



WWRF 21

Sustainability and the Future Internet

**Manageable Bubbles of the Future Internet:
Personal Super Virtual Devices**

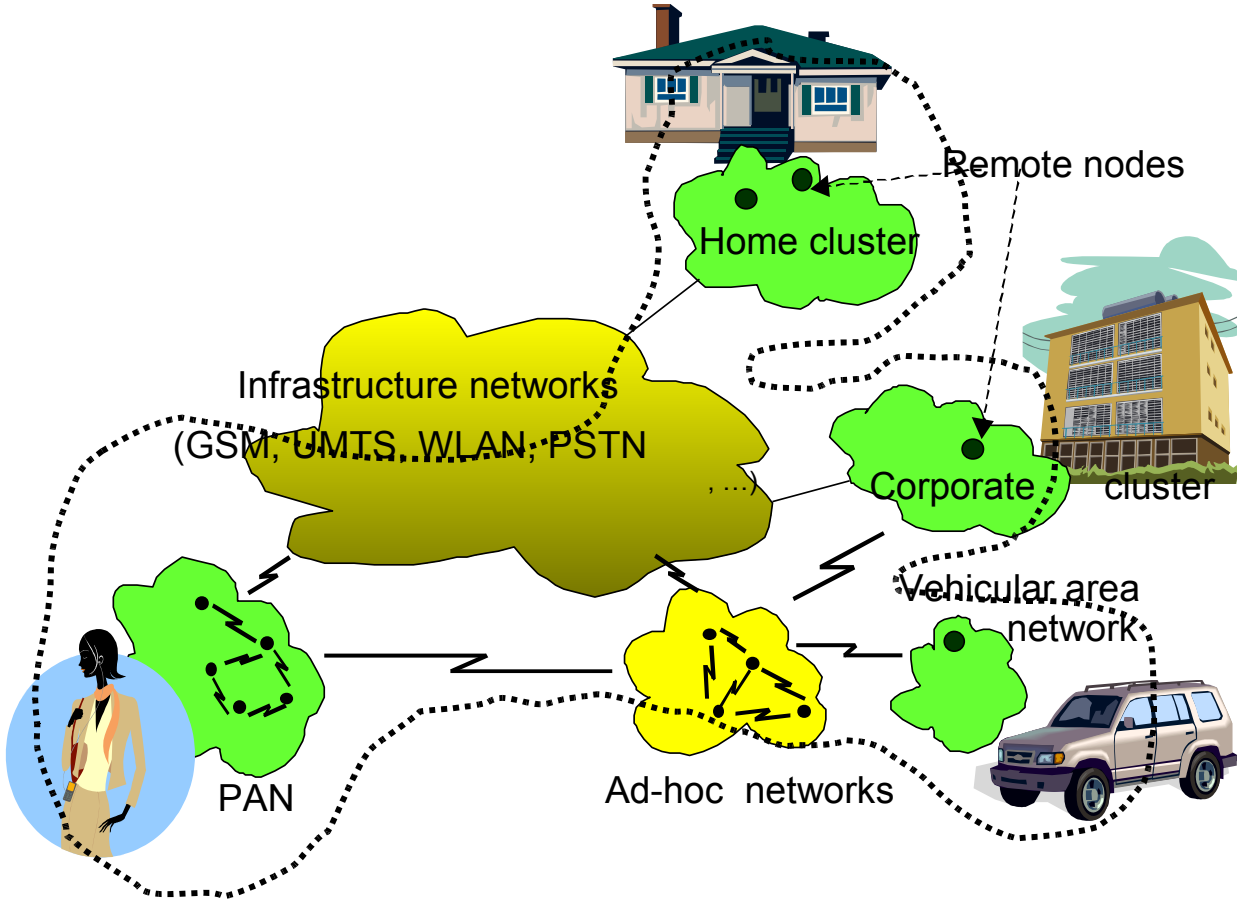
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Presentation Overview

