THALASSIM
Modelling Standardisation of the Electrical Interfaces

ESA Workshop on Avionics Data, Control and Software Systems (ADCSS)

ESTEC, Noordwijk, The Netherlands,

2-4 November 2010

THALES ALENIA SPACE Cannes

November 2nd, 2010

- CONTEXT
- OVERVIEW
- MODELLING OF ELECTRICAL UNIT I/F
- BENEFITS OF THE STANDARDIZATION

- THALASSIM is a simulator product line used at THALES ALENIA SPACE France to support a large range of facilities:
  - High Fidelity Simulator: equivalent to a Functional Engineering Simulator
  - Software Verification Facility (SVF)
  - Platform Simulator (SimPF): equivalent to a Functional Validation Test bench
  - Avionic Test Bench (ATB and SimATB): equivalent to a Spacecraft AIV Simulator
  - Dynamics Spacecraft Simulator (DSS): equivalent to a Training, Operation and Maintenance Simulator
- THALASSIM is based on the K2 simulation infrastructure which provides all the services needed to make and to exploit a simulator.
  - These services allow the assembly of a simulator from instances of models and the definition of the communication links between the instances.
  - The communication mechanisms used in the K2 infrastructure are data flow and event based.

- In order to increase reusability and efficiency while reducing cost and scheduling time, and thereby increase competitiveness in the development of our simulators, THALES ALENIA SPACE chose to:
    - raise the level of standardisation in the modelling of electrical unit interfaces
    - define a software interface control document applicable to all equipment/unit models
    - have a high level of fidelity with regard to the electrical interfaces of real equipment/unit
- This presentation is intended to emphasise the standardisation of electrical interfaces for the equipment/unit required for the Constellations, Telecommunication and Observation & Science Spacecraft product lines. These lines include:
    - Spacebus 4000 and Alphabus product lines
   - Global-Star 2, O3B Constellation
    - Sentinel-3

This standardisation covers all the main electrical interface types

- Telecommand
- Telemetry data
- OBDH bus
- B1553 bus
- Spacewire link
- System alarm
- Digital Relay acquisition
- Clock signal
- Low / High Level command,
- Power supply
- Digital serial
- Analog , …

of THALES ALENIA SPACE spacecrafts

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Telecommand inputs

- Electrical I/F
    - SBDL_TC_IN signals
- Simulation approach
    - Asynchronous simulation
    - TC interface is implemented by using an activation routine
    - This activation is of SBDL_TC_IN type. The data sent on this activation is a CLTU
- Data structure [K2_TYPE_ICD]
    - Parameter record
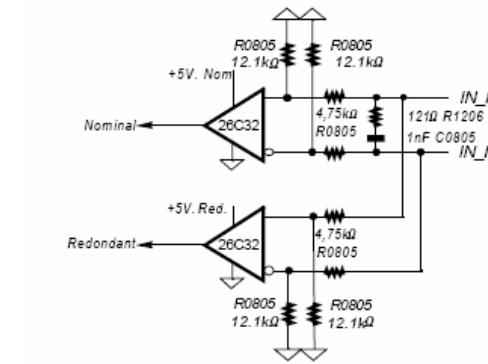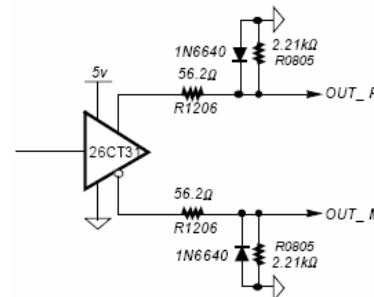
Source side (TC transmitter) | **User side (SMU receiver)**
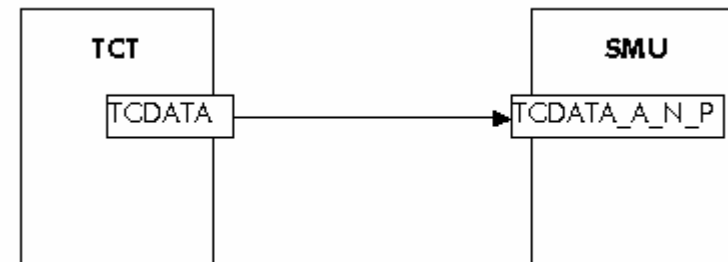
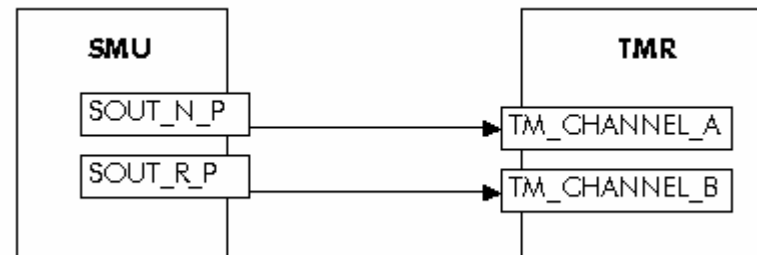| Name	Description	K2 Type	Unit
TC_Data	A byte array containing the CLTU (306 bytes max) and some synchronization bytes	K2::Char [512]	
TC_Data_Size	Size of the TC_Data array (<=512)	K2::UInt16	Byte
TC_Bit_Rate	Bit rate of the TC sending	K2::UInt32	Bit / s

