
Experimental Infrastructure Discussion Notes

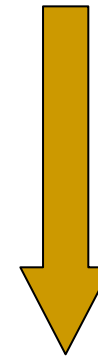
Break-out Session IV

Wireless Technologies

What wireless technologies apply to the GENI network, and which emerging radios should we try to incorporate?

- Sensor radios (Zigbee, Mote)
 - Low power, low bit-rate, limited mobility
- 802.11x
 - Local-area, high-speed, low mobility
- 3G,4G
 - Wide-area, medium speed, high mobility

- WiMax, MIMO
 - Wide-area coverage, high-speed, low mobility
- Cognitive radio
 - Flexibility, spectrum efficiency, optimized performance
- UWB
 - Short range, high speed, limited mobility



*available radios,
possibly requiring
open-API work*

*Emerging technologies
requiring R&D and platform
development work*

Radio design considerations

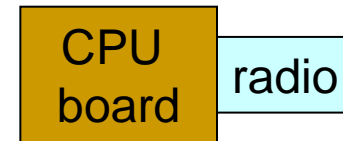
- Modular – radios can be plugged into platforms as new technologies emerge
 - Open-interfaces (low level API) for flexible experiments - needs incremental engineering effort for each radio in GENI
 - New cognitive/radio radio technologies for innovative capabilities
 - Spectrum allocation is a critical need
 - [Request to NTIA/FCC](#)
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Platforms

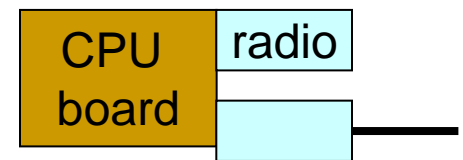
What wireless network platforms are available now and which ones are suitable for GENI network?

- Clients/Sensor
- Radio APs, BTSs
 - Modular, Open, Virtualizable
- Radio routers/Forwarding nodes
- Measurement equipment
- Sensor Gateway
- Programmable radios
- Leverage NSF testbeds

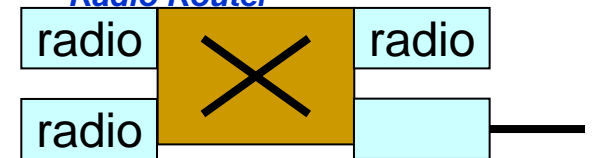
Client/sensor platform



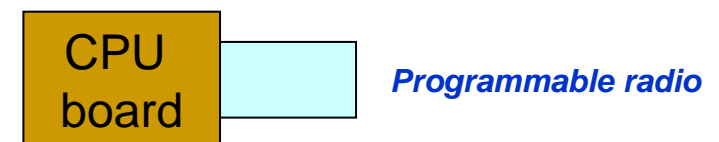
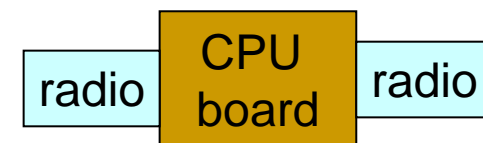
Radio AP