- Personal Networks
- Personal Network Federationss
- Virtualisation Layer
- Research Issues
- Conclusions

Personal Networks (PN)



Personal network (PN)

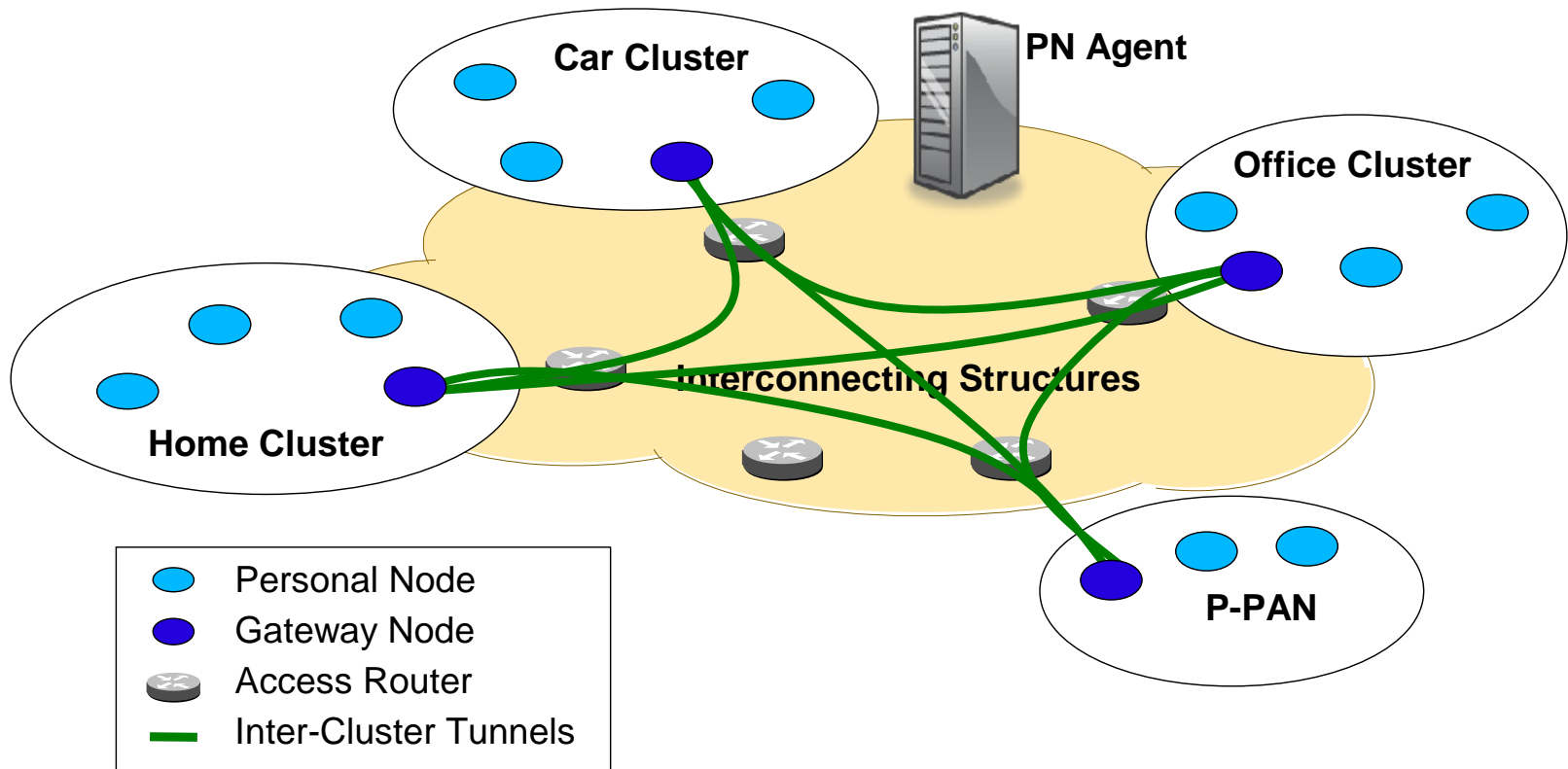
Example Applications for Personal Networks:

