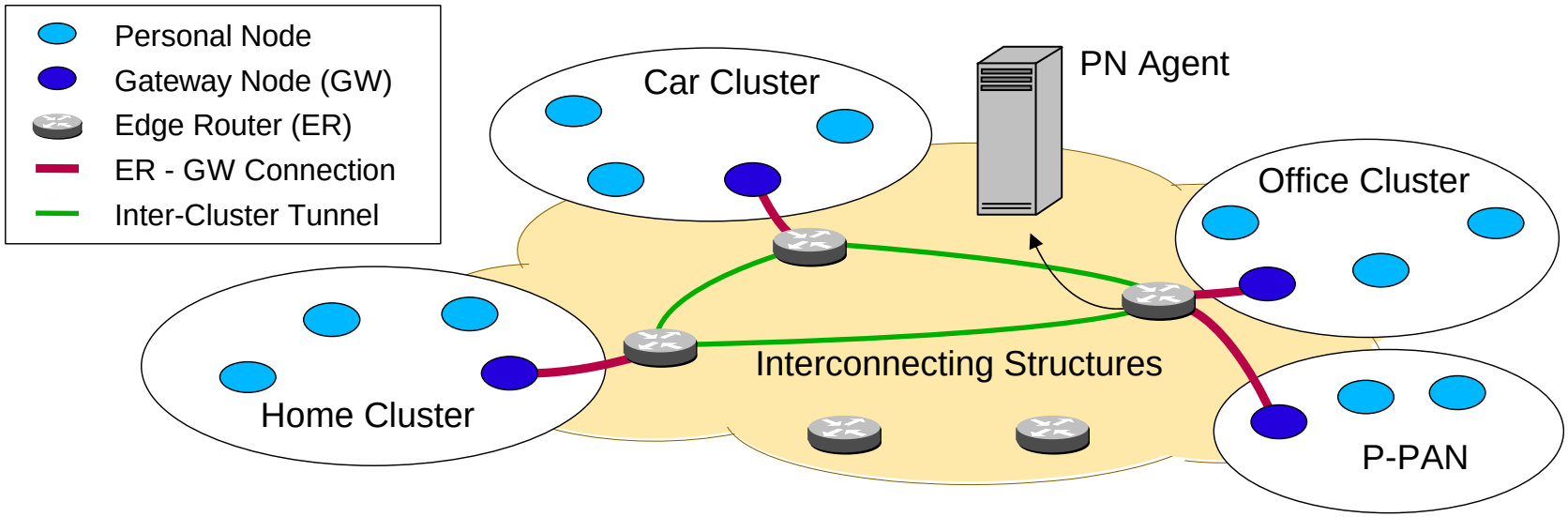

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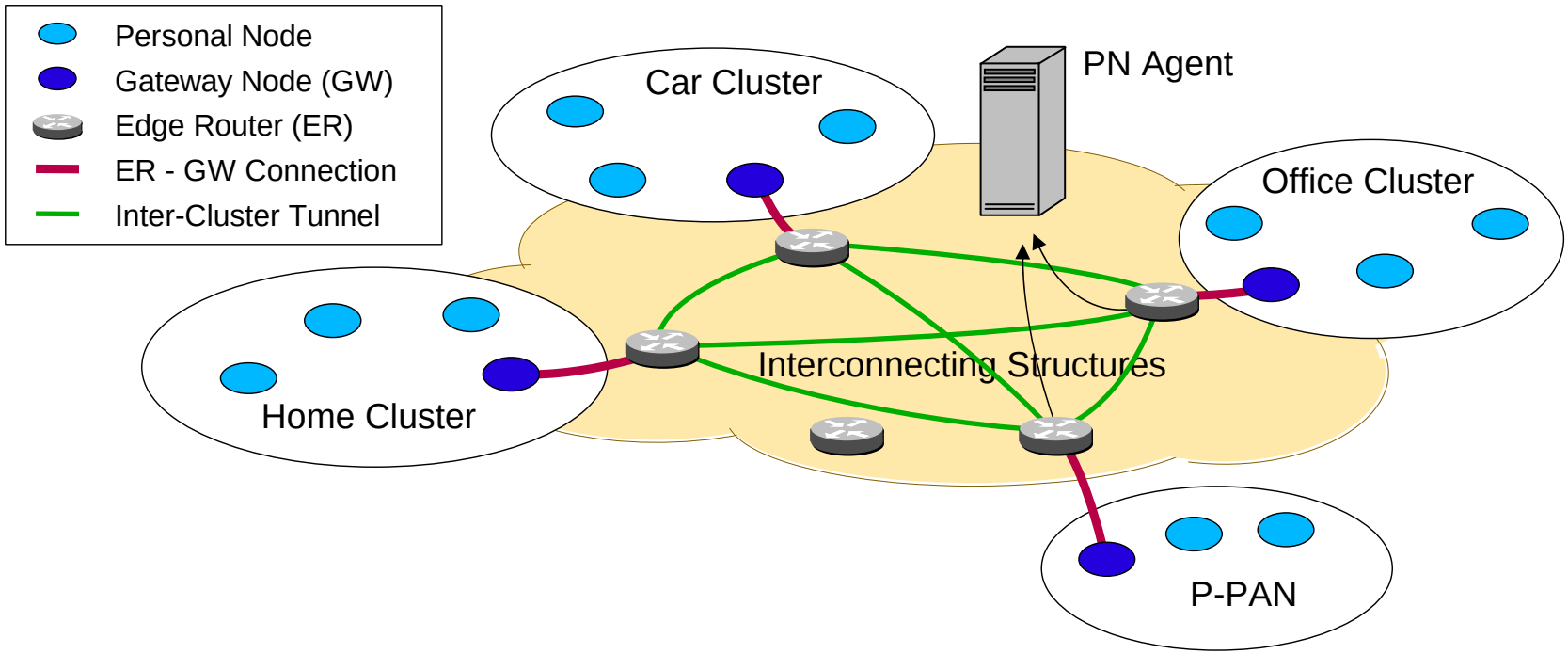

