Ubiquitous Wireless Interworking (UWIN)

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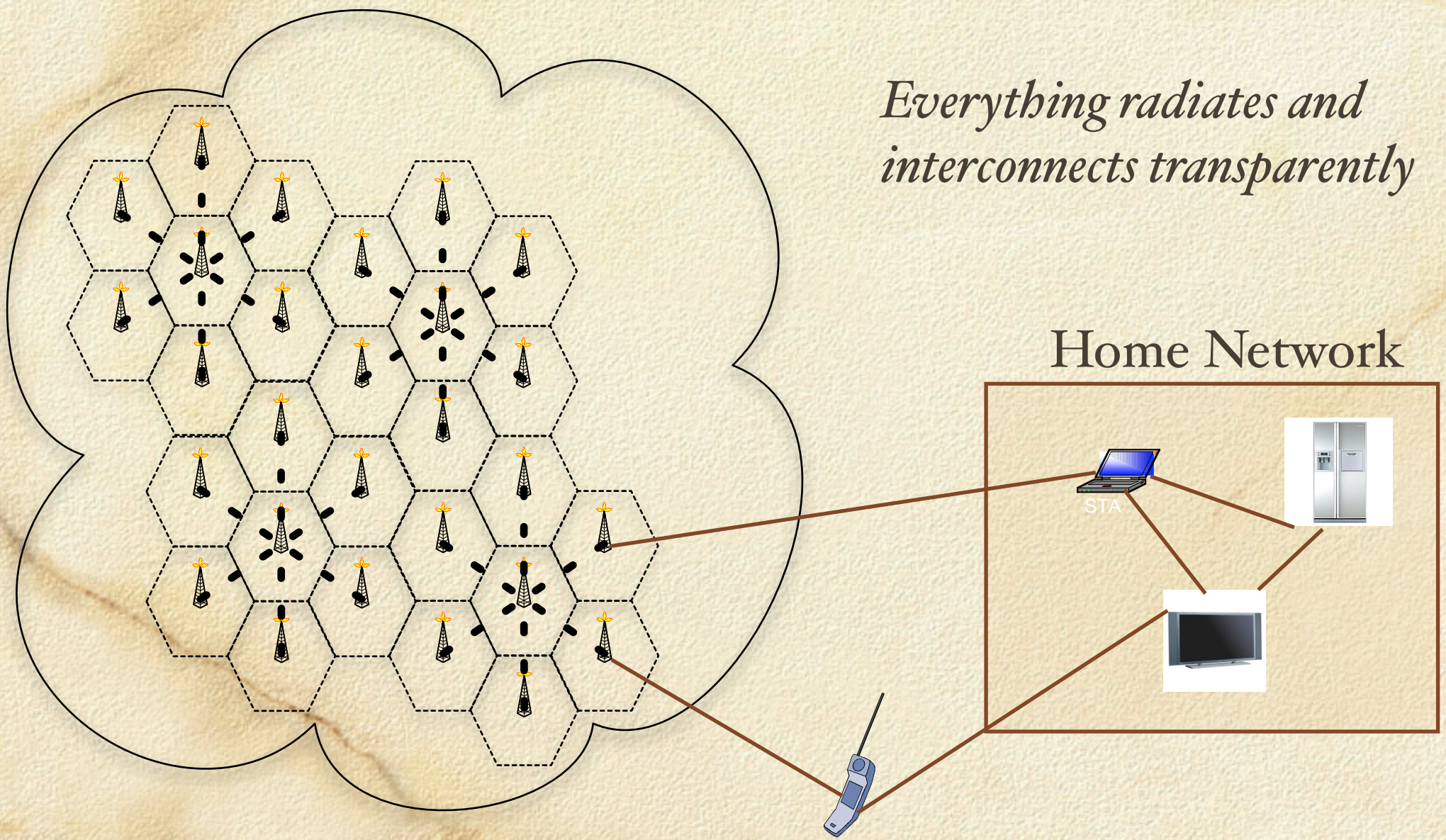
Vision of Future