- Remote access to personal data whenever and wherever the data is located (e.g., mp3, movies, documents, etc)
- Automatic backup/replication of personal data in multiple locations, including “in the cloud” (e.g., agenda, newly taken photos, etc)
- Access to remote sensors and actuators, such as webcams, home appliances, home automation, etc
- The usage and sharing of services with other PNs as well as non-PN devices

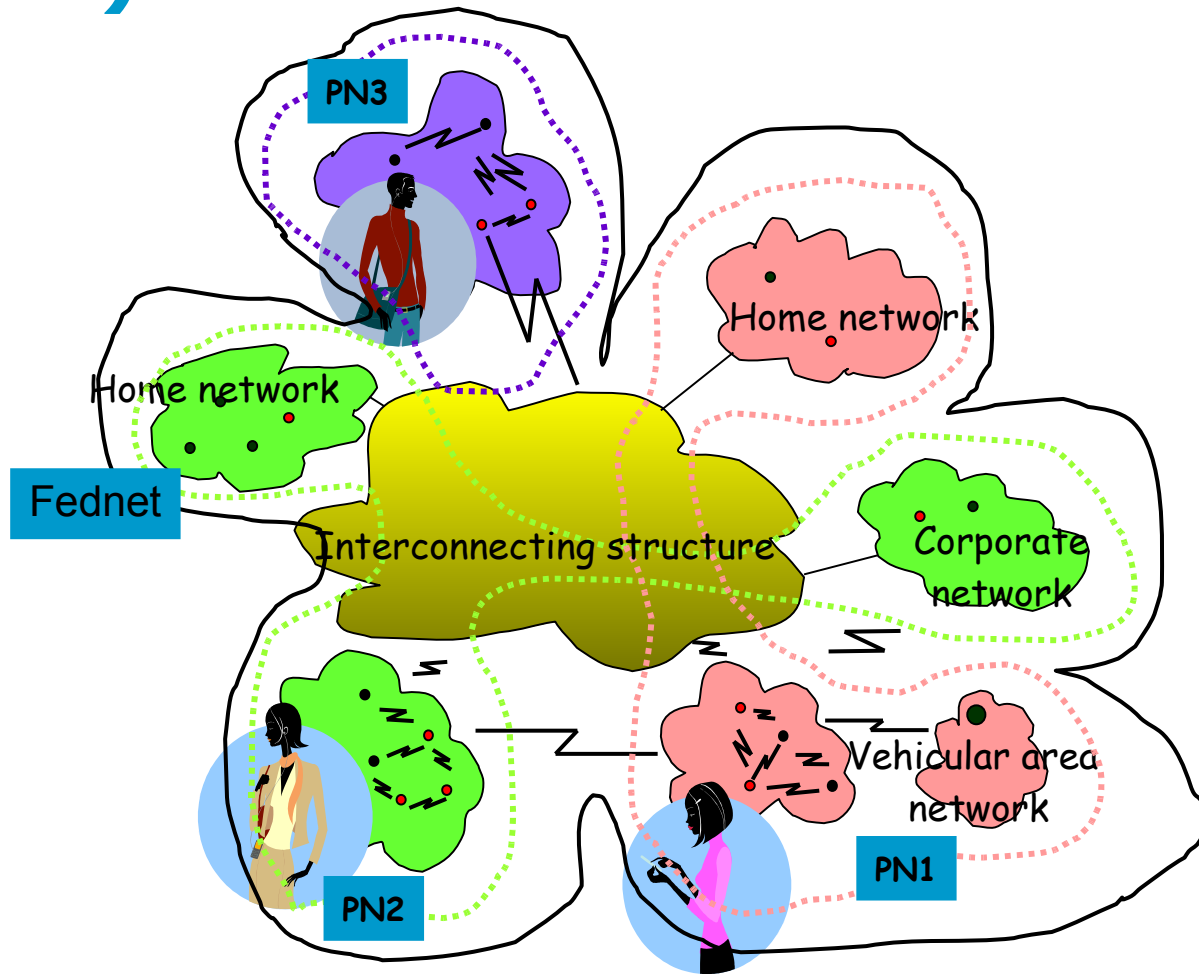
Personal Networks offer:

