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Recent Topics in Computer Networking: LiteOS

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Outline

Design goals

Components

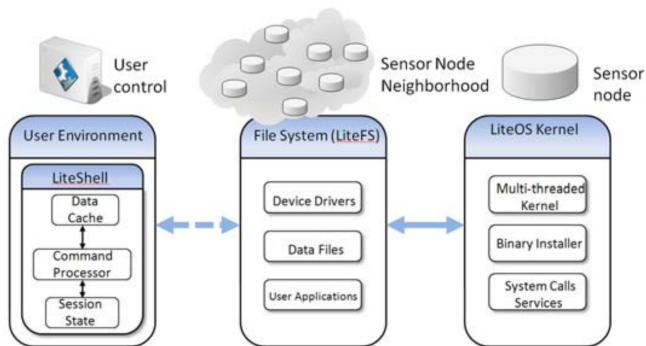
Design goals of LiteOS

- Provide Unix-like abstraction from wireless sensor nodes
 - Shell
 - Hierarchical filesystem
 - **Programming:** Threads, C
- Small resource requirements
 - Designed for MicaZ nodes
 - 8 MHz CPU, 128 KB program flash, 4 KB RAM

Assumptions on . . .

- *topology*: wireless sensor nodes with (powerful) computer as “base station”
- *environment*: trusted, no authentication implemented

Components: Overview



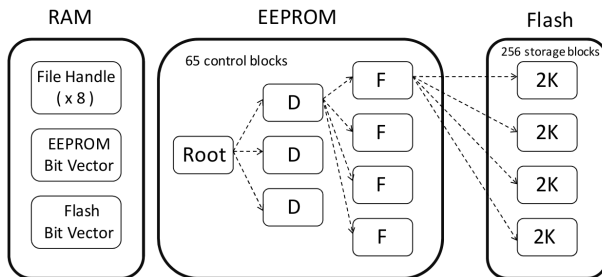
- LiteShell
- LiteFS
- LiteOS kernel

LiteShell

- Runs on “base station”
 - Shell state is *only* on base station
 - Commands translated to internal messages
- Provided commands for...
 - *dirs/files*: ls, mkdir, cd, cp, etc.
 - *processes*: ps, kill, exec
 - *debugging*: breakpoint, continue, snapshot, restore, etc.
 - *environment* (history, etc.) and *device commands* (./<deviceName)

LiteFS

- Hierarchical filesystem with directories and files (applications, devices, data)
- Each node's filesystem “mounted” to a root directory on base station
- Access control: user levels 1 - 3 with permissions `rwX` each
- Internal representation:



LiteFS API

Common API for LiteFS exists:

- `fopen()`, `fclose()`, `fread()`, `fwrite()`,...
- `fcreatedir()`, `fcopy()`, `fmove()`,...
- `fsearch()`, `finfonode()`,...

LiteOS kernel

- Supports multithreading
- *Priority-based or round-robin* scheduling
- Dynamic (un)loading of applications
- Event handling
 - internal events: e. g. sending of packet succeeded \Rightarrow threads
 - external events: e. g. packet received \Rightarrow callbacks
- Dynamic memory allocation (`malloc()`, `free()`)

LiteOS kernel: Dynamic (un)loading

- (Un)Loading of applications involves relocating memory access (start address, allocated memory address, stack top)
- Two approaches:
 1. Application's source code available:
Recompile application with new memory locations
 2. Source not available:
 - Based on application's assembler derive a *model* describing how addresses change when relocated
 - Upload application and model to node

LiteOS: Event handling example [CASH08]

```
1  void application() {
2      bool wakeup = FALSE;
3      uint8_t currentThread;
4      currentThread = getCurrentThreadIndex();
5      registerRadioEvent( MYPORT, msg, length, packetReceived
6                          );
7      sleepThread( T_timeout );
8      unregisterRadioEvent( MYPORT );
9      if( wakeup == TRUE ) { /* ... */ }
10     else { /* ... */ }
11 }
12 void packetReceived() {
13     _atomic_start();
14     wakeup = TRUE;
15     wakeupThread( currentThread );
16     _atomic_end();
17 }
```

Summary

- Unix-like environment with shell, hierarchical “network filesystem”, C programming
- Multithreaded, event handling via threads or callbacks
- Small hardware requirements on nodes
- Dynamic (un)loading of applications
- Shell integrated debugging

Thank you for your attention.

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Literature



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