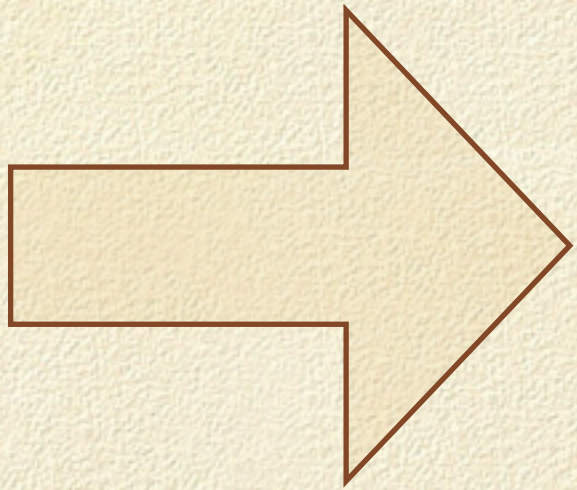
Everything radiates and interconnects transparently



Business and Technical Trends

Security and Network Challenges

Network ubiquity ↑
User mobility ↑
Base-station mobility ↑
Cost ↓
Service Extensibility ↑
Coverage on-demand ↑
Peer-to-peer ↑
Active content ↑
Software defined radio ↑
Multi-data Multi-managers (MDMM) ↑



Security Perimeter no longer exits and devices MUST protect and configure themselves

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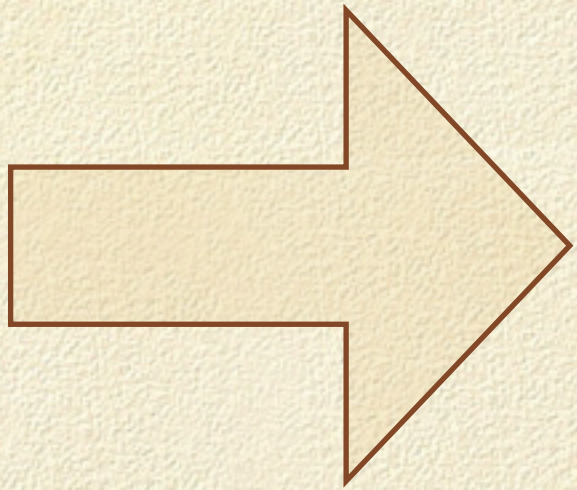
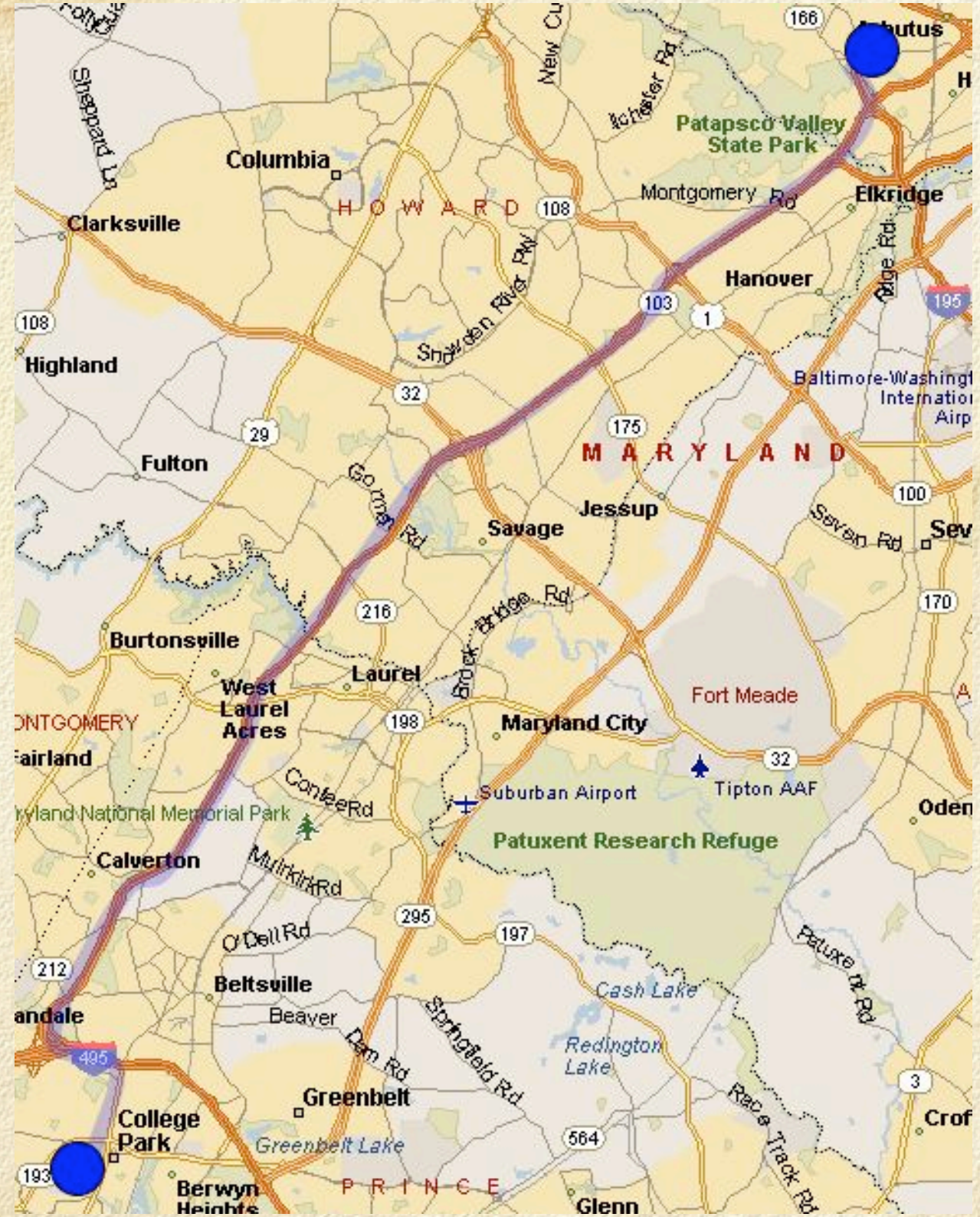


