

- Process Management
- Reprogramming
- Interrupt Management
- File System
- Networking

Process Management

- Execution Model
 - Event-based: TinyOS, SOS
 - Thread-based: MANTIS (HW support & App requirement)
 - Hybrid: Contiki
- Multi-tasking
 - Scheduling & Context switch overhead
 - Address space separation & protection
 - Inter-process communication & synchronization

Reprogramming

- Reprogramming Level
 - Application Level: TinyOS
 - **Component Level:** MATIS, SOS, Contiki (*flexibility*)
 - Instruction/Variable Level: Mate (a tool on TinyOS)

- Reprogramming Approach
 - Virtual Machine
 - Native Code
 - **Loadable Modules**

Reprogramming

- Virtual Machine
 - Pros: Code Compact (reducing data size transmitted)
 - Cons: Applications rely on VM & large overhead
- Native Code
 - Full image replacement (via external memory & node reboot)
 - Approaches based on binary differences (patches)

Reprogramming

- Loadable Module
 - SOS MANTIS Contiki
- SOS
 - Modules: message & function.
 - Message handlers: init, final, timer, etc.
 - Function: registration & subscription; synchronous interaction.
 - Message: message queue; asynchronous interaction.

Reprogramming

- Contiki
 - CELF (Compact ELF).
 - CELF linker & loader: reduced size & 8/16 bit symbols.
 - Pre-linking & Dynamic linking.
 - Compressor: reduce CELF file size (transmission efficiency).
 - Convertor: from ELF to CELF (compatibility with ELF).

Interrupt Management

- Closely related to real-time performance
 - Specific task context for ISR (VxWorks).
 - ISR & IST (WinCE)
- Dynamic interrupt priority.
- Nested interrupt handling.
- ISR-Process interaction (semaphore, pipe, etc).

Storage & File Format

- Large volume permanent storage device.
- File system support (Ext2, FAT, etc).
- Security issue (data file encryption).

Networking

- Protocols & modules serve as configurable components.
- Multi physical layer device (modem) support.
- Protocol support on different layers (VBF, SDRT, etc).
- Interface for adding/removing protocols.
- Cross layer design support.