- Results record
    - Empty

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Telemetry outputs

- Electrical I/F
  - SBDL_TM_OUT signals
- Simulation approach
  - Asynchronous simulation
  - TM interface is implemented by using an activation routine
  - This activation is of SBDL_TM_OUT type. The data sent on this activation is a CADU.
- Data structure [K2_TYPE_ICD]
  - Parameter record

Source side (SMU transmitter) **User side (TM receiver)**

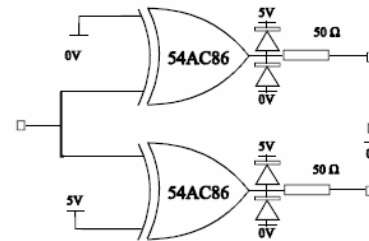| Name	Description	K2 Type	Unit
CADU	A byte array containing the CADU	K2::Char [1024]	
CADU_Size	Size of the CADU (=1024)	K2::UInt16	Byte
TM_Bit_Rate	Bit rate of the TM sending	K2::UInt32	Bit / s

- Results record
  - Empty

System alarms

- Electrical I/F
  - SBDL or EVBL signals
- Simulation approach
  - Asynchronous simulation
  - Each alarm is an activation call point / routine of EVBL_ALARM type
  - The information sent on this activation is a boolean data :
    - TRUE when the alarm is set ON
    - FALSE when the alarm is set OFF

Source side (STR transmitter)

User side (SMU receiver)

- Data structure [K2_TYPE_ICD]
  - Parameter record

Name	Description	K2 Type	Unit
Alarm_ON	True when the alarm is ON, else False	K2::Boolean	

  - Results record
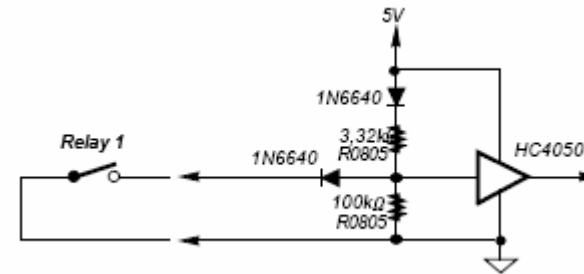   - Empty
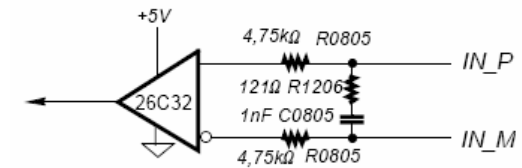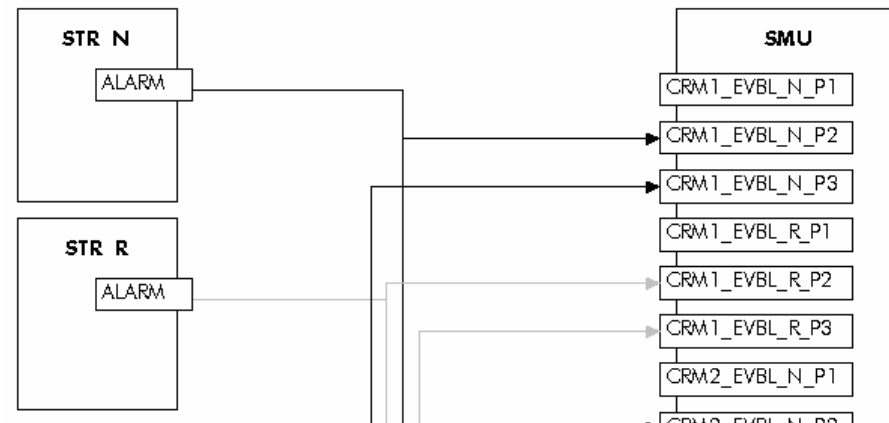
Launcher and umbilical interfaces