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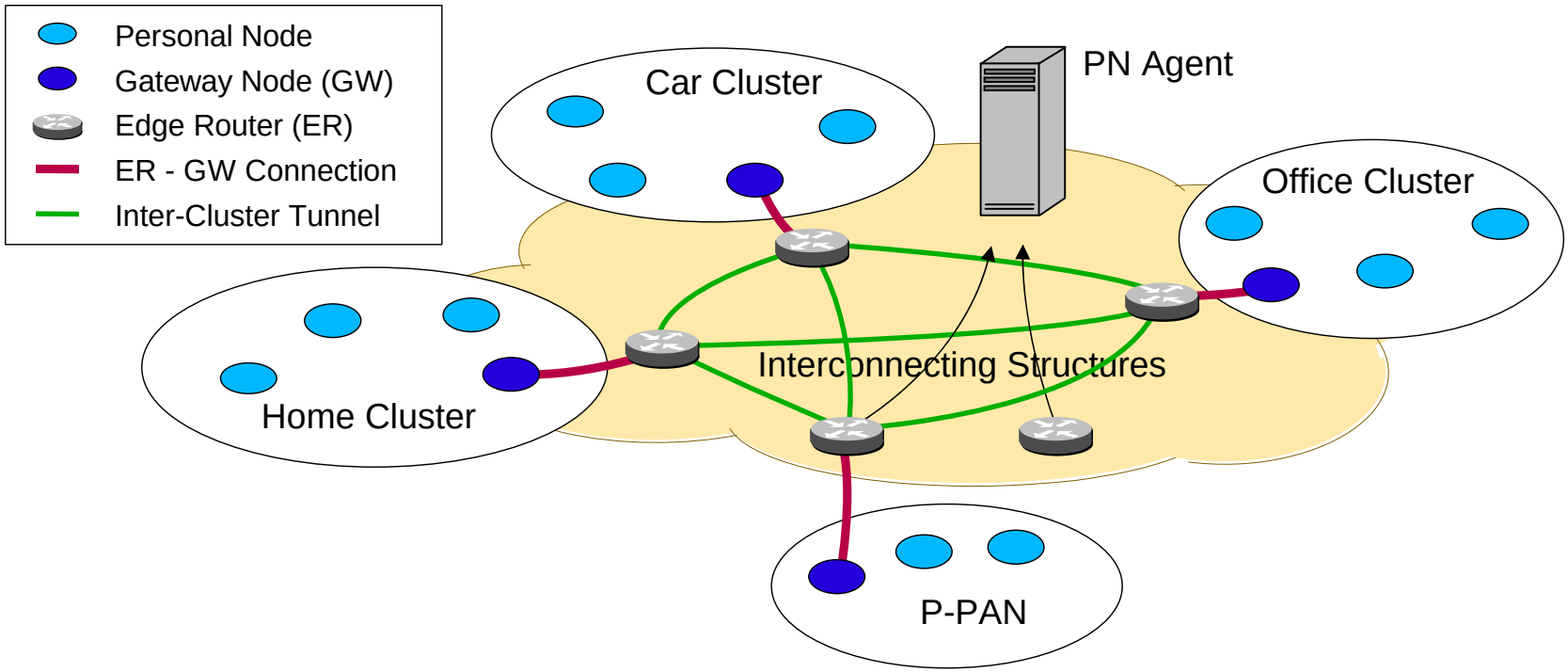

