2A717 - Beyond DREAMS

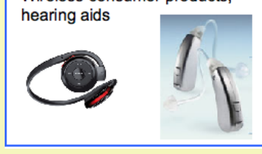
European Nanoelectronics Forum
Noordwijk, November 17-18, 2009

How to deal with

Design **R**efinement of **E**mbedded **A**nalog **M**ixed-signal **S**ystems ?

Type 1: Wakeup Receiver for high performance applications to achieve near zero standby power

Wireless consumer products; hearing aids

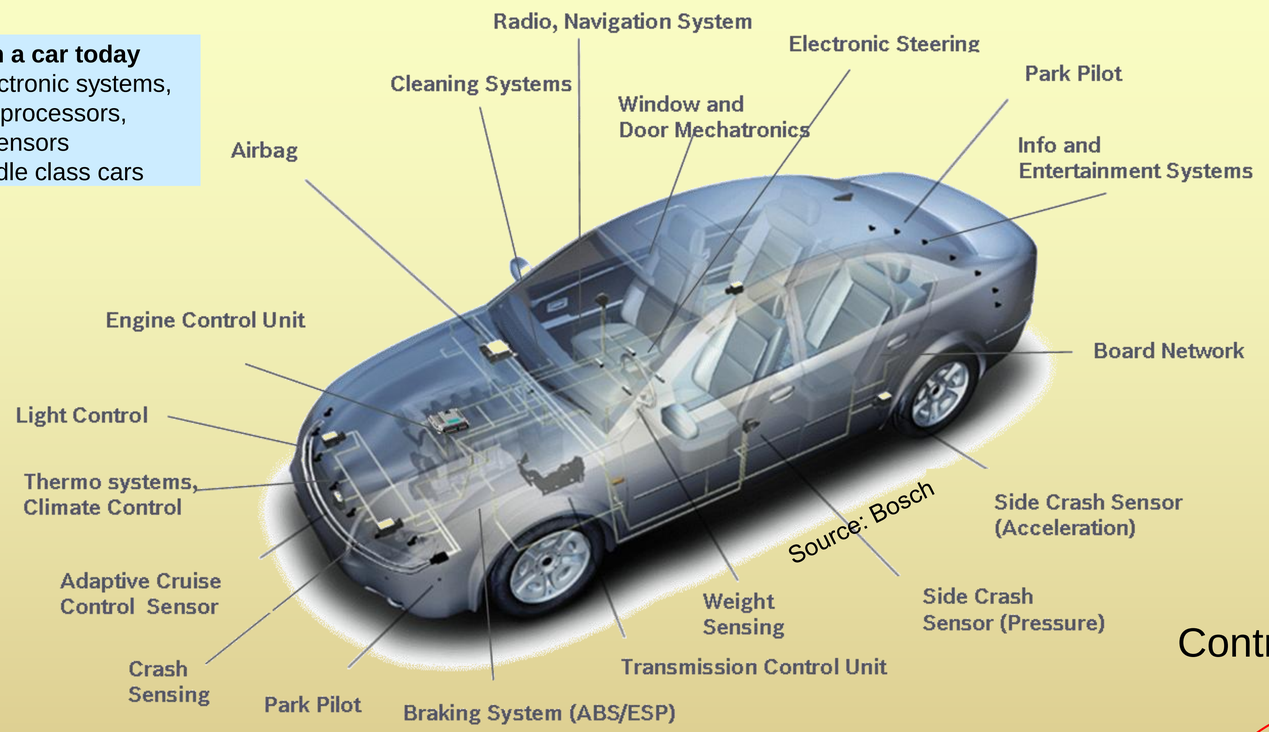


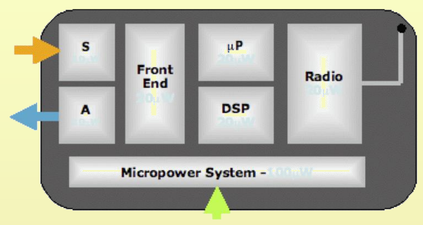
Source: IMEC-NL

Type 4: Transceiver for ULP low data rate communications

Medical implantables

Electronics in a car today
~30 electrical/electronic systems,
50-100 microprocessors,
>100 sensors
in modern middle class cars