- Electrical I/F
    - DR_ALARM signal
- Simulation approach
    - Asynchronous simulation
    - Each alarm is an activation call point / routine of DR_ALARM type
    - The information sent on this activation is a boolean data :
        - TRUE when the alarm is set ON
        - FASLE when the alarm is set OFF
- Data structure [K2_TYPE_ICD]
    - Parameter record

Source side (Strap)

User side (SMU receiver)

Name	Description	K2 Type	Unit
Alarm_ON	True when the alarm is ON, else False	K2::Boolean	

- Results record
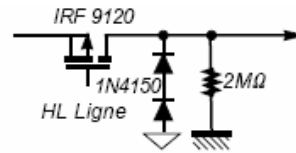   - Empty

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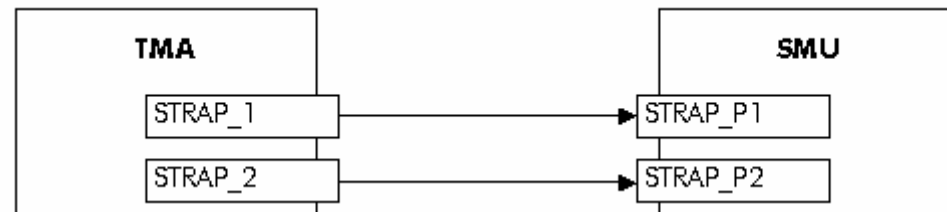
Clock and synchronization interfaces

- Electrical I/F
  - CLK signal
- Simulation approach
  - Asynchronous simulation
  - A model needing a clock signal has to implement an activation routine and connect it to the relevant activation call point
  - No specific information is sent with this activation

- Data structure [K2_TYPE_ICD]
 - Parameter record
    - Empty

  - Results record
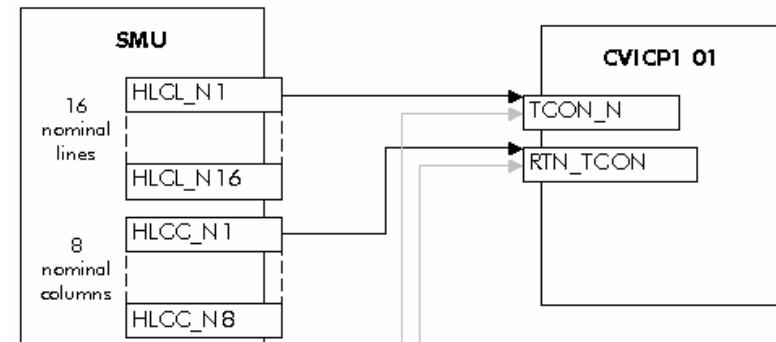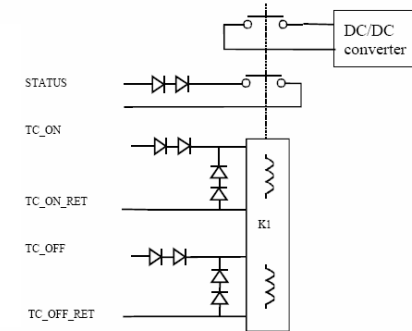   - Empty