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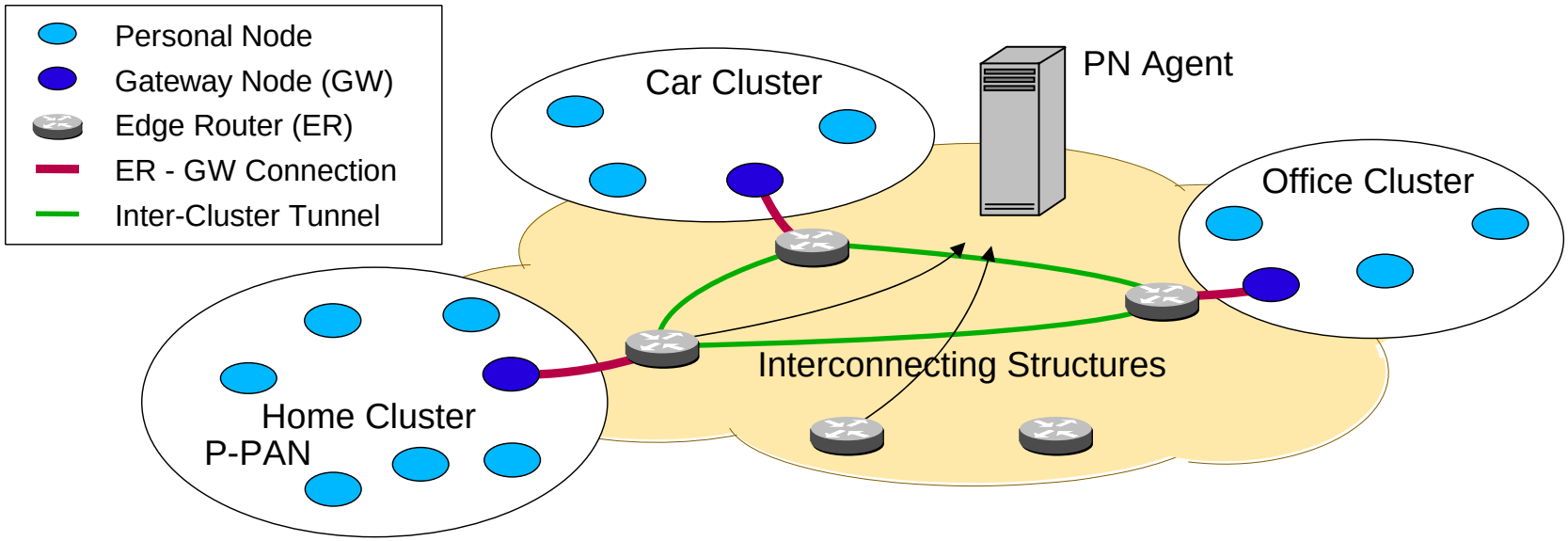
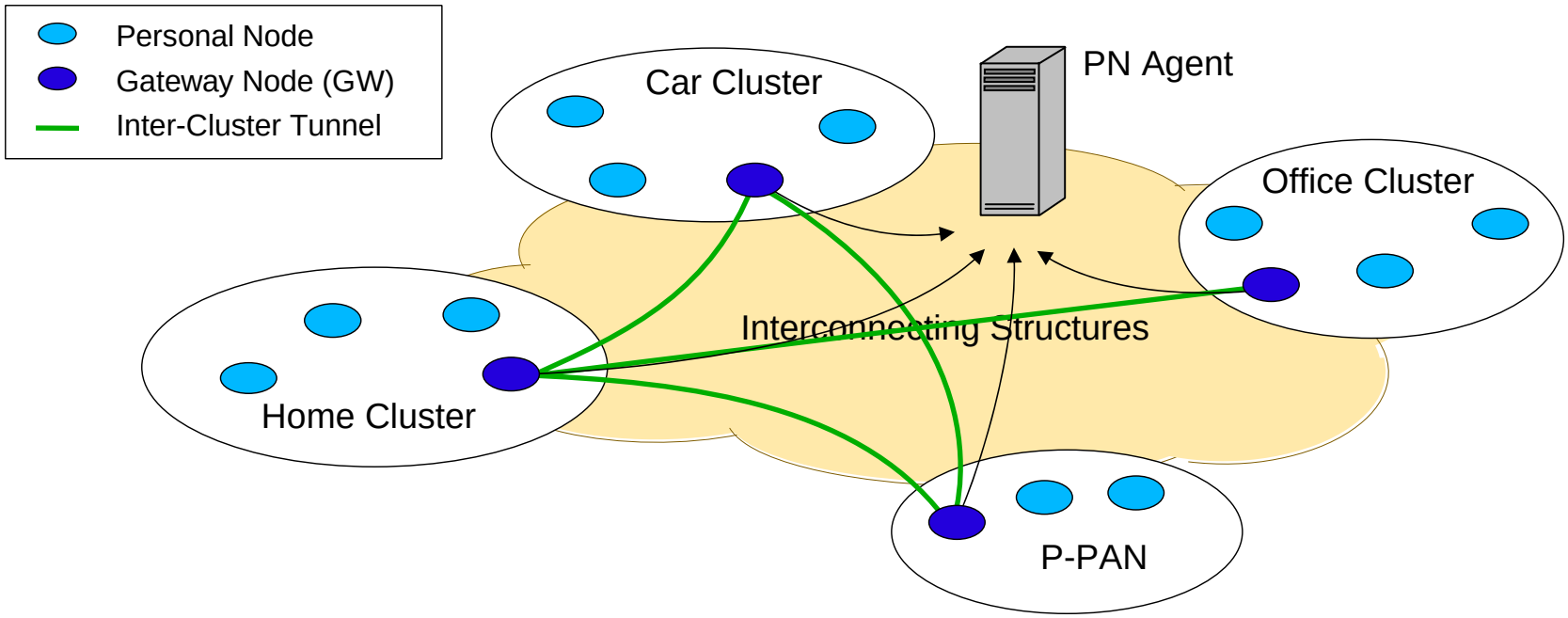