Security and management MUST be handled concurrently

UWIN Test-Bed

- Design and Deploy a real world next generation cellular system- initially on campus and then extended to a major Interstate
- Adaptability of test-bed is key feature

Approximately 21 miles



Why?

- Many problems will remain unknown until a realistic test is performed, *i.e. Probe-Wait time was never known to be a problem until our WLAN research.*
- Results from a realistic test-bed are an extremely powerful supporting statement for new ideas.
- Other wireless test-beds are focused solely on ad-hoc networking, or are operationally (i.e. no research planned) focused.
- Enables experimentation with new applications

Technical Road-map

Research Questions

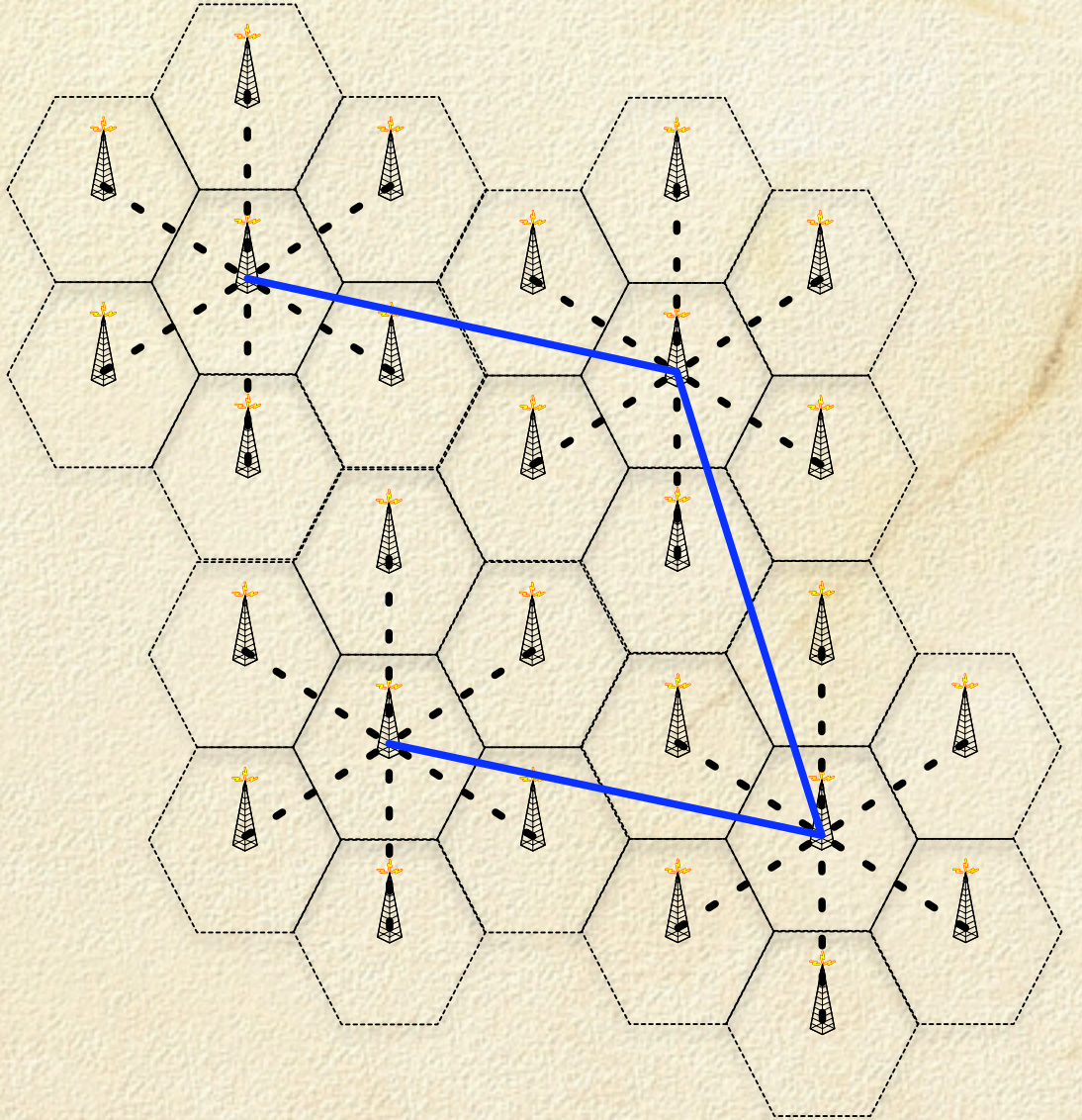
- How to enable secure Interworking?
  - User roaming
  - Dynamic ad-hoc and mesh extensions
  - Device initialization
- How to deploy and manage the next generation wireless infrastructure?
  - Must lower costs for service providers throughout the life-cycle (install, operate, and maintain).
  - Dynamic coverage expansion and reconstitution
  - What are the real-world limitations of star-cell?

