

# Model based Real-Time networked applications for Wireless Sensor Networks



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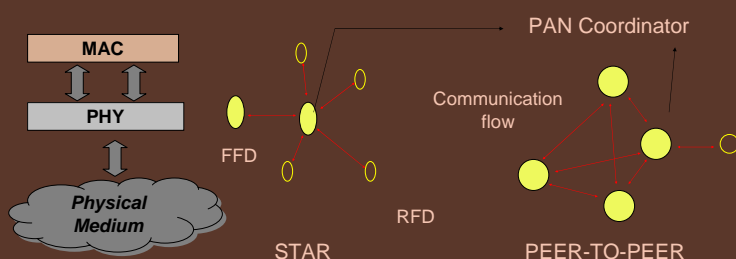
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- **Model-Driven Engineering (MDE)** is a methodology for software development focusing on models abstracting the targeted domain. In MDE the models are primary artifacts while the implementation (the code) descends from the translation of such models. This approach is favorable for code quality and reuse.

## Network stack

The **IEEE 802.15.4** protocol specifies the Medium Access Control (MAC) layer and the Physical Layer for Low-Rate Wireless Personal Area Networks (LR-WPANS). In IEEE 802.15.4 the star and the peer-to-peer topologies are supported as shown in the figure.

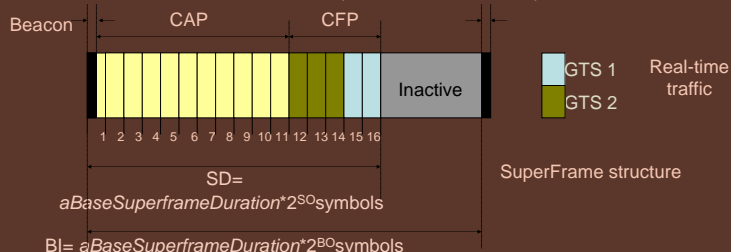


Two different device types can participate in an IEEE 802.15.4 network:

- full-function device (FFD)
- reduced-function device (RFD)

Data transfer mode:

- Beacon enabled (use of Superframe)
- Non-beacon enabled (unslotted CSMA/CA)



## MicroKernel

• **ERIKA Enterprise** is a multi-processor real-time operating system for small microcontrollers:

- available in double licensing: GPL and commercial;
- implementing APIs similar to OSEK/VDX;
- having a very small RAM footprint (~3 Kbytes);
- supporting Scilab/Scicos models;
- supporting IEEE802.15.4 wireless communication with QoS;
- supporting innovative scheduling algorithms (Fixed Priority, Stack Resource Policy, and Earliest Deadline First) suited for real-time applications.

ERIKA runs on several platforms (e.g. Microchip dsPic®, Amel Atmega128®, Altera NIOS II®).



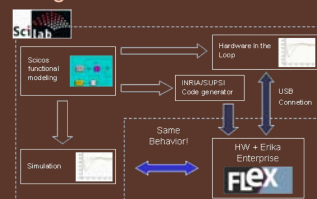
**FLEX** is the ERIKA Enterprise development board for MicroChip dsPic®.

<http://www.evidence.eu.com>

## Design support

- **Scilab** is an interactive user-friendly environment for numerical computation;
- **Scicos** is the built-in block-based dynamical simulator of Scilab.
- The **Scilab/Scicos** framework provides a code generator which is capable to produce a completely stand-alone code: within some hypothesis, the final target code behaves in the same way of the simulation, preserving the properties previously proved in the original model;

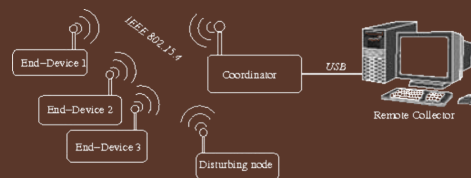
The code generator for ERIKA Enterprise is derived from a previous version working with RTAI Linux:



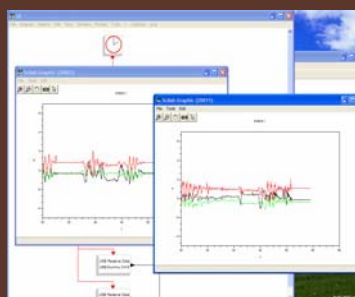
- to target small embedded microcontrollers, the code generator has been modified to cope with small footprint and memory, low computation power, no FPUs, etc;
- to target real-time applications, the code generator has been adapted to the timeliness management of the ERIKA kernel.

## DEMO

• The demonstration shows the real-time transmission of sensor data towards a fixed base station. Network topology is star. Via a USB link, the data are transferred to a PC thus plotted into a Scicos monitor window.



- Three devices transmit sensitive data through GTS.
- Another device sends best-effort traffic in the CAP without causing collisions and any drop in QoS.



Model driven technology	✓
Traffic differentiation	✓
RT-Networking	✓
USB communication	✓
Remote monitoring	✓