- Ubiquitous communication among personal devices and beyond
- Automatic configuration and seamlessness
- Self-organization and transparent mobility handling
- Secure communication with privacy protection
- Discovery, provisioning, and access control of services
- Secure context management
- Personal content management
- Low cost solutions and easy deployment

The Architecture of a Personal Network



Federations of Personal Networks (Fednet)



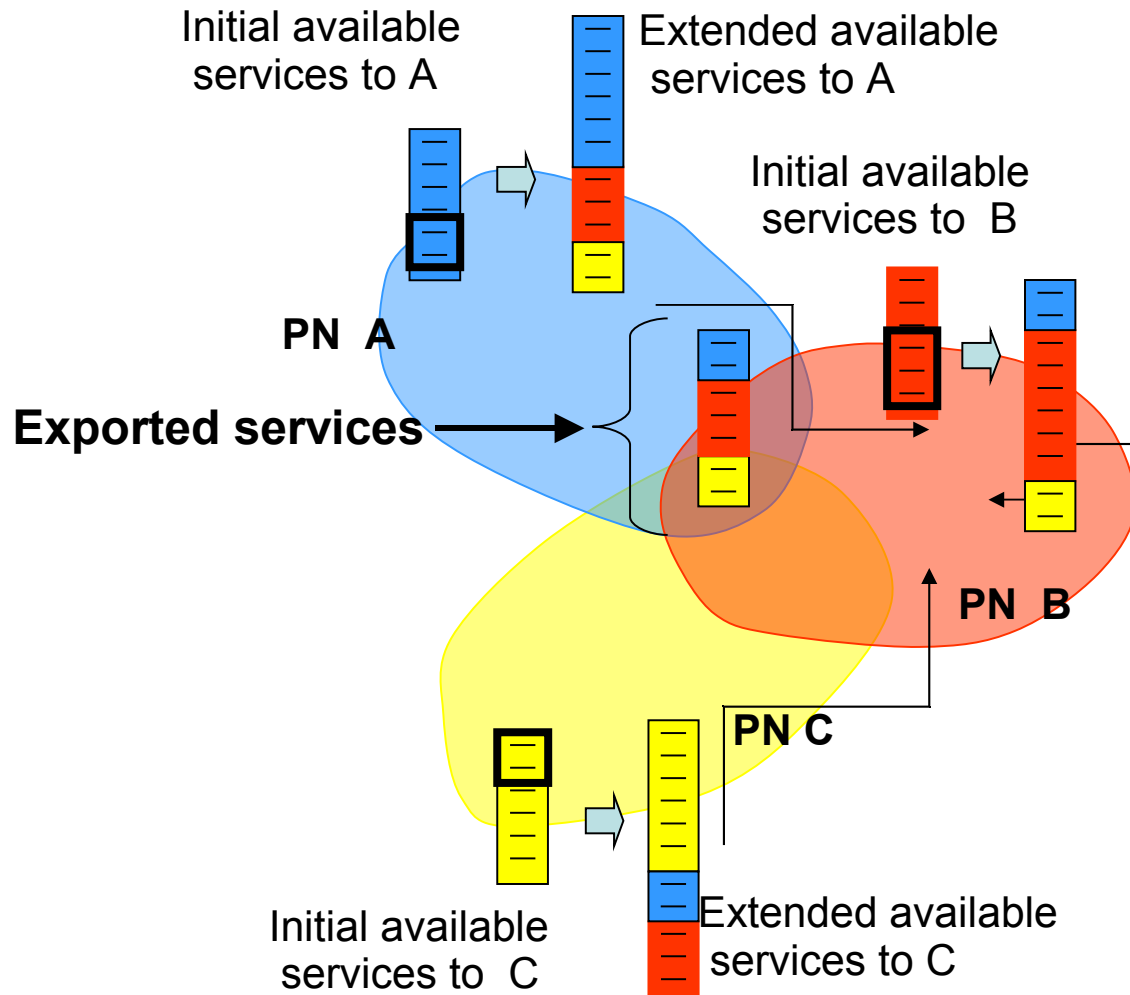
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Fednets

