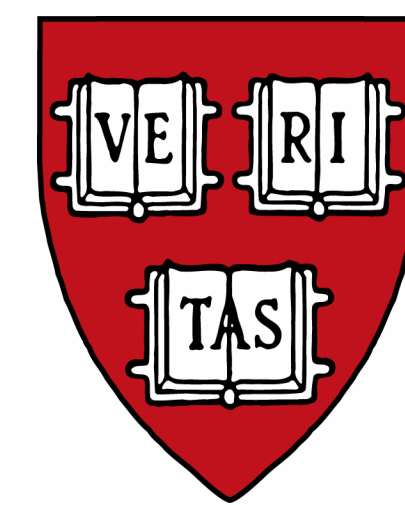


MoteLab: A Web-enabled Sensor Network Testbed



Geoff Werner-Allen and Matt Welsh

Harvard University

Sensor Net Testbed for the Masses

Web access to a permanently-deployed sensor net testbed

- User logs into Web page
- Uploads binaries and descriptions of message types to log
- User schedules job for open slot, with time limits
- Back-end reprograms nodes at the appropriate time

Automatically log messages from every node

- Create database tables for each run
- User supplies MIG-generated Java classes describing message formats
- Data logging, debugging, visualization

Access data in real-time or from archive after run

- Connect to live database to receive data in real time
- User can download complete dump of database tables after run

eMote - Ethernet-connected mote

Crossbow, Inc.



- All data sent to mote's serial port available on TCP port
- Another TCP port used for reprogramming with `uisp`
- Power-over-Ethernet possible

Next Steps

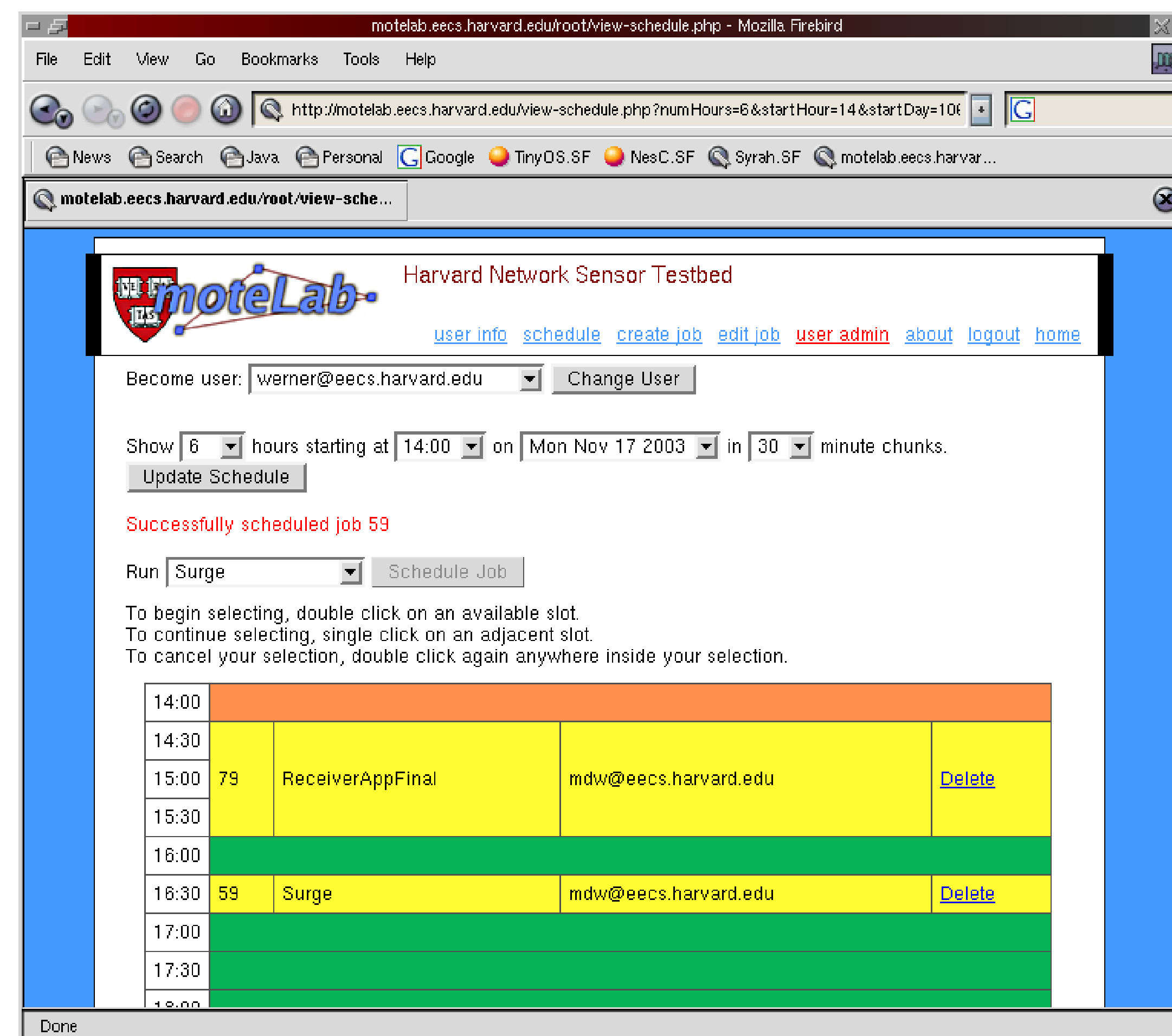
Integrate in-situ power monitoring

- Ethernet-connected digital multimeter attached to one eMote
- Capture high-resolution amperage traces
- Trigger trace based on mote I/O pins