Research Questions cont.

- Opportunity to "*think outside of the box*" with wireless networking/security!
- What new services are enabled, and old services improved?
- How are updates from the service provider verified, tested, and uploaded?

Star Cell

- Increase cell size via wireless extensions
  - Center cell interconnects with the distribution system (wired or wireless)
  - Dynamic topology
  - Self-configuration



Secure Device Self-Configuration

- ALL self-configuration protocols (UPnP, Rendezvous) require Layer 2 connectivity. This presumes that either:

  1. A Layer 2 security association already existed (pre-configuration), or

  2. No Layer 2 security is being utilized.

Secure Self-Configuration

- The algorithms and protocols that enable secure device configuration are generic and can be applied to:

  1. Next Generation cellular equipment, and

  2. Consumer electronics

Prototype Star-Cell

- Use what we've learned from current indoor test-bed
- Software defined radios from Aetheros (participant in test-bed)
  - Allows us to perform MAC experiments
  - Allows us to change frequencies supported
  - Allows us to change modulation method
- Linux (or LONGHORN based OS depending on MSFT involvement)
- Solar powered when required
- Self-configuring for ease in deployment

Instrumentation

- Extensive instrumentation to collect detailed data in real-time
- Data collection at different levels
  - Physical
  - MAC
  - IP
  - TCP
  - Application

Work-load Characterization

- Creating workload models at several levels
- Study basic usage
- Study patterns
- …

SIP-MIPv6 Interworking

- SIP = Session Initiation Protocol

  Provides a mechanism for call establishment and management (determine source address, add new streams, add new participants, transfer call…)

- The IP address in a SIP message from an MN must be the source address of the MN

SIP-MIPv6 cont.

- What address should an MN use for SIP communication
  - its home address or its care-of address?
    - Home address: Back to tunneling!
    - Care-of Address: Reinvite destination nodes upon changing Care-of Address?
- Solutions:
  - Is the SIP proxy an IPv6 node?
  - HMIPv6?

Additional Technologies Involved

- IPv6
- SIP based VoIP
- DIAMETER / AAA roaming and peerage protocols
- Ad-hoc routing

Timeline

Spring 2004	Star-Cell design
Summer 2004	13 start-cells on campus
Fall 2004	Experimentation
Winter 2005	Exp. continued
Spring 2005	Redesign of start-cell as needed
Summer 2005	Deploy along Interstate
Fall 2005	Experimentation