Radio Router



Sensor Gateway



Flexibility & Programmability

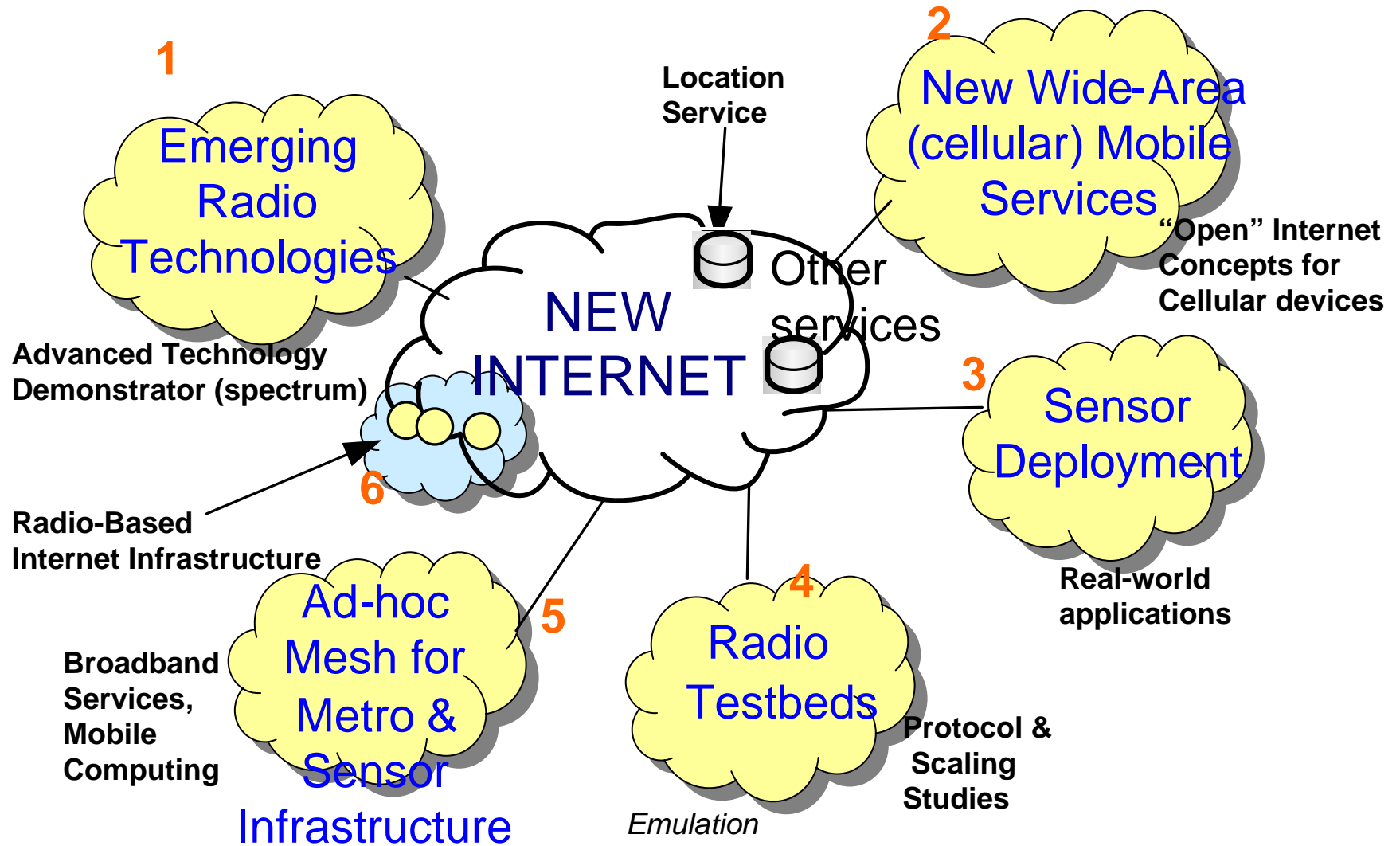
How is flexibility and programmability implemented in the wireless portion of The GENI infrastructure? How would it work with wired network virtualization?

- Tools, design flow needed as long-term
 - Linux platforms
 - Spectrum co-ordination
 - Measure, quantify, allocate
 - Needs infrastructure to support
 - Control/Monitoring framework
 - Virtualization possible at AP, BTS, not at sensors
 - Redundant approach to virtualization possible
 - Production wireless network difficult to virtualize
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Flexibility & Programmability Contd.

- PlanetLab Virtualization Model
 - Slices
 - Control management
 - Coordination between wired and wireless testbeds
 - PlanetLab, ORBIT, Emulab, sensor networks
 - Design of single unified control plane
 - Forums for design of new end-to-end protocols
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Concepts for Wireless Experiments



Summary Recommendations

- Incorporate existing radio technologies taking care to ensure open API devices to foster software innovation
 - In parallel, support advanced technology demonstrator incorporating cognitive radio technologies
 - Incorporate open 3G/4G cellular and/or WiMax radio for wide-area experiments, in addition to 802.11 radios, etc.
 - Request FCC for dedicated spectrum for GENI
 - Need for RF measurement infrastructure to support evaluation of wireless testbeds
 - Develop virtualizable radio platforms including sensors, 802.11 nodes, 3G mobile nodes, forwarding node, sensor gateway and radio router (...future: programmable radios)
 - Provide client (sensor, mobile) development kits in addition to infrastructure networks
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Summary Recommendations

- Support both emulation and real-world experiments, reaching out to both scientific and end-user communities
 - Integrate and expand existing NSF wireless testbeds (ORBIT, Emulab, Whynet, EmNet,..) for protocol research objectives
 - Additional infrastructure for regional deployment of new applications of sensors, mobile computing, etc.
 - Design virtualization methods for wireless network platforms
 - Harmonize virtualization concepts between wired network and unify control and management architecture
 - Set up processes for harmonizing testbed management across various domains (wired, mobile, sensor, etc.)
 - NSF-sponsored committee for discussion of unified end-to-end protocol designs?
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