

Architectures for Intra-Personal Network Communication

R.V. Prasad, Martin Jacobsson, Sonia Heemstra de Groot, Anthony Lo, Ignas Niemegeers

Personal Networks

Personal Networks is about user-centred 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).

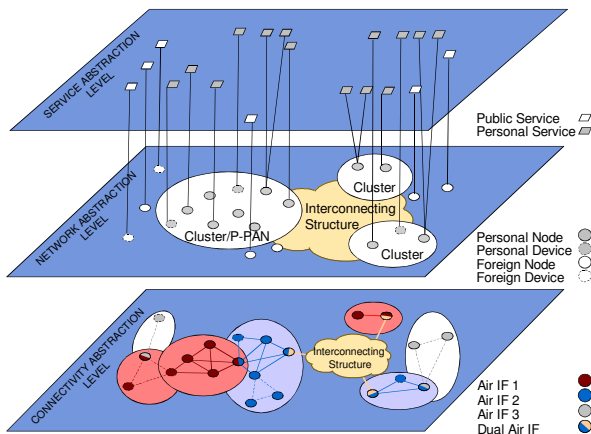


Figure 1: Three Level View of a Personal Network

Personal Networks Architecture

As shown in Figure 1, 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 common trust relation form a 'Cluster'. Clusters can communicate with other Clusters via the infrastructure. Figure 2 – 4 show how tunnels can be created to interconnect the Clusters. The highest level in this architecture is the service abstraction level.

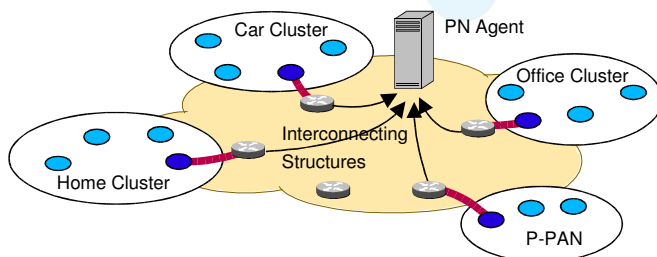
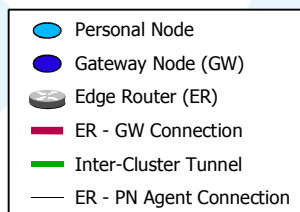


Figure 2: Cluster Registration through Edge Routers

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.

PN Agent: An infrastructure-based management framework that knows the locations of all Clusters in a PN. The PN Agent helps the Clusters to locate each other and establish inter-Cluster tunnels.



The Edge Router (ER)

Edge Routers (ER) are endpoints in the fixed infrastructure network that communicate with the GW Nodes and support them by offering some PN functionality. Figure 3 shows a PN making use of Edge Routers. Edge Routers can offer the following benefits:

- **ERs offload personal nodes:** They communicate with the PN Agent and take care of the tunnel establishment and management. This will offload some heavy tasks from the mobile nodes. They can also offload other higher level tasks, such as service discovery and name resolving.
- **ERs are more powerful:** Since ERs are fixed nodes, they are more powerful than any mobile Personal Node. This can speed up the setup and maintenance of PNs.

An Edge Router-less Architecture

The ERs are infrastructure entities that are to be explicitly designed for PNs. They possess the following drawbacks:

- **ERs share PN functionality:** That is to say that ERs are special servers that are in the infrastructure but do special tasks for PN.
- **ERs are hard to deploy:** Since ERs are routers with PN functionality, deployment of new devices into the infrastructure is needed before the benefit of ERs can be utilized.
- **ERs need to be trusted:** Since, the tunnels are between ERs, security information needs to be shared with them. This may endanger the security of PNs, since the user must trust the ERs.
- **ERs do not reduce the complexity of the architecture:** ERs still need a fully equipped PN Agent and GW Nodes. The presence of ERs does not simplify the architecture.

Figure 4 shows an example of a PN without using Edge Routers. Here, the Gateway Nodes are the end-points of the tunnels. The Gateway Nodes and the PN Agent have to perform the tasks of the Edge Routers.

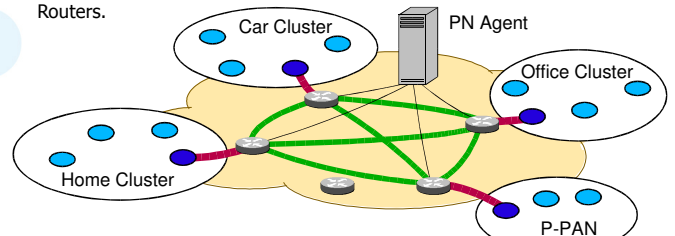


Figure 3: A Personal Network using Edge Routers

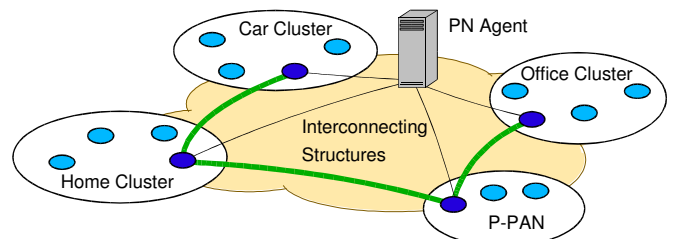


Figure 4: A Personal Network without Edge Routers

Conclusions

Three options for the architecture are possible with regards to the Edge Routers:

- **Mandatory use of Edge Routers**
- **Use Edge Routers when available**
- **No Edge Routers at all**

We propose an architecture without Edge Routers until the PN technology gain a wide-spread user base. At that time, Edge Routers can be considered.