Funding and Participation

Participation

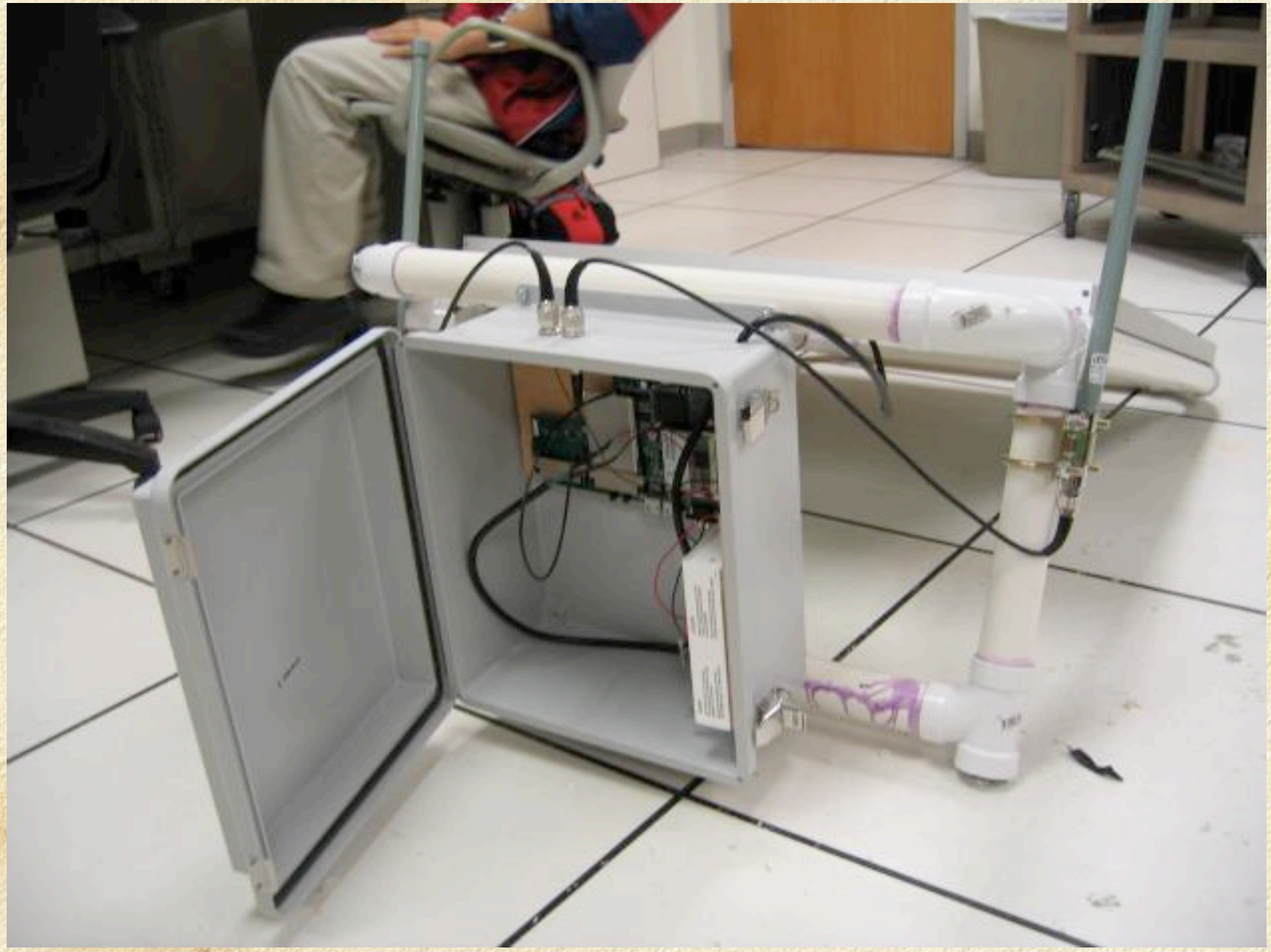
US Govt	X
Samsung	X
Microsoft	Negotiating
Verizon	?
DoCoMo	X
Atheros	Technical