Roll out to other research groups

- Intel Research Berkeley, MIT, UCLA, Crossbow
- Public CVS access available soon

<http://motelab.eecs.harvard.edu>



MoteLab Architecture

Web front-end implemented in Apache and PHP

- Clean mechanism for scripting access to job description database

Perl program for maintaining job schedules

- Check job schedule database periodically
- Reprogram nodes according to next job on schedule
- Launch database logger daemon

Java-based database logger daemon

- Creates database tables for each message type
- Based on inspection of MIG-generated classes provided by user
- Reads and parses messages read from each mote's serial port
- Log each received message to database

Harvard Student Projects

35 students captured RSSI traces in CS building

- Low correlation of distance and RSSI
- Node and antenna orientation, doors/walls, etc. more significant

Power-adaptive, secure multihop routing

- Basis for in-hospital vital sign monitoring project
- Tune transmit power of CC1000 to achieve optimal connectivity
- ECC-based key distribution scheme on top of TinySec

MoteTrack: RSSI-based localization scheme

- Use RSSI "signatures" to profile connectivity
- Able to track mobile node location to 2-3 m

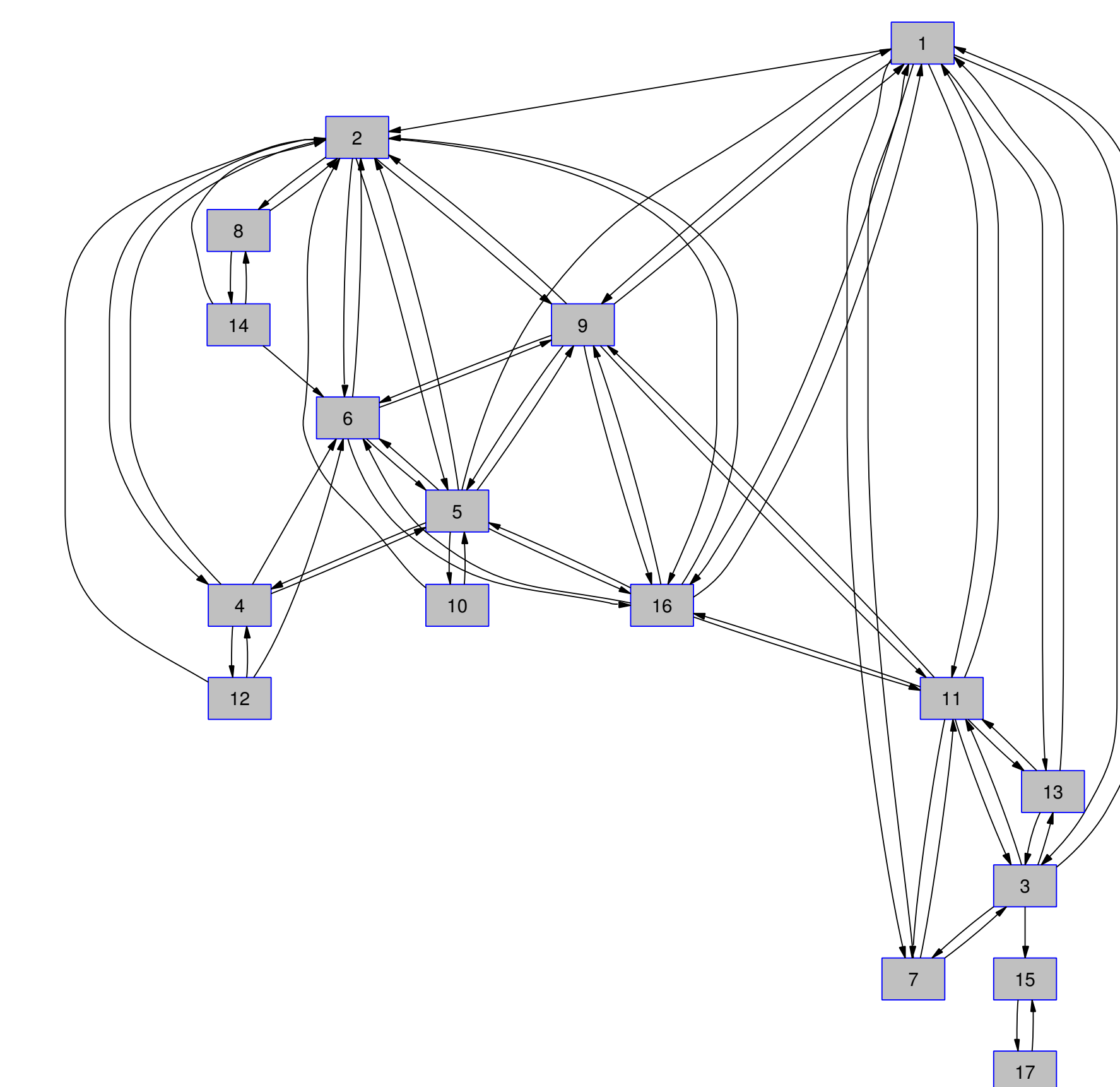
Current Deployment at Harvard



20 nodes currently deployed, moving up to 40

- Bottleneck: Finding available network ports

Radio Connectivity Map



Default transmit power, 50% receive rate for link

<http://motelab.eecs.harvard.edu>