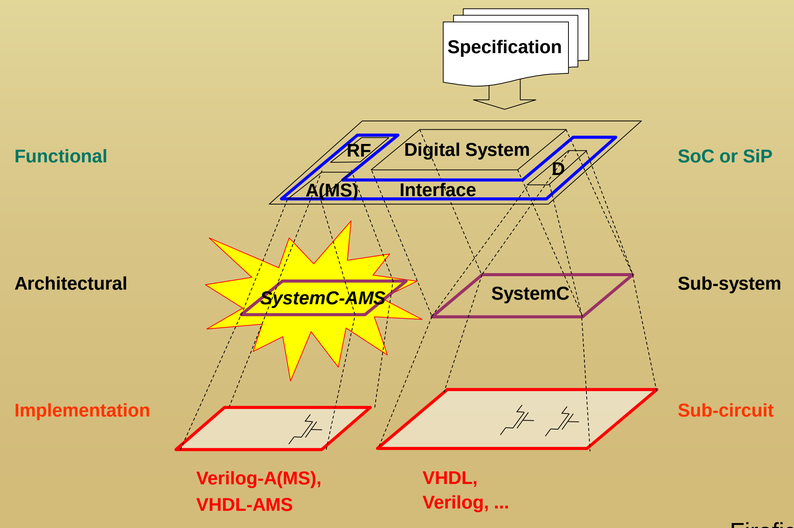


Source: IMEC-NL

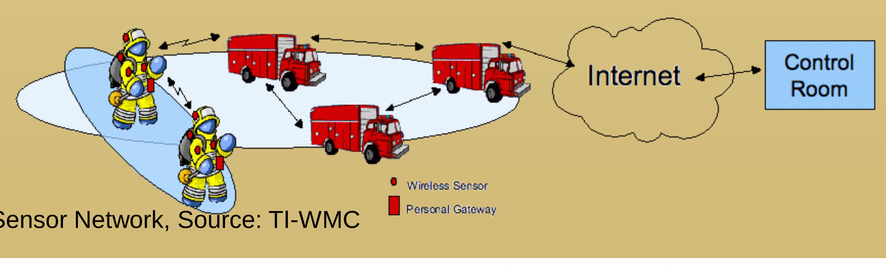
IEEE 802.15.4a specifications

	Min	Typ	Max	Unit
RF frequency	3.5		10.0	GHz
Pulse Repetition Frequency		499.2		MHz
Pulse Duration	0.738	2.003	2.003	ns
Frame length		1.55	10.6	ms
Data bits			1209	
Data rates	0.11	0.85	27	Mb/s

Provide the missing links !

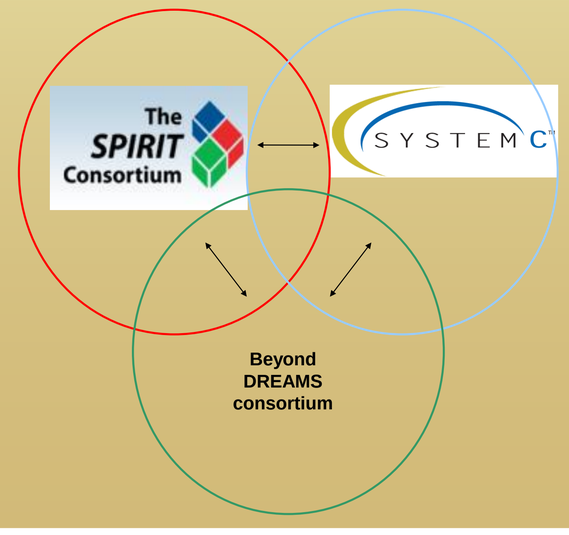


Extend the existing standards already in use for digital, re-use of IP block and sub-systems for EAMS !