User side
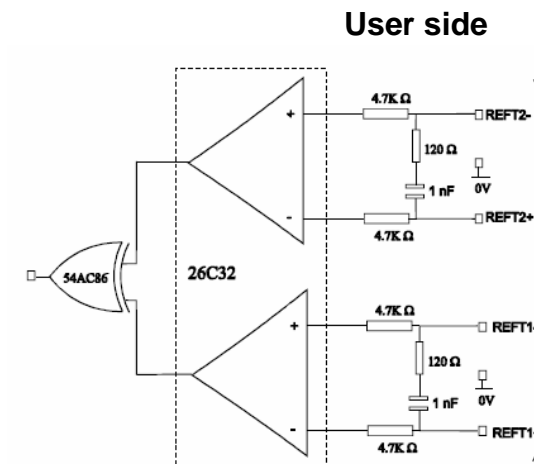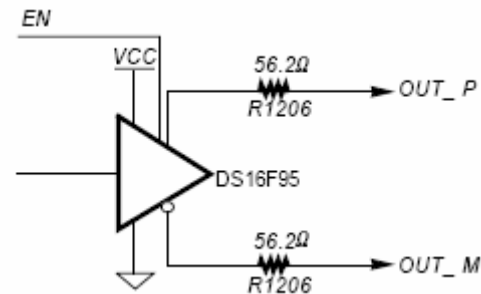
Low and High Level Command

- Electrical I/F
    - LLC / HLC signal

Source side
(SMU transmitter)

- Simulation approach
    - Asynchronous simulation
    - Each Low / High Level Command is an activation call point / routine of LLC-HLC type
    - The information sent on this activation is the pulse command duration

User side
(STR receiver)

- Data structure [K2_TYPE_ICD]
    - Parameter record
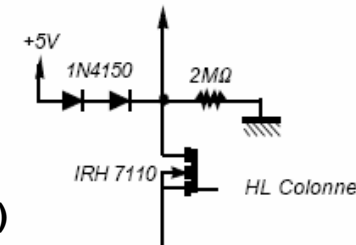
Name	Description	K2 Type	Unit
Pulse_Duration	Duration of the signal pulse	K2::Duration	