The Edge Routers-less Scenario

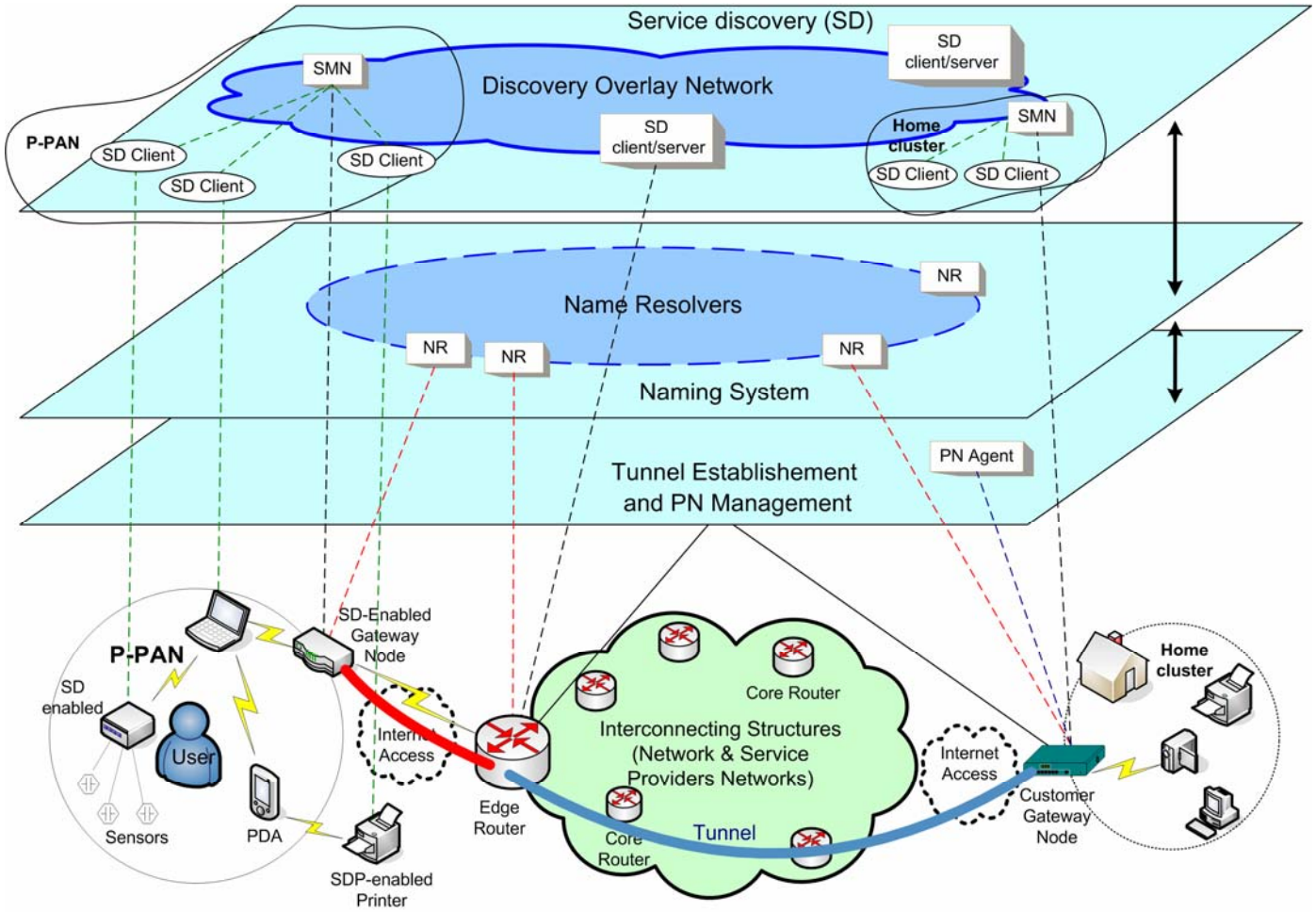


Intra-PN Routing and Addressing

- PN is a multi-hop ad hoc network where the tunnels are links.

- Two proposals:
  - Proactive ad hoc routing with flat addressing
    - No address structure
    - Addresses are automatically assigned when a Node is included in the PN
    - Each Gateway Node, Edge Router or the PN Agent know which Cluster a certain Node is in. I.e. it has a list of all Nodes
  - Reactive ad hoc routing with Cluster-based addressing
    - Each Cluster has a unique address prefix (unique within the PN)
    - When Cluster splits and merges, Node addresses must be updated
    - Each Gateway Node, Edge Router or the PN Agent only needs to know which Cluster has which prefix. I.e. it only needs a list of all Clusters

General Network Architecture



Service Discovery in Personal Networks

- Five tiers:
  1. The same Radio Domain (e.g. Bluetooth SDP)
  2. Within the Cluster (only Personal Nodes)
  3. In the close vicinity (also Foreign Nodes)
  4. Within the whole Personal Network (only Personal Nodes)