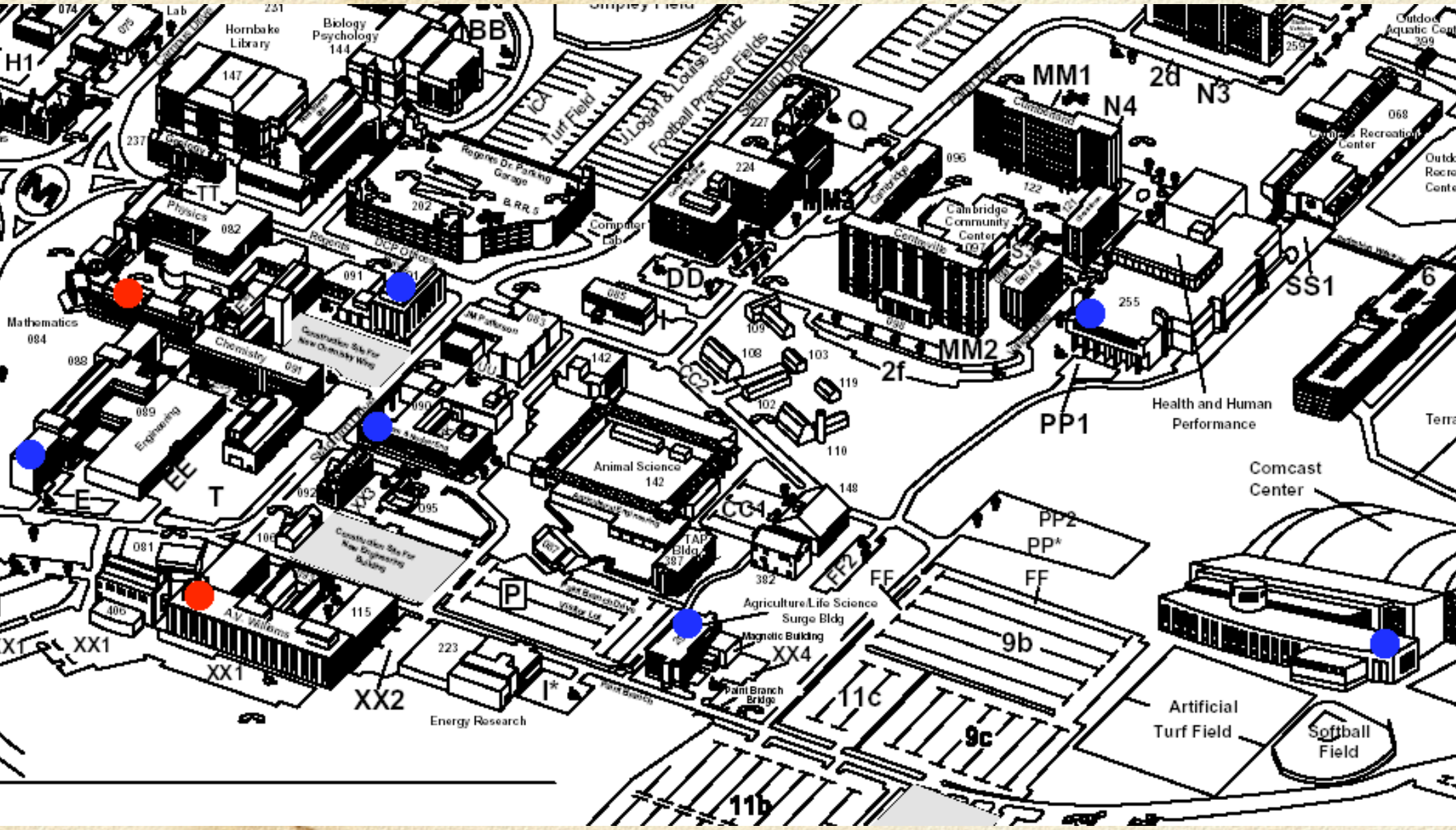
Status

Star-Node

- Designed and initial prototypes built and deployed (2 out of 12) on campus
- Currently collecting environmental telemetry and designing protocols
- Total cost per node is ~$1,000


NETGEAR




Hornbake Library
Biology Psychology
Turf Field
Football Practice Fields
J.Logan & Louise Schutz
Stadium Drive
Regents Dr. Parking Garage
Physics
Computer Lab
Cambridge Community Center
Health and Human Performance
Mathematics
Chemistry
Engineering
Animal Science
Agriculture/Life Science
Surge Bldg
Magnetic Building
Paint Branch Bridge
Energy Research
Comcast Center
Artificial Turf Field
Softball Field
Construction Site For New Chemistry Wing
Construction Site For New Engineering Building
A.V. Williams
Visitor Lot
Paint Branch
MM1
MM2
N4
N3
PP1
PP2
PP*
FF
9b
11c
9c
11b
XX1
XX2
XX4
2d
2f

Bureaucracy

- Beginning discussions with State Highway Administration
- Discussing Microsoft participation in two weeks at Microsoft invitation only “wireless summit” in Seattle. They have indicated desire to provide HW and SW.

The Beginning