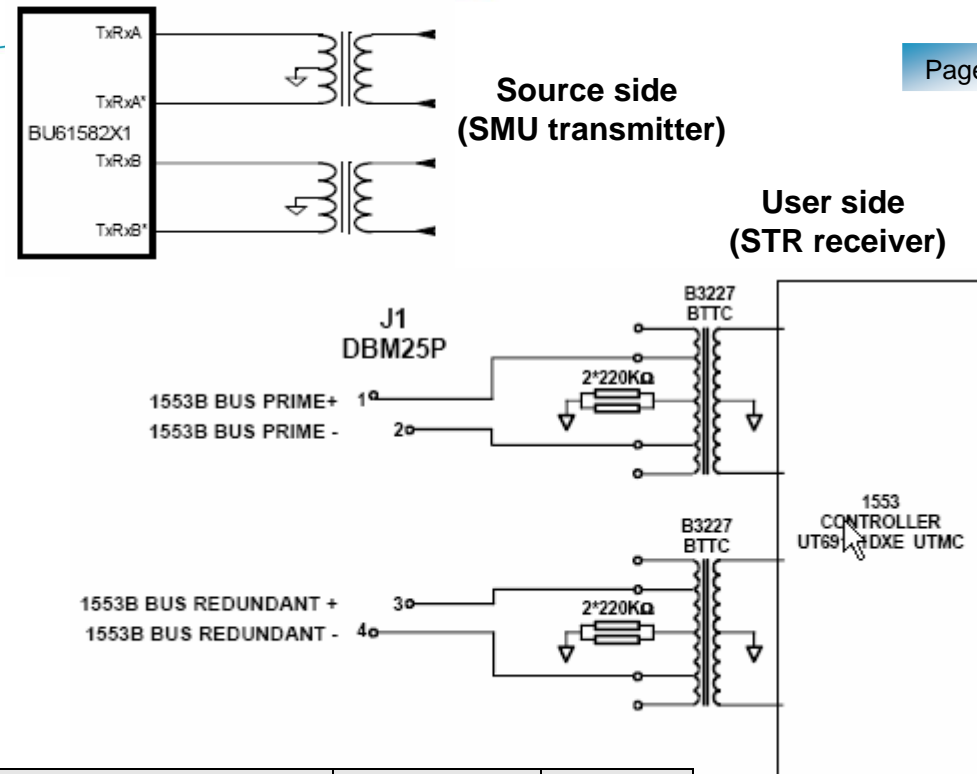- Results record
    - Empty

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1553 Bus

- ■ Electrical I/F
    - ■ 1553 signal

- ■ Simulation approach
    - ■ Asynchronous simulation
    - ■ the 1553 bus is implemented by using the K2 bus routine / call point mechanism, thus with activation routine (with an address) / call point (of bus type)

- ■ Data structure [K2_TYPE_ICD]
    - ■ Parameter record

Name	Description	K2 Type	Unit
1553_Command_Word	Command word (see structure below)	K2::UInt64	
1553_Data_Word	Array of 31 data words (see structure of each word below)	K2::UInt16 [31]	
1553_Data_Word_Size	Number of data words used in the message	K2::UInt8	

    - ■ Results record

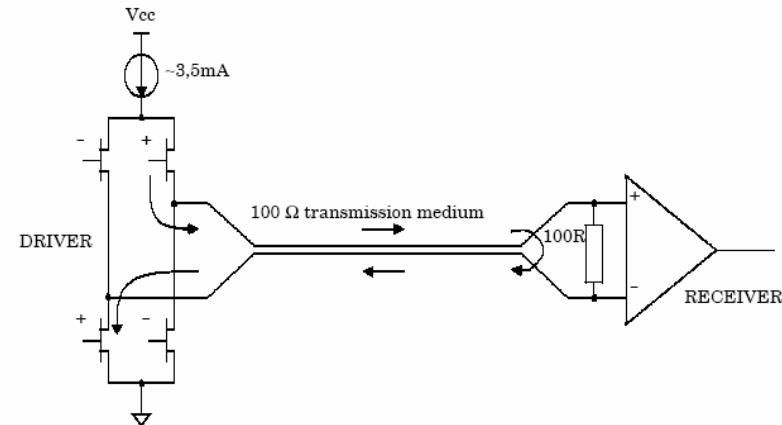| Name	Description	K2 Type	Unit
1553_Status_Word	Status word (see structure below)	K2::UInt16	
1553_Data_Word	Array of 32 data words (see structure of each word below)	K2::UInt16 [32]	
1553_Data_Word_Size	Number of data words used in the message	K2::UInt8	

Source side (SMU transmitter)

User side (STR receiver)

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Spacewire link

- Electrical I/F
    - Spacewire signal
- Simulation approach
    - Asynchronous simulation
    - Spacewire link is implemented by using the K2 bus routine / call point mechanism, thus with activation routine (with an address) / call point (of bus type)
- Data structure [K2_TYPE_ICD]
    - Parameter record

Name	Description	K2 Type	Unit
Control_Flag	False for Data True for EOP/EEP markers	K2::Boolean	
Cargo	Data to transfer	K2::UInt8	

- Results record
    - Empty

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Unique Standard for simulation of the electrical interfaces

- To improve communication/collaboration between users and between projects
- To rationalize the developments
    - Direct reusing of models phase to phase and project to project
- Based on a collaborative work controlled by a design authority
    - To take into account new electrical interfaces :
        - Example : I/F Spacewire need has been developed for Sentinel-3 and will be re-used on Iridium project
    - To take into account all the range of simulator :
        - FES / SVF / SC AIT Simulator / FVT / AIV Simulator / TOMS

THALASSIM Modelling standardisation is very different to SSRA (System I/F Network)

- Developed before SSRA
- Based on Event links & Field links (≠ I/F links in SSRA)
    - Solution accessible/comprehensive for final users (≠ computer science experts)
    - Suitable w.r.t the usual use cases
- Effort to be compatible with SSRA is significant w.r.t benefits