Writing software for wireless sensor networks is difficult
- Non-deterministic environment
- Working close to resource limits makes systems extremely fragile

Testbeds for Wireless Sensor Networks
- Increase observability
- Enable testing on real hardware
- Help validating simulation results

The observation layer provides means to reprogram target nodes, monitor running programs, and interact with sensor nodes.
The system layer represents the actual sensor network, consisting of individual sensor nodes, wireless links and environment.

The receiver node periodically polls the radio channel (LPL) while the sender node sends packet bursts to communicate with the receiver node. The CPU and transmission activities are exported using a GPIO pin. The power trace of the sender nicely corresponds to the exported states.

Test bed server
Observation layer
System layer

FlockLab Highlights
- Distributed high resolution power profiling on every target
- Easily extensible to other target platforms
- Monitoring of program state through GPIO pins
- Adjustable voltage
- Tightly coupled observer-target architecture enables accurate timestamping and long term logging

Several node platforms and operating systems are supported:
- Tmote Sky
- Opal (collaboration with CSIRO)
- IRIS (collaboration with IBM)
- TinyNode184
- TinyOS, Contiki, Moterunner

User Interface

Test configuration is done using XML

```xml
<!-- Target configuration -->
<targetConf>
<obsIds>033 010 018 022 006 008 029 031</obsIds>
<voltage>3.3</voltage>
<dbImageId>232</dbImageId>
</targetConf>

<!-- Power Profiling Service configuration -->
<powerprofConf>
<obsIds>033 010 018 022 006 029 031 008</obsIds>
<profConf>
<durationMillisecs>180000</durationMillisecs>
<relativeTime>
<offsetSecs>0</offsetSecs>
<offsetMicrosecs>0</offsetMicrosecs>
</relativeTime>
</profConf>
</powerprofConf>
```

Scripting support:
Test generation can easily be included into a Makefile build environment.
Test results, images and configurations are also available as mountable web directory (WebDAV).

Example Test Data

Synchronized Power and State Traces from Distributed Nodes

The receiver node periodically polls the radio channel (LPL) while the sender node sends packet burst to communicate with the receiver node. The CPU and transmission activities are exported using a GPIO pin. The power trace of the sender nicely corresponds to the exported states.