Mobile Network Architecture & Protocols

WINLAB IAB Meeting
October 29-30, 2001

I. Seskar, D. Raychaudhuri
MobNets: Introduction

This project aims to explore the fundamentals of next-generation mobile network architectures and protocols, looking beyond the issues addressed by today’s mobile IP, WLAN and 3G solutions.

Problem:
• Standardization process is too long for today’s fast-paced technological innovations
• Solution needs ability to evolve the protocol to meet future needs while minimizing standards complexity
• Need for customization
MobNets: **Multimode Networks**

Emerging Multimode Networks

Multiple devices with multitude of interfaces

Techniques for seamless service:
- Authentication, global roaming
- Security issues
- Dynamic handoff
- End-to-end QoS control
- Network management
- Service level agreements (SLA)
MobNets: Protocol Design Scenarios

1. Compatible upgrades to WLAN protocols for service features such as flow QoS and multicasting;
2. Interworking of multiple radio link technologies such as Bluetooth, 802.11, GPRS and 3G/WCDMA;
3. Data caching in the network in context of mobile Infostations type services;
4. Content delivery techniques for mobile users, including those based on variations of IP multicast and new semantic routing techniques. [This project involves collaboration with Semandex Networks, a NJ-based startup that has developed an XML content router product.]
MobNets: Dynamic Protocol Upgrades

• Already exists in application layer protocols and middleware components as pluggable modules (WEB browser plug-ins, VoIP applications etc.) and is slowly moving into lower layers.

• What is needed is a framework that provides a uniform set of APIs and methods used to select, download, configure, and monitor each protocol layer.

In addition, successful solution has to:
- be applicable to endpoint devices as well as routers.
- provide security and fault-recovery
- deal with legacy devices
- be flexible
MobNets: Dynamic Protocol Upgrades (cont)

Assumptions:
- Well defined interfaces at every layer
- Exposed data structures and parameters supporting methods and algorithms
- Modular approach
- IP as a base for control connectivity
- Controller that ensures transfer, module correctness and integration into the stack
MobNets: Interworking

Peer-level collaboration of network entities supporting global roaming, handoff, etc

802.11

- vCard/vCal
- WAE
- WAP
- FTP
- HTTP
- UDP/TCP
- IP
- 802.2 LLC
- 802.11 MAC
- DSSS
- FHSS
- INFRARED

---

Bluetooth

- vCard/vCal
- WAE
- OBEX
- WAP
- AT Comm.
- TCS BIN
- SDP
- UDP/TCP
- IP
- PPP
- RFCOMM
- L2CAP
- HC Interface
- LMP
- Baseband
- Bluetooth Radio
- AUDIO

↔ = Context transfer
MobNets: Infostation Caching

- Opportunistic caching in Infostation environment:
  - Content caches in the Infostatons
  - Increased multicasting of popular content

![Diagram showing Infostation caching system]
MobNets: Content Routing

- Emerging content-routing techniques will facilitate real-time, location-aware information delivery in a scalable way (collaboration with Semandex Networks) ...

Source: Dan Reininger, Semandex Networks
MobNets: Approach

Open architecture network in mobile context tasks:

- Identify radio and mobility related parameters
- Design open APIs
- Develop dynamic downloading of service module software for “all” network levels (assumption is that the system is TCP/IP based)
- Address legacy support issues
- Develop support for incremental service deployment
- Develop service description concept
- Develop conflict resolution mechanisms
MobNets: Experimental Testbed

Purpose:
- Evaluate different approaches in terms of protocol functionality
- Evaluate software performance
- Enable rapid prototyping
- Implement open architecture network on a generic hardware platform
- Provide support for legacy device integration
MobNets: Testbed node

Each node has 3 general purpose PCs:
- 1U form factor
- Single or dual CPU configuration with up to 1 GB of memory
- Quad 100 Mb/s Ethernet

Node can be used as:
- Router
- Server/Cache
- Access point
- Or combination of the three
MobNets: Software platform

Main SW features:

• Open Linux OS
• By using packet filters minimizes driver development
• Multiple independent developers each with separate protocol stack
• Uses existing TCP/IP stack for control only
• Java based
Benefits of using Java:

• Code portability
• Huge existing code base
• Existing security/authentication model
• Support for pluggable entities
• Support for important concepts
  (runtime loading, concurrency, CORBA, RMI etc.)
• Support for XML based protocols

Drawbacks:

• Performance hit
• Re-implementation of TCP/IP
MobNets: Status

• The project is in its initial phase with the following sub-projects currently underway:
  - Architectural design and network testbed establishment.
  - Generic API for 802.11b and Bluetooth access points development
  - 802.11/Bluetooth interworking development
  - User space TCP/IP protocol development