  5. The rest

- Service Discovery Management Node (SMN)
  - Each Cluster has an SMN
  - It manages tier 2 and 3 services
  - Interacts with other SMNs in other Clusters to facilitate service discovery between the Clusters.

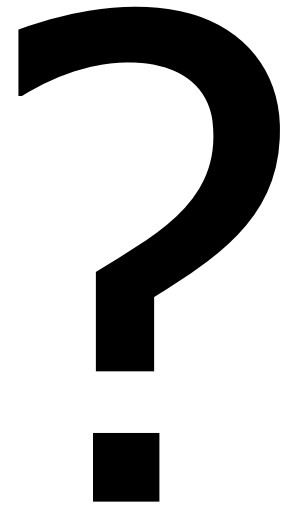
Naming in Personal Networks

- Naming of what:
  - Nodes/Devices
  - Clusters
  - Personal Networks
  - Services
- Name resolving
  - Within the Personal Network and within the Clusters
  - Between PNs to identify other PNs and their public services
- Synergies with Service Discovery is also being investigated

Conclusions and Future Work

- We have developed an architecture for Personal Networks and identified solutions to many of the issues
- IST-MAGNET is currently investigating all solutions mentioned here
- Several prototypes are being developed to learn more about each proposed solution and to compare them
- A closer look is needed on communication between different person's PNs. Sharing and borrowing of network devices and resources must be further studied.

Any Questions?



http://www.ist-magnet.org/