Architectural Solutions for Foreign Communication in Personal Networks

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Personal Networks (PN)

Personal Networks are all about user-centered wireless communication. Personal devices around a person form a small Personal Area Network (PAN), and will work in full cooperation with each other. We call this network a Private Personal Area Network (P-PAN). Personal devices in other places will form similar networks when direct wireless communication is possible. These networks are called 'Clusters' and facilitate local communication between personal devices. To facilitate remote communication between personal devices, tunnels are established over infrastructure networks to interconnect the Clusters and the P-PAN. This is what we call a *Personal Network* (PN).
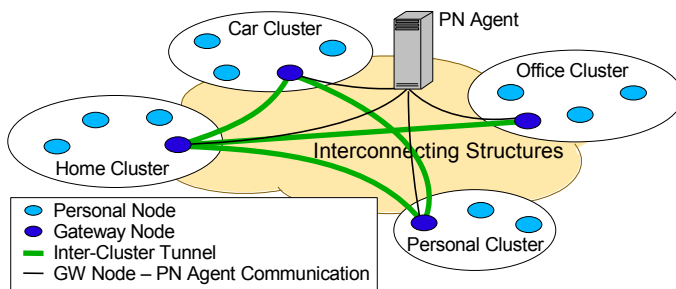

Figure 1: Inter-connected Clusters form a Personal Network

Gateway Node (GW): A Personal Node within a Cluster that enables connectivity with the outside world, either directly or via an infrastructure-based network. Clusters communicate with each other over tunnels created and maintained between GW Nodes.

The Three-Level PN Architecture

As shown in Figure 2, a PN is composed of three *abstraction levels*; the connectivity, the network and the service abstraction levels. The connectivity abstraction level consists of various wired and wireless link layer technologies and allow two nodes implementing the same radio technology to communicate. The network level divides the nodes into Personal and Foreign Nodes, based on trust relationships. Personal Nodes that are nearby and have a long term trust relation form a Cluster. The network level also contains tunnels among the Clusters. The highest level in this architecture is the service abstraction level and it consists of servers and applications. A service discovery protocol makes applications and servers find each other at this level.
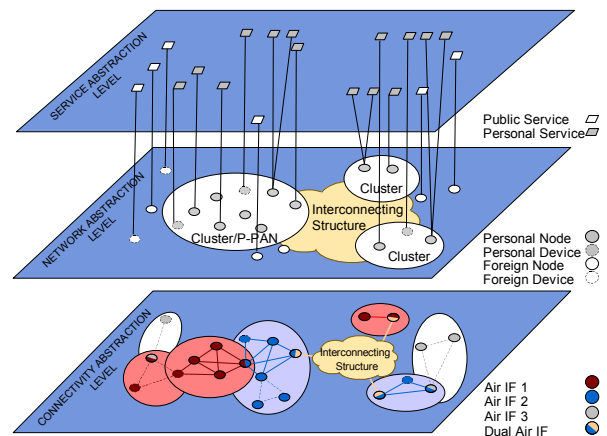

Figure 2: Three Level View of a Personal Network

Foreign Communication
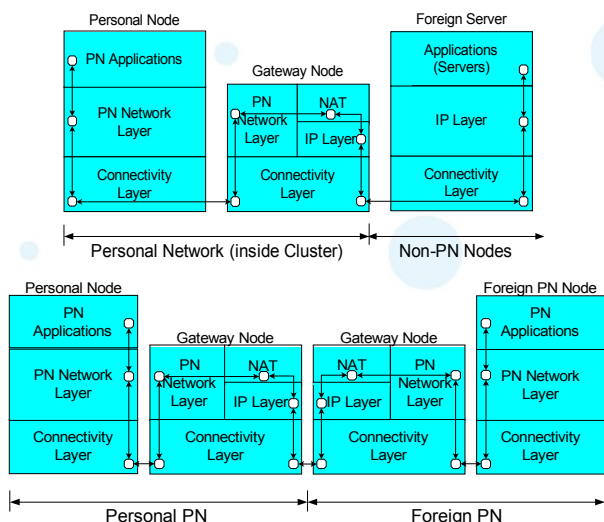
At the network level

Figure 3: Foreign Communication at the network level

Steps in connecting to a Foreign Node:
1. Find potential Foreign Nodes to communicate with.
2. Discover and select a 'proper' Gateway Node
3. Check the authenticity of the Foreign Node
4. Send packets via the selected Gateway Node (Source routing can be used within the Cluster)
5. The Gateway Node translates addresses between the PN and the outside world. It gives an illusion of a direct connection.

When accepting incoming connections, advertisements can be used.
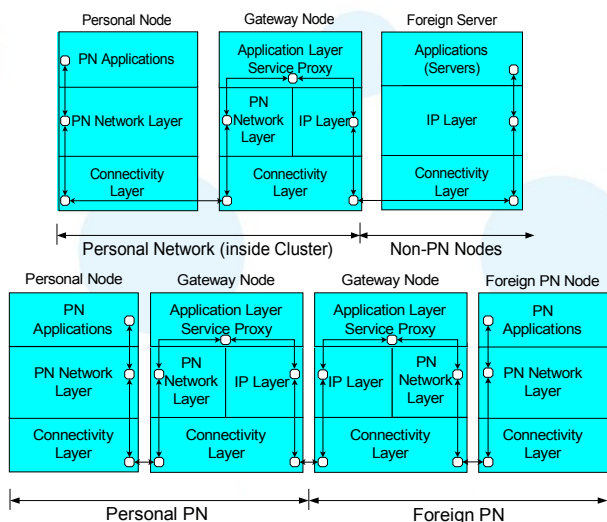
At the service level

Figure 4: Foreign Communication at the service level

Conclusions

Gateway Nodes connect the PN with the outside world and either work as network address translator at the network level or a service proxy at the service level:

- **Network level** provides end-to-end IP communication and makes use of only one (TCP) connection, which may provide better QoS.
- **Service level** provides a finer granularity access control since higher layer information can be used.

The two solutions can of course work together or in parallel.

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