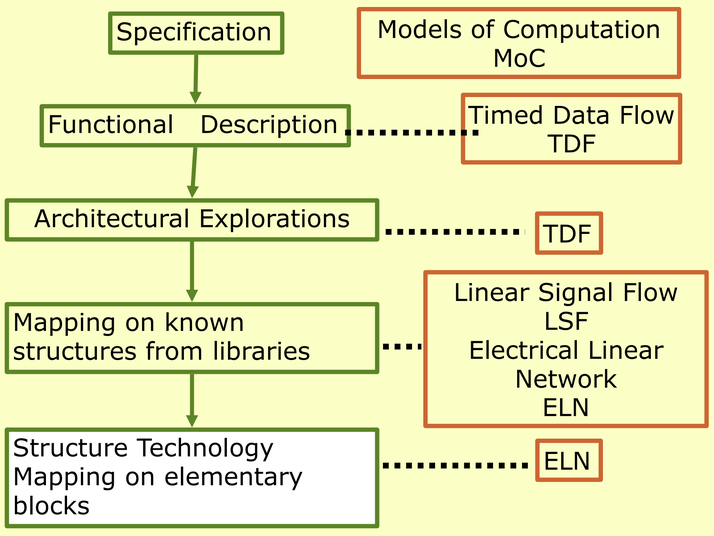
Firefighter Body Sensor Network, Source: TI-WMC

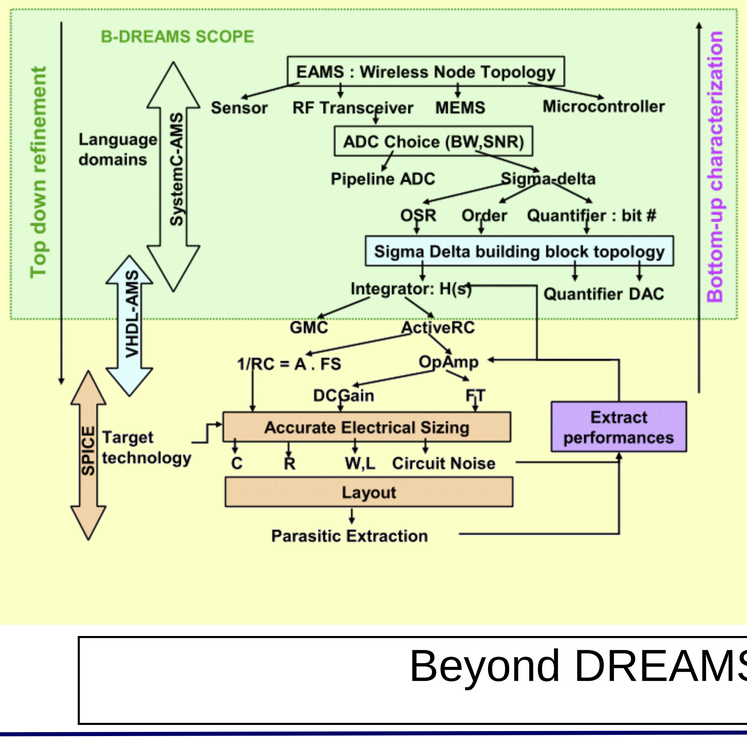
Contribute to standardization !



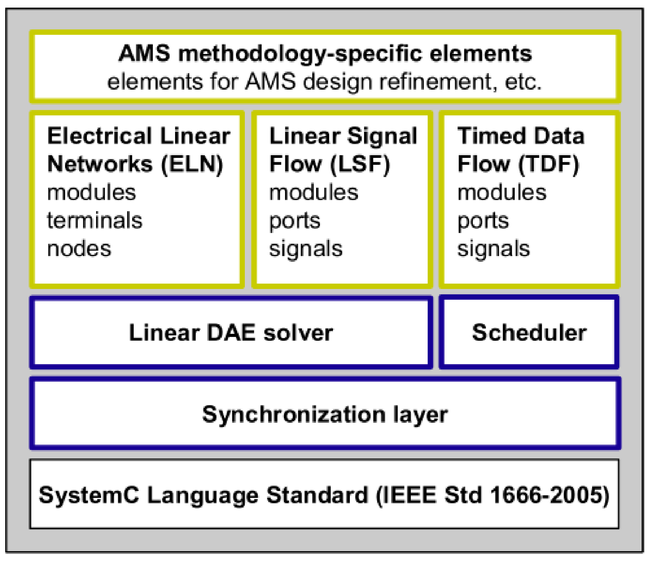
The Beyond DREAMS partners works on these 3 axes:

Refinement Methodology

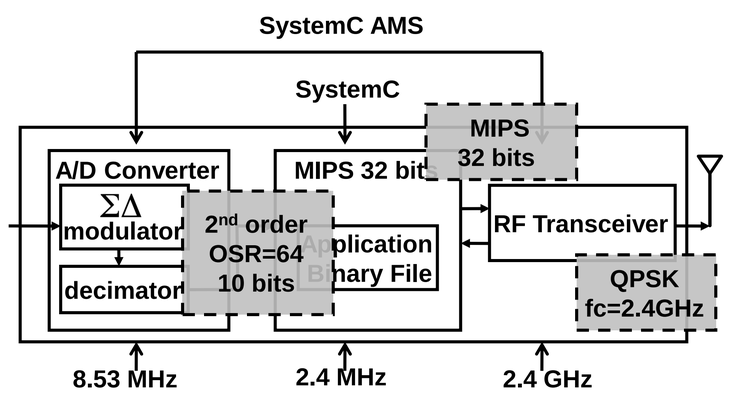




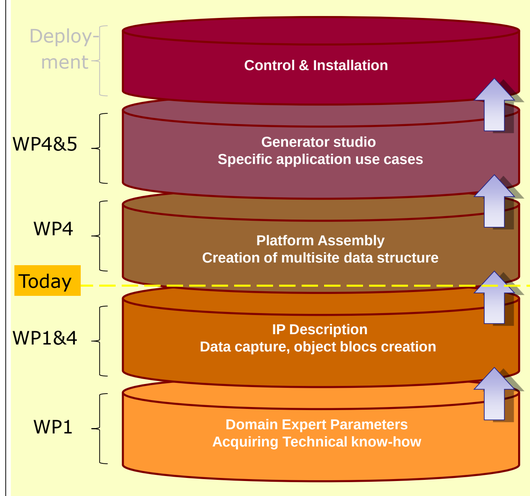
SystemC AMS Extensions



SystemC AMS Application Specific Libraries



Design Framework based on IP-XACT Extensions



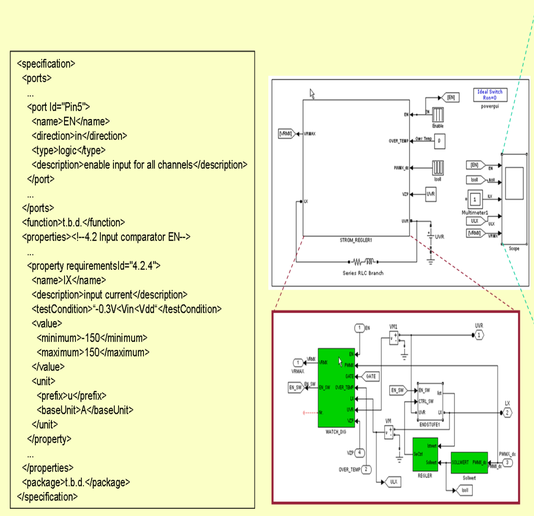
Use cases

- Design entry and AMS IP integration
- Simulatable specifications

Keys of success:

