CAN @ Airbus

Overview of use of CAN bus at Airbus Defence and Space

DEFENCE AND SPACE

Jean DALENQ

June 12, 2019, Gothenburg

AIRBUS

Agenda

- Eurostar E3000 and Eurostar Neo Payload Serial Bus
  - Mission
  - Eurostar E3000 and Eurostar Neo implementation
  - Development status
- Eurostar Neo Platform Modules Communication Bus
  - Mