ADCSS 2013

CAN in Space applications – Telecom - Payload

Telecom Directorate

DALENQ Jean // 23rd October 2013

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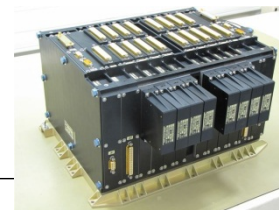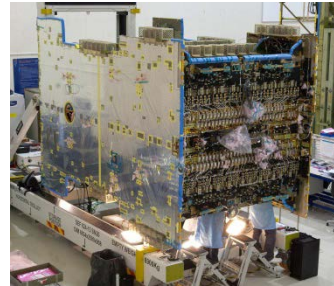# CAN bus on Eurostar E3000
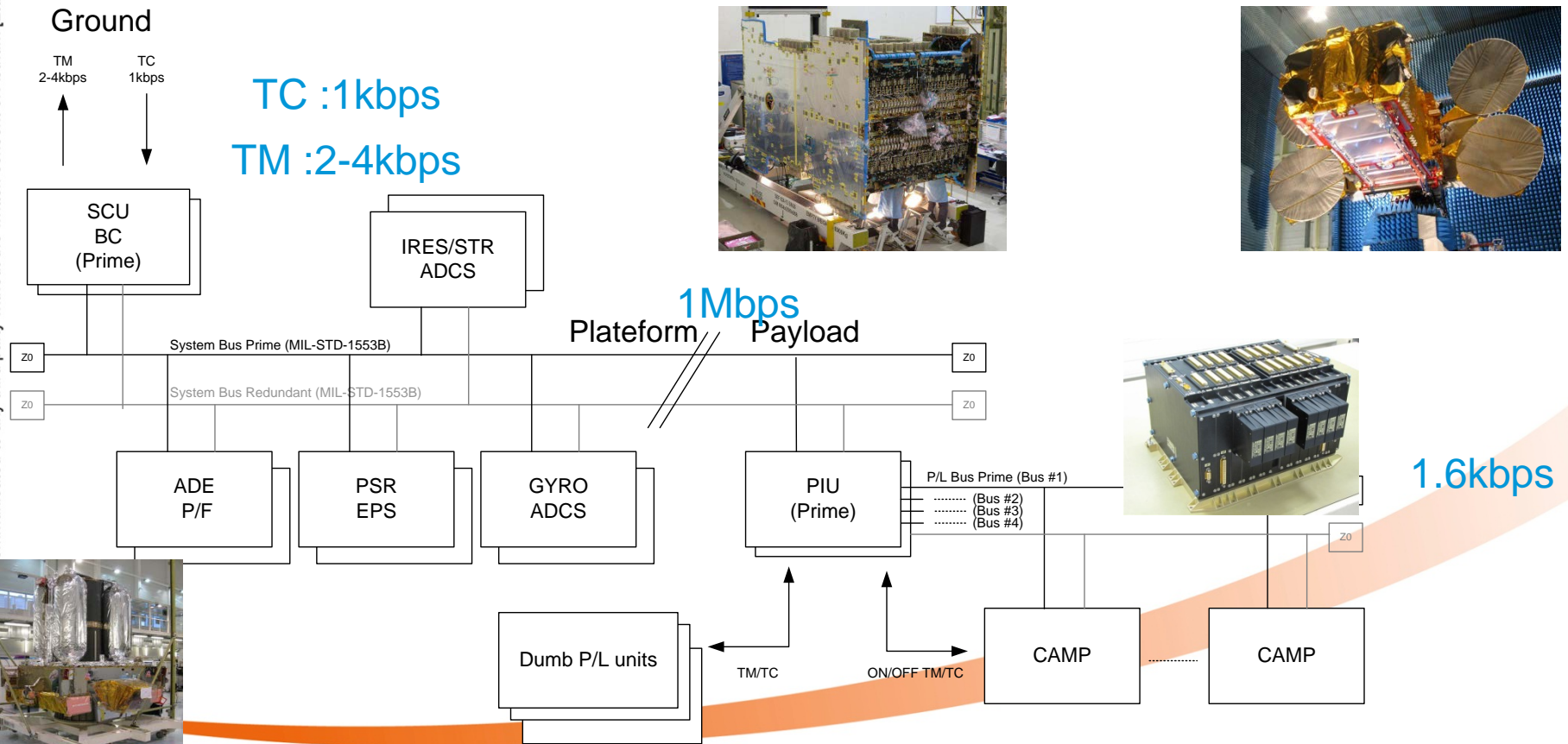
- Agenda
  - E3000 DHS
  - Use of Telecom Payload Serial Bus
  - Motivations to go through CAN
  - Implementation Philosophy
  - Physical Layer
  - Protocol
  - Bus Management
  - Redundancy Management
  - Progress Status

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CAN bus on Eurostar E3000

- ## Eurostar E3000 DHS

Ground

TM
2-4kbps

TC
1kbps

TC :1kbps

TM :2-4kbps

SCU
BC
(Prime)

IRES/STR
ADCS

1Mbps

Plateform   Payload

Z0   System Bus Prime (MIL-STD-1553B)   Z0

Z0   System Bus Redundant (MIL-STD-1553B)   Z0

ADE
P/F

PSR
EPS

GYRO
ADCS

PIU
(Prime)

P/L Bus Prime (Bus #1)
-------- (Bus #2)
-------- (Bus #3)
-------- (Bus #4)

1.6kbps

Z0

Dumb P/L units

TM/TC   ON/OFF TM/TC

CAMP   ....   CAMP

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Insert partner, programme, product, or service logo

CAN bus on Eurostar E3000

■ **Use of Payload Serial Bus**

    ■ Main of P/L Serial Bus users are Channels AMPlifiers

        ▪ FGM/ALC step setting (1byte)

        ▪ OPA step setting (1 byte)

        ▪ FGM/ALC, Mute, ARC statuses (< 1 byte)

        ▪ Input/Output Power (1 byte (*))

        ▪ Temperature (1 byte (*))

        ▪ Primary Bus Current (1 byte (*))

        ▪ TWT Helix Current (1 byte (*))

        ▪ TWT Anode Voltage (1 byte (*))

        ▪ (*) currently 8 bits resolution but growing trend

        ▪ Today's P/L : 40 to 80 CAMP, tomorrow more than 100

    ■ Others Users : CPSU, APME, TDP…

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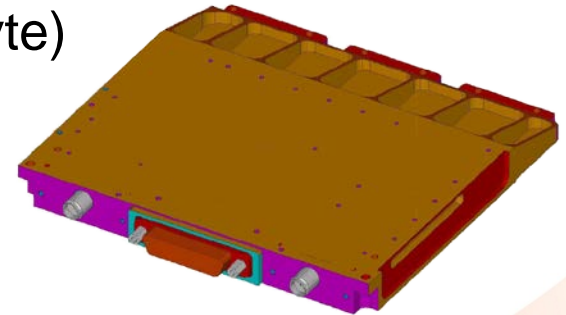
CAN bus on Eurostar E3000

- **Use of Payload Serial Bus**
  - Data Rate :
    - During Operation Life Time : collect TM @ 0.1Hz
    - During Investigation, AIT : collect a TM set @1Hz
    - Trend is collect a TM set @ 10 Hz
  - Tolopogy :
    - Up to 80 RT connected on bus via daisy chain
    - 3 or 4 bus is used
    - Up to 30 meters per bus

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CAN bus on Eurostar E3000

- ■ Motivations to go through CAN
  - ■ Current P/L bus is LSSB (Low Speed Serial Bus)
    - ▪ Data Rate 1.6kb/s (8 kHz Clock)
    - ▪ 32 RT max per bus
    - ▪ 5 Twisted Pair per redundancy (20 wires per redounded bus)
    - ▪ 10 useful bits per TC or TM Request word
    - ▪ Proprietary

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- **Motivations to go through CAN**
  - CAN Bus improves :
    - Data Rate : 500kb/s (targeted, up to 1Mb/s)
    - Up to 64 RT with baseline implementation
    - 1 Twisted Pair per redundancy (4 wires per redounded bus)
    - 8 data bytes + ID for data management purpose
    - Iso Standard

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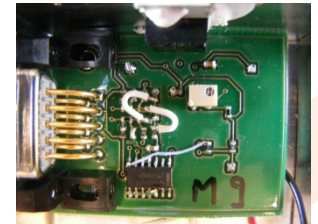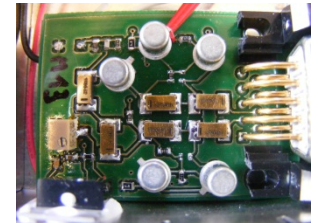AN EADS COMPANY

CAN bus on Eurostar E3000

- **Implementation Philosophy**
  - Closest to the LSSB approach:
    - Cold redundant buses (no need for fast reconfiguration.)
    - Master/slave dialog (simple management/validation…)
    - Master Connected only to one redundancy (simple, robust)
    - Autonomous bus selection for RT (transparent redundancy management)

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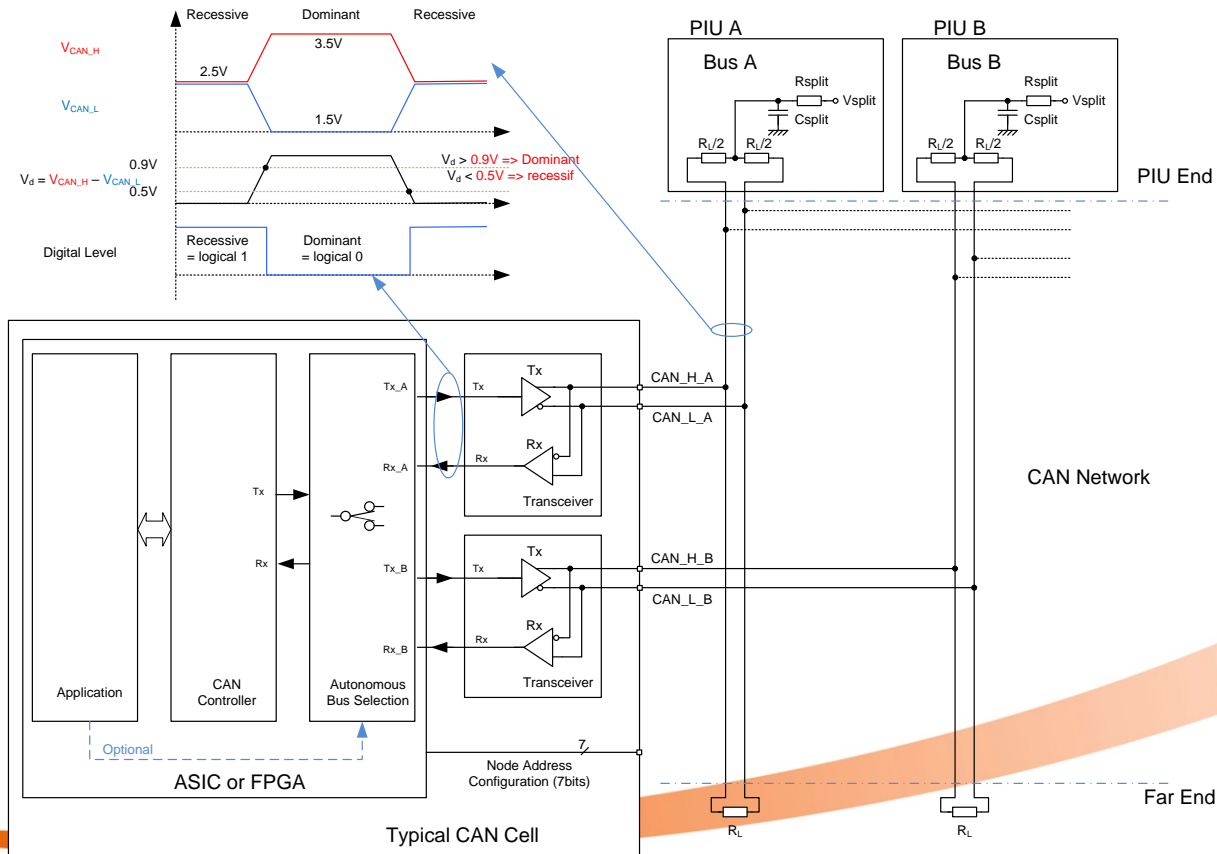AN EADS COMPANY

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- **Physical Layer**
  - Cable Unshielded twisted pair, (poyimide, 3€/m)
  - Active Split termination @PIU end, Un-split @far End
  - Transceiver :
    - Prefered is Integrated Iso.
    - Solution with discrete part validated
  - Number of nodes : Up to 64 per bus
  - Bus length : Up to 40 meters @ 500kb/s
  - Cold redundant buses
  - Data rate :
    - 125 kb/s (discrete transceivers)
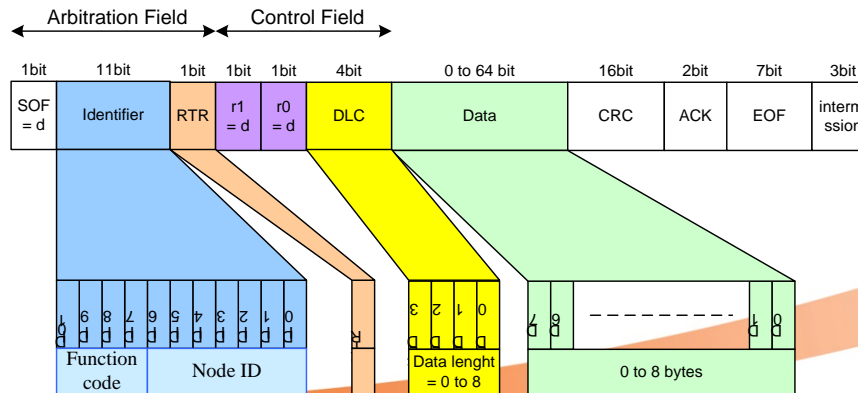   - 500 kb/s (integrated transceivers)

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CAN bus on Eurostar E3000

- **Physical Layer**

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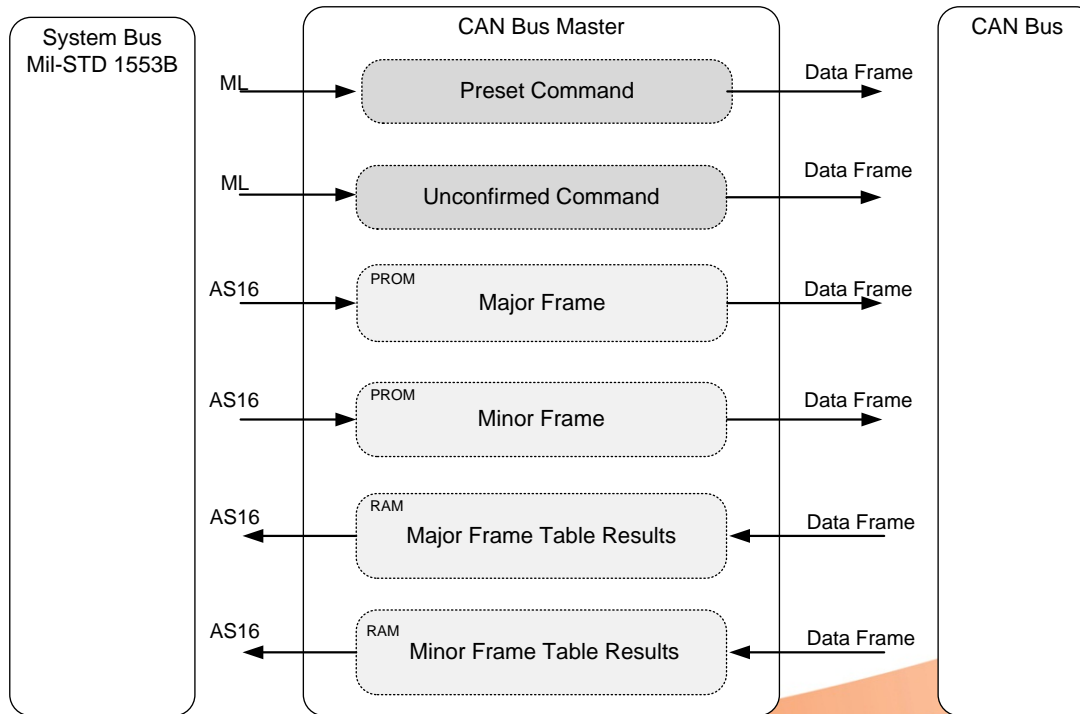# CAN bus on Eurostar E3000

■ Protocol

  ■ Unified with Thalès Alenia Space in the frame of Neosat
  ■ CAN Open/Pre-defined Master/Slave Connection Set (Standard Frame)
  ■ Telemetry Request : Receive PDO
  ■ Data Transmission : Transmit PDO
  ■ Unconfirmed Command : Receive PDO

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- ## Bus Management
  - ### CAN bus Gateway Logic

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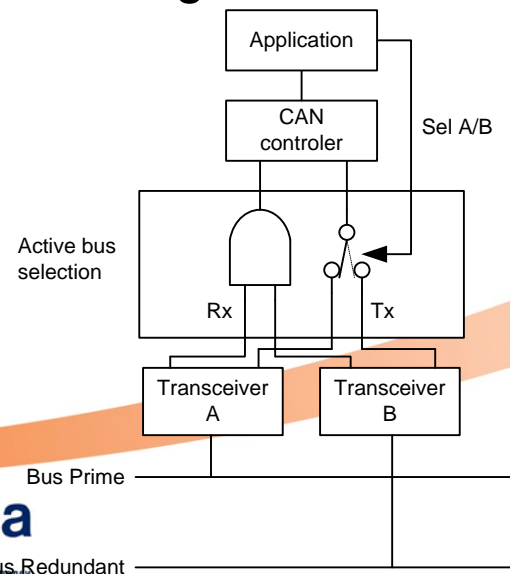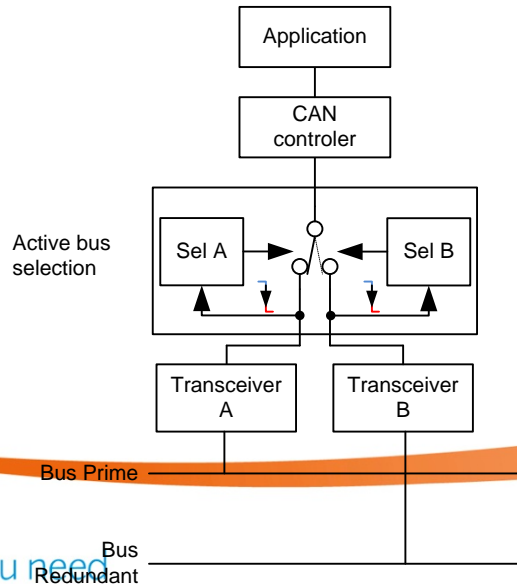
CAN bus on Eurostar E3000

- **Bus Management**
  - CAN bus Gateway polls in continuously the RTs
  - The RTs' TM are stored in CAN bus Gateway shared Memory
  - Major and Minor Frames are implemented for data rate/data quantity management (1553B management heritage)
  - Unconfirmed commands can be interleaved with TM Acq.
  - A table of preset commands is available to simplify 1553 management (Astrium Complex subscriber limitation vs size of CAN frames)

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- **Redundancy Management (RT)**
  - To minimize CAN implementation footprint @ RT level, solutions with a single CAN controller have been preferred
  - 3 options are allowed
    - Selection on Recessive to Dominant levels
    - Selection on Valid CAN Frame
    - Selection on Heart Beat Message

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CAN bus on Eurostar E3000

- **Progress Status**
  - Protocol : Frozen √
  - CAN Gateway Specification : Frozen √
  - CAN Gateway FPGA : Coded √
  - CAN Gateway Board : Manufacturing in progress √
  - CAN Discrete Transceiver : Validated √
  - Physical Layer Test : TRR passed √
  - Functional Validation Test (Feb 2014) : Under definition √

  - E3000 with CAN Ready for bid : Q1-2014 √

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Thank you for your attention !

……Any Questions

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