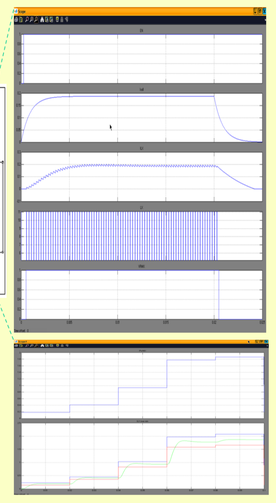
- Vertical approach
- Unique methodology
- Industry-needs oriented
- Fast deployment
- User friendly interface

Simulatable Specifications



Specification in XML

System architecture



Simulation results

Beyond DREAMS WEB Site https://wiki.eas.iis.fraunhofer.de/beyonddreams

MEDEA+

STM
Magillem
UPMC-LIP6
CEA-LETI
INP-TIMA

Bosch
Infineon IFX
Fraunhofer G.-IIS/EAS

NXP
D-Sync
TU Delft
TI-WMC
IMEC-NL

TUV

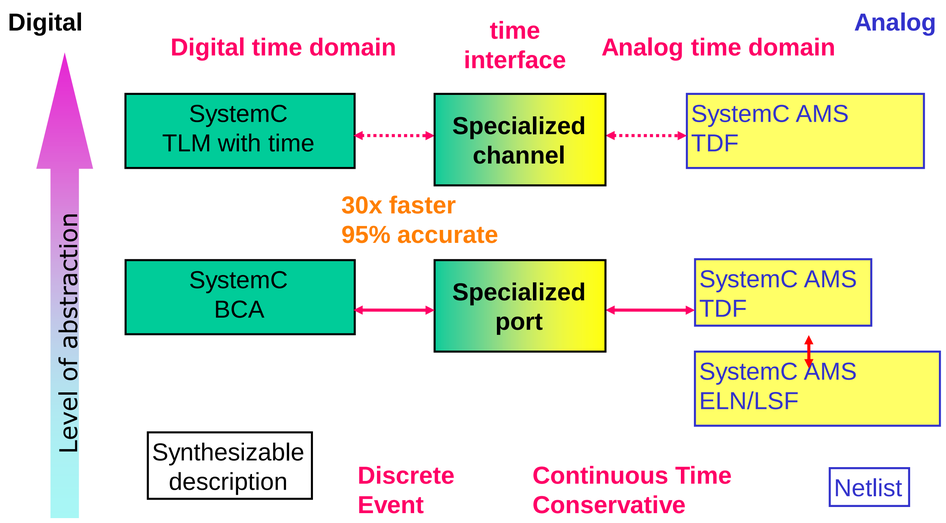
EUREKA

2A717 - Beyond DREAMS

European Nanoelectronics Forum
Noordwijk, November 17-18, 2009

SystemC AMS extensions

Model of Computation



TLM-TDF interaction concepts

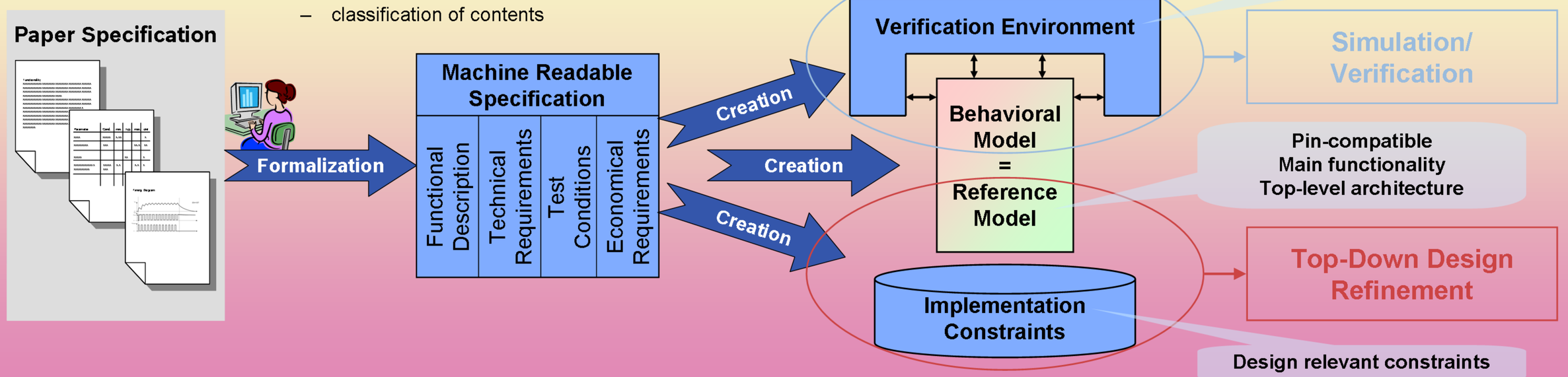
```
SCA_TDF_MODULE(prefi_ad) :  public virtual
  basic_slave_base< long , long >
{
   sca_tdf::sca_in <double>    in;    // signal input port

   typedef  tlm_transport_if … if_type;
   sc_export<if_type> slave_port;

   sca_tdf::ams2tlm<double>  a2d;