- Fednets = cooperation of a set of PNs under mutually agreed rules
- Extension of the basic PN functionality: allowing each other access to selected services
- Driven by purpose or by opportunity
 - Ad-hoc group centric system
 - For achieving a specific goal
- Fednets offer:
 - Exporting personal services to other parties
 - Group-based service composition
 - Enhancing individual capabilities
 - Extension to hierarchies

Sharing of Services in a Fednet



Personal Network (Federation) Research and Standardization

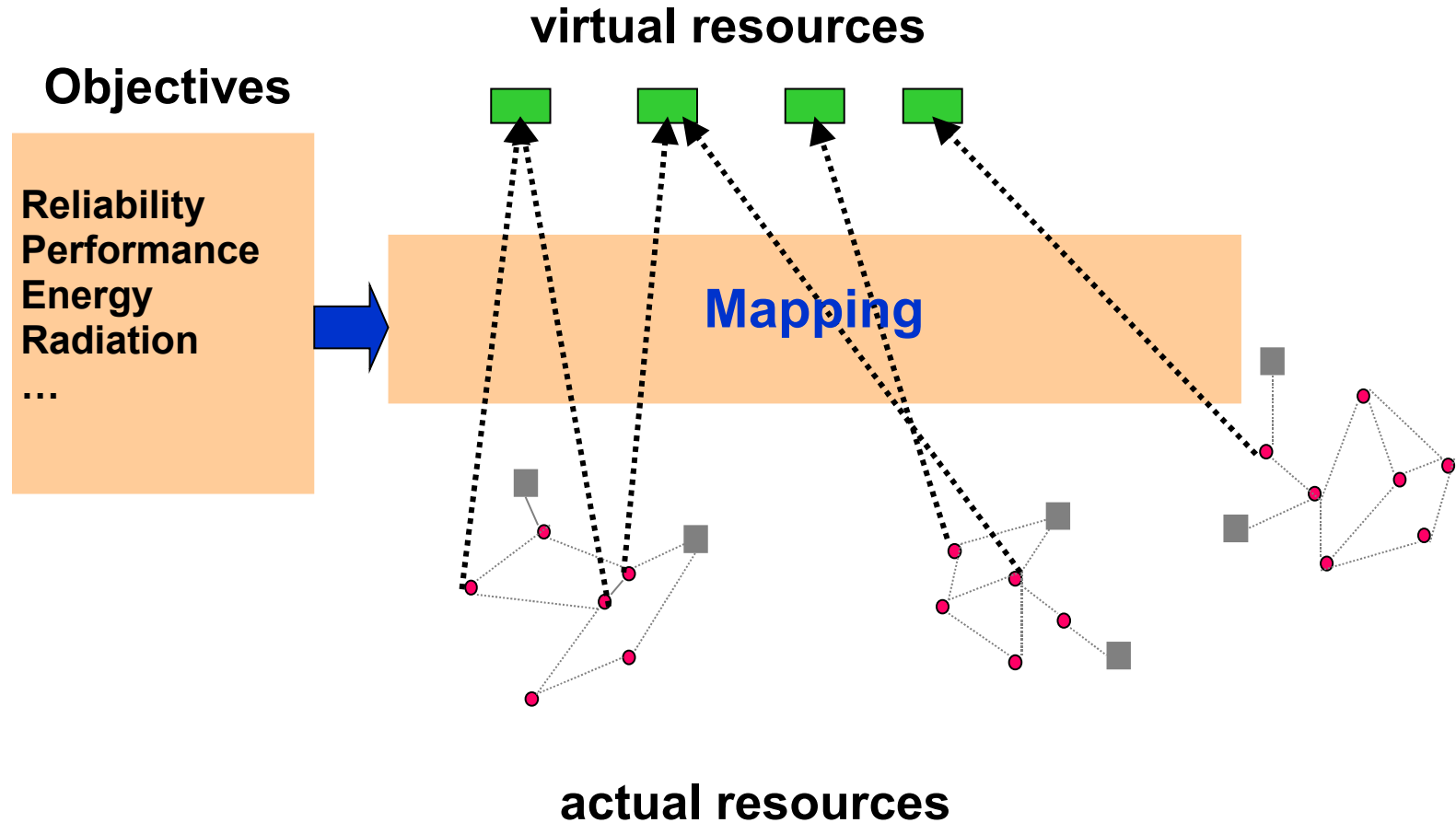
- IST MAGNET and MAGNET Beyond (FP6)
Nokia, NEC, Philips (NXP), Alcatel, France Telecom, TeliaSonera, Telefonica, VTT, CSEM, TI-WMC, CEA-LETI, TU Delft, and many other European universities
- Freeband PNP2008 (Dutch)
Philips, KPN, TNO, TI-WMC, Universiteit Twente, TU Delft
- Current Standardization Efforts:
 - Ecma International (TC32)
 - OMA
 - ETSI e-health

Virtualisation Layer: Virtual Device

- 1000 wireless devices per person*
- How can a single person manage that?
- Create the illusion that it is one virtual device consisting of many physical devices/PNs/Fednets:
Virtual Device
- Distribute virtual storage, computation, and other resources over the physical devices.
- A sort of “Mobile Self-Organizing Cloud” for a person

* Nigel Jefferies, “Global Vision for a Wireless World”, Wireless World Research Forum, 18th WWRF meeting, Helsinki, Finland, June 2007.

Virtualisation Layer (VL)



Virtualisation Layer = Middleware?

- Virtualisation Layer (VL) Needs to Build on:
 - Wireless and mobile networking (self-organized networking)
 - Service-oriented architectures (service discovery/provisioning/ etc)
 - Context management frameworks (context information collection/distribution/processing)
- Provide Support for the Applications and Services:
 - Well-defined and portable API
 - Hide maintenance and administration from application, services, and ultimately the users
 - Use knowledge intelligently to enhance the application and service operation and thereby the user experience

Research Issues

- Heterogeneity and Mobility of Devices
 - Sensor motes up to server farms
 - Battery powered vs. mains powered
 - IEEE 802.15.4 up to LTE Beyond
 - Dynamic network topologies
 - Poor or intermittent connectivity
- Security and Privacy
 - Usable access control
 - Automatic intrusion detection and prevention

Research Issues

- Dependability
 - Availability, reliability, safety, security
 - Video conferencing
 - Medical applications
 - Disaster-relief
 - VL may manage routing paths and used resources
- Energy Efficiency
 - Minimize power consumption and radio radiation
 - 1000 devices / person
 - VL may manage available resources, including available radios, CPUs, storage, etc.

Example: Storage

- Heterogeneous Resources
 - Storage capacity and speed varies
 - Intermittent connectivity or poor/expensive links
 - CPU required for de- and encryption
- Application Requirements
 - Guarantee file access when needed
 - Avoid loss of data when devices are lost or fail
 - Store privacy sensitive information safely
 - File sizes and storage requirements differ:
 - Movies
 - Bank transaction information

Conclusions

- Future networks will be characterized by a huge number of privately owned networks of all kinds and sizes
- Most of them ad-hoc, temporary, very heterogeneous, dynamic and beyond the management of professional organizations
- Need technologies to create order in the chaos
- PN technology is an example of such technologies and can be extended
- The virtual device and virtualisation layer can provide manageability and intelligence to applications and their users.
- Need for application-support research.

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