# FLEXNets

## FLEXIBLE WIRELESS COMMUNICATIONS SYSTEMS AND NETWORKS

http://flexnets.upc.edu

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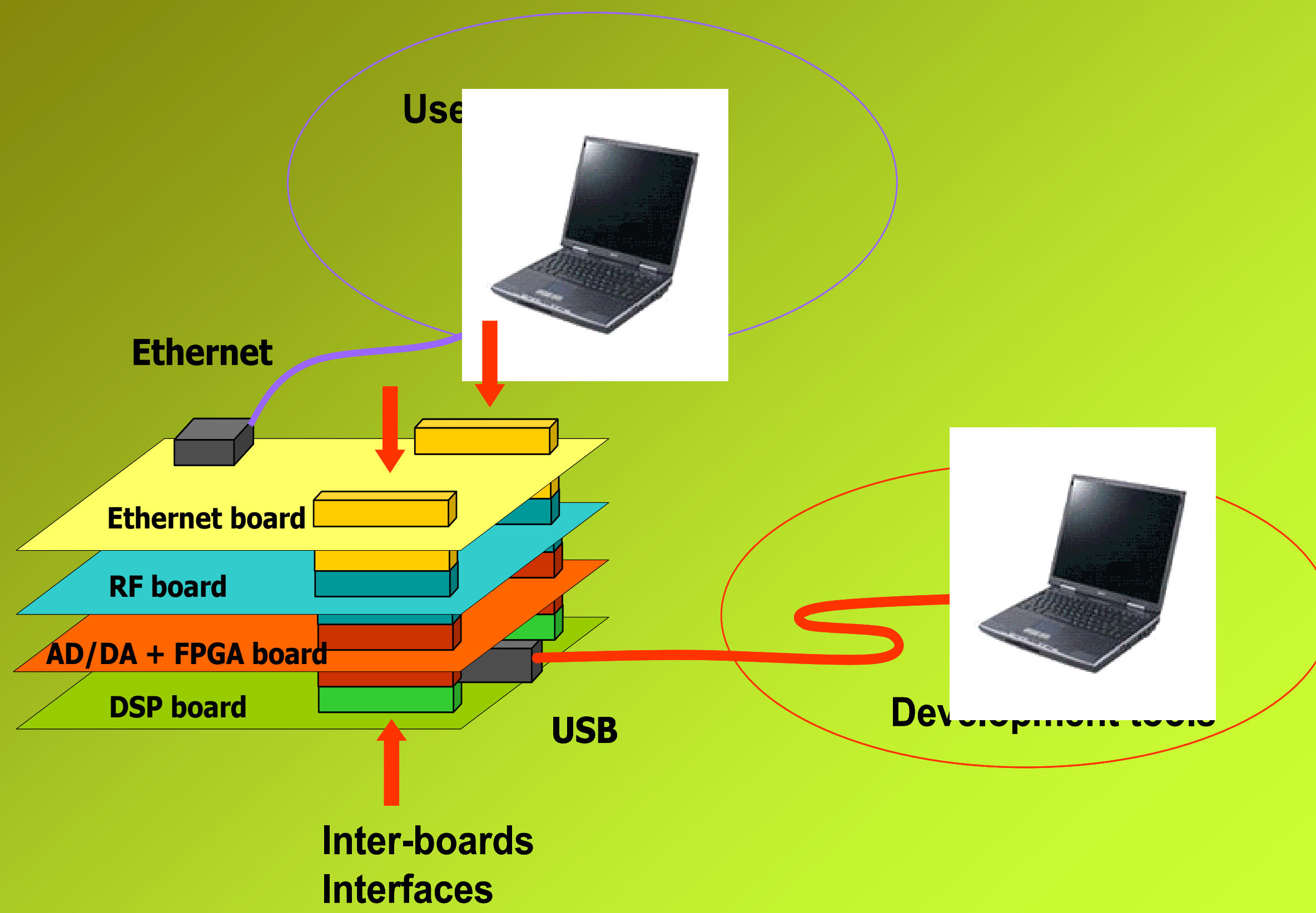
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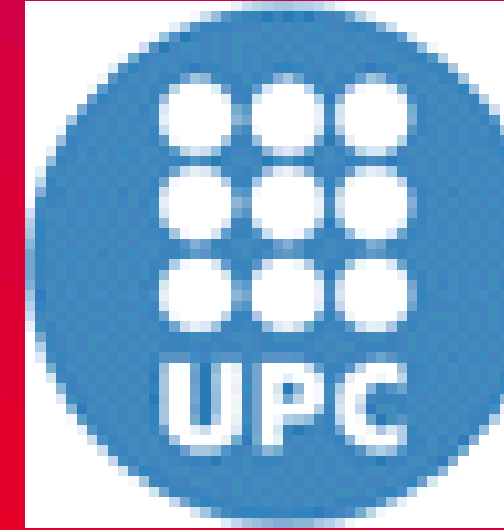
## FLEXNets Initiative

- ➢ **Open source framework for flexible wireless communications networks**
- ➢ **Tool for collaborations**
- ➢ **Supports cognitive radio systems**

**Major areas considered:**
- ❑ Operating framework: **ALOE project**.
- ❑ HW designs: **FLEXHW project**.
- ❑ Waveforms: **FLEXwave project**.
- ❑ Computing resource management: **FLEXCRM project**.

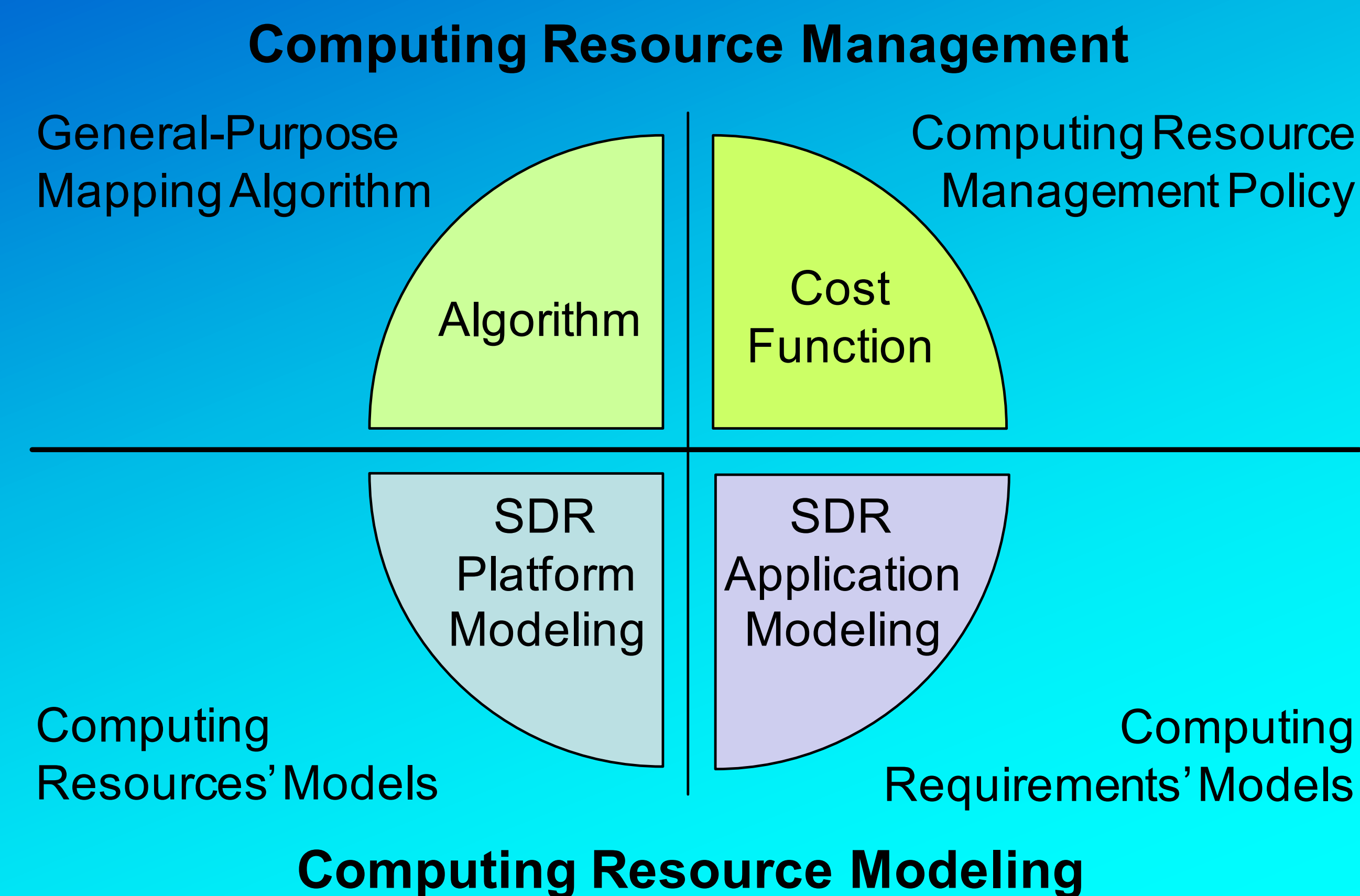## FLEXHW Project

**Mezzanine boards, DSK TMS320C6XX**

User
Ethernet
Ethernet board
RF board
AD/DA + FPGA board
DSP board
USB
Development tools
Inter-boards Interfaces

## FLEXWaves Project

- ❑ **Development of industry standard waveforms**
- ❑ **Focus on flexibility**
- ❑ **Processing chains with isolated, well-characterized and flexible components**
- ❑ **WiMAX 802.16e and UTRAN available**
- ❑ **Developed by master thesis students**

## FLEXCRM Project

- ❑ **Computing Resource Management (CRM) framework**
  - ➢ **Heterogeneous multiprocessor platforms**
  - ➢ **Waveforms with hard real-time computing requirements**

**Computing Resource Management**

General-Purpose Mapping Algorithm | Computing Resource Management Policy

Algorithm | Cost Function

SDR Platform Modeling | SDR Application Modeling

Computing Resources' Models | Computing Requirements' Models
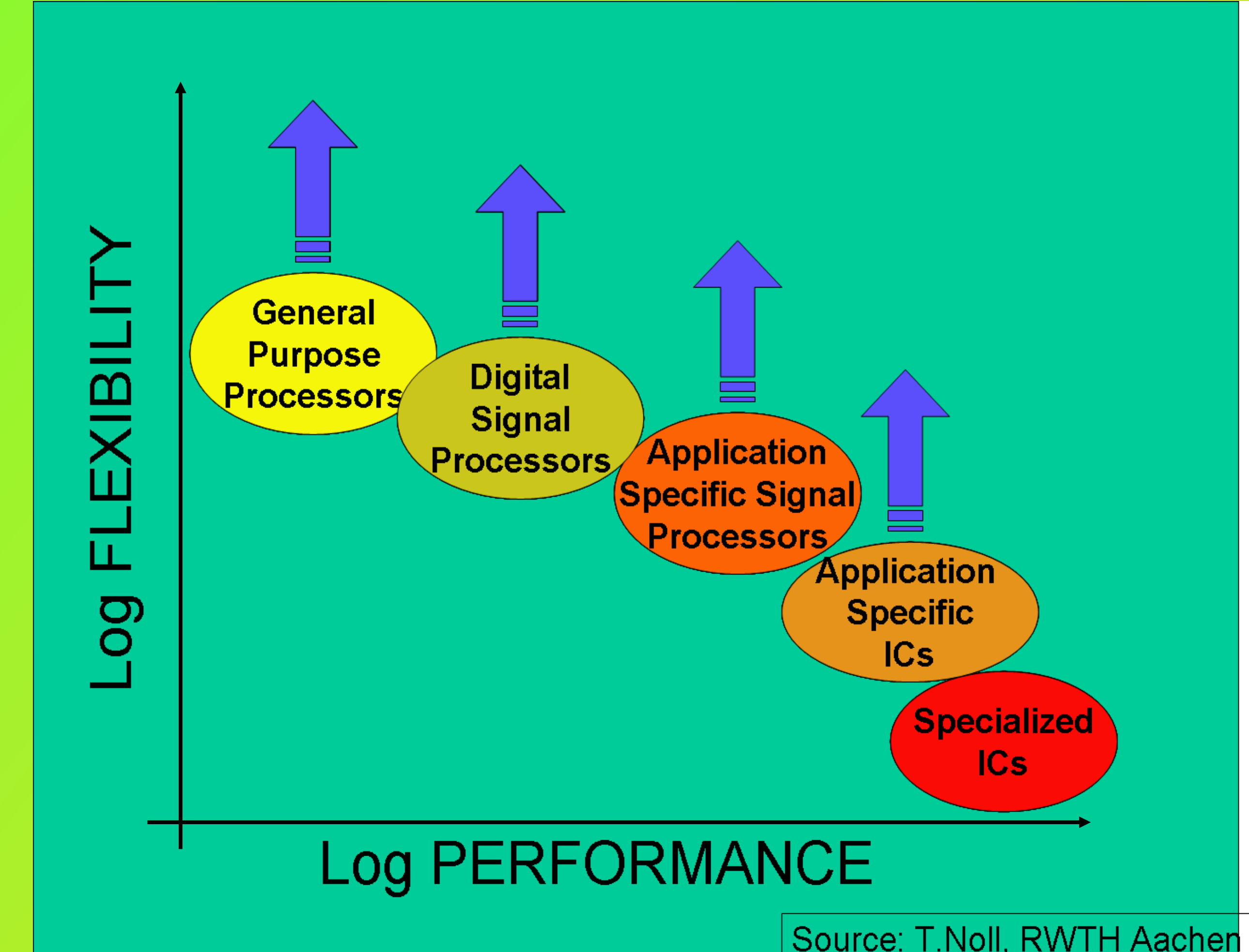
**Computing Resource Modeling**
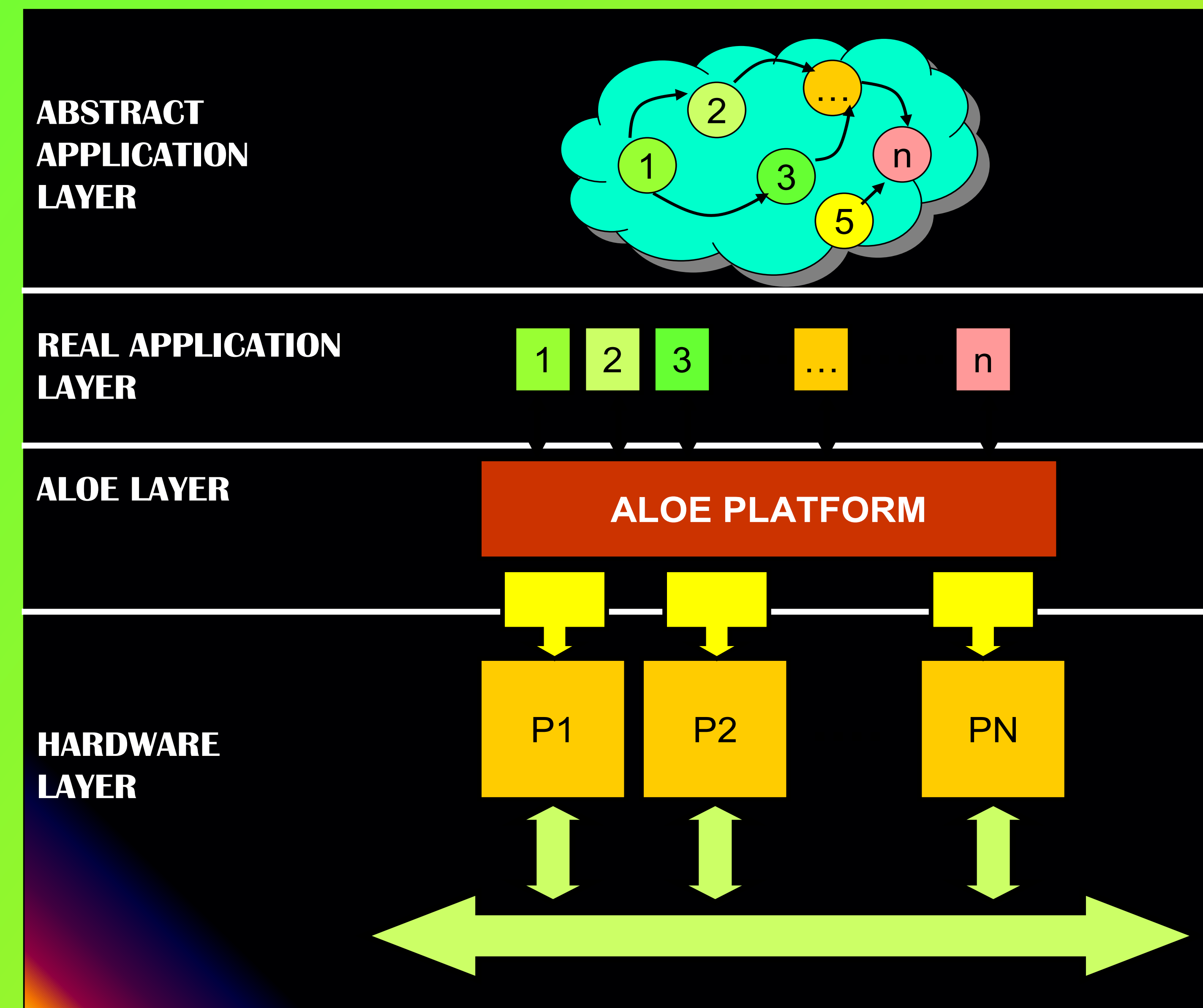
## ALOE Project
### Abstraction Layer and Operating Environment

**Flexibility:**
- ❑ **Design time flexibility**
  Development process based on the use of (HW & SW) codesign methodologies and tools
- ❑ **Run time flexibility**
  - ▪ Abstraction of processors &platforms for code reuse
  - ▪ Distributed programming: location independent interfaces
  - ▪ Model for automatic mapping (FlexCRM)

Log FLEXIBILITY

General Purpose Processors
Digital Signal Processors
Application Specific Signal Processors
Application Specific ICs
Specialized ICs

Log PERFORMANCE

Source: T.Noll, RWTH Aachen

### ALOE concept and layers

ABSTRACT APPLICATION LAYER
2 ... 1 3 n 5

REAL APPLICATION LAYER
1 2 3 ... n

ALOE LAYER
ALOE PLATFORM

HARDWARE LAYER
P1 P2 PN

## Middleware for distributed computing

- ☞ Low overhead
- ☞ Specially designed for flexible radios
- ☞ Scalable
- ☞ Portable
- ☞ Includes FlexCRM techniques
- ☞ Isolates platform from software design

## Technology enabler for
- ❑ Cognitive radio
- ❑ Hardware and software reuse
- ❑ Rapid radio prototyping

### ALOE FUNCTIONAL DIAGRAM

USER SPACE
CCRM
CMD MAN
Management tools

MANAGEMENT SPACE
SYNC MAST | HW MAN | SW MAN | STATS MAN
BRIDGE
ACTION
CAPTURE

SENSOR/ ACTUATOR SPACE
SYNC | FRONT END | SW LOAD | EXEC | STATS

COGNITIVE COMPUTING RESOURCE MANAGEMENT

COGNITIVE APPLICATION & EXECUTION ENVIRONMENT

## ALOE Architecture

OBJECT
API

ALOE Software Library (service to objects)

**ALOE Software Daemons**

FRONT END | STATS | CMD MAN | SYNC MAST
SW LOAD | EXEC CTRL | SW MAN | SW MAP
SYNC | BRIDGE | STATS MAN

API

ALOE Hardware Library (service to upper ALOE layers)

API

OPTIONAL OS

**HARDWARE**