   sca_tdf::tlm2ams<bool>      fc_high;

   void set_attributes()
   {
     a2d.set_delay(1.0,SC_US);
     fc_high.set_delay(2.0,SC_US);
   }

   SCA_CTOR(prefi_ad)
   {
     slave_port(*this);
   }
```

```
basic_status write( const long& adr , const long& data)
{
   fc_high.write(bool(data));
   return basic_protocol::SUCCESS;
}
basic_status read( const long& adr , const long& data)
{
   data = long(1024.0 * a2d.read());
   return basic_protocol::SUCCESS;
}

void processing() {
     double tmp;    // high or low cut-off freq.

    if(fc_high.read())    tmp = ltf_1(b, a1, s, in.read());
    else                        tmp = ltf_0(b, a0, s, in.read());
      a2d.write(tmp);
   }
};
```

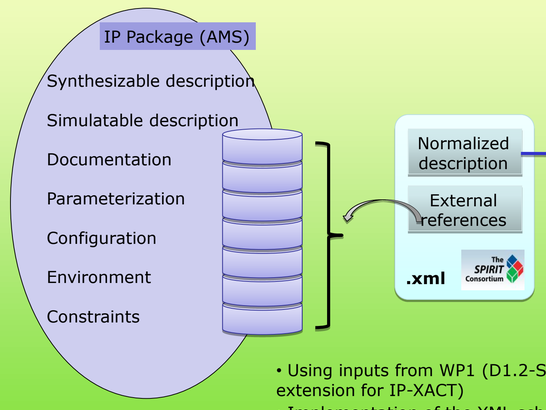
TLM<->TDF synchronization variable

Simulatable Specification

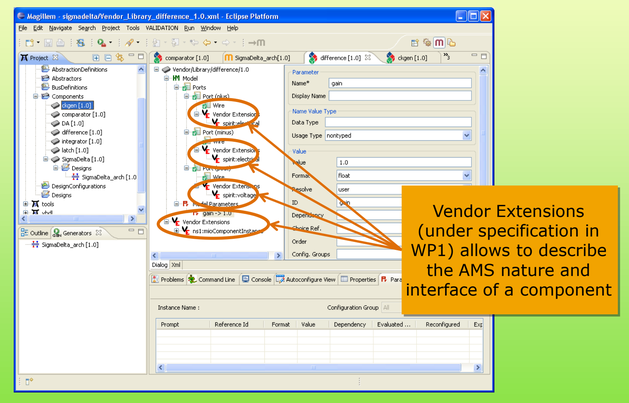
- Machine-readable specification requires
  - definition of formats
  - classification of contents

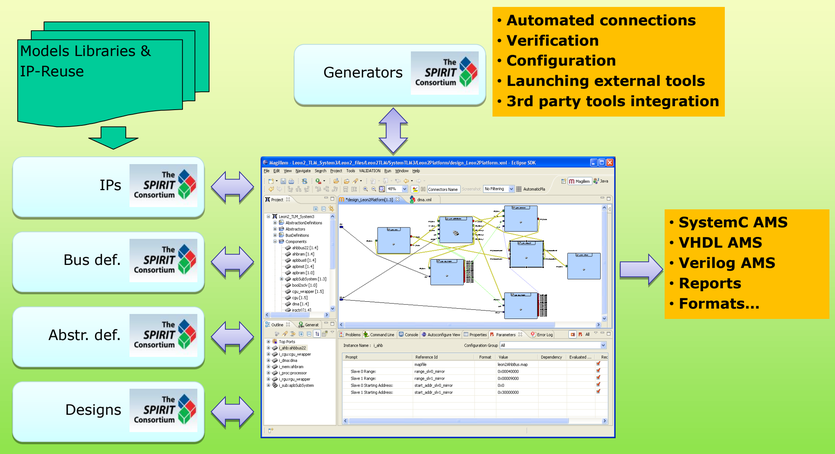


Design framework & IP re-use : IP-XACT extensions



- Using inputs from WP1 (D1.2-Specifications of the AMS extension for IP-XACT)
- Implementation of the XML schema (prototype with vendor extensions)

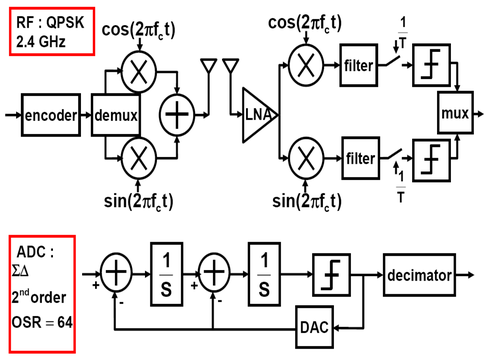




Source:Magillem

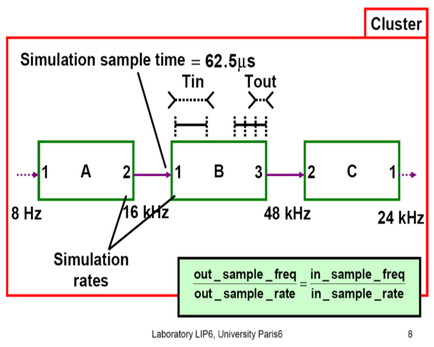
Wireless Sensor Network application first results

Wireless Sensor Network Transceiver



Laboratory LIP6, University Paris6 15

Multi-Rate Synchronous Data Flow



Laboratory LIP6, University Paris6 8

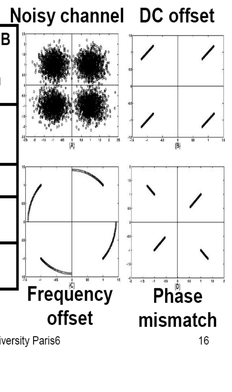
Wireless Sensor Network Node: Results

	Settings	Simulation	Matlab	SystemC-AMS	
ADC alone	OSR=64 10 bits 8.53MHz	16*1024 pts	1.6 s	0.9 s	
RF alone	2.4 GHz	10^e3 bits 10^e7 pts RF	150.7 s	classic 63.0 s	BB 0.036s
2-nodes transmission	Same settings	10^e3 bits	-	181.7 s	

Laboratory LIP6, University Paris6 17

Wireless Sensor Network Node :Results

RF Simulation (2.4 GHz)	SC-AMS classical simulation	SC-AMS BB eq. RF simulation
1000 bits transmission	63.0s	0.036s
DC offset	19.9s	0.018s
Frequency offset	24.9s	0.022s
Phase mismatch	44.4s	0.031s



Laboratory LIP6, University Paris6 16

Source:UPMC-LIP6

MEDEA+

STM
Magillem
UPMC-LIP6
CEA-LETI
INP-TIMA

Bosch
Infineon IFX
Fraunhofer G.-IIS/EAS

NXP
D-Sync
TU Delft
TI-WMC
IMEC-NL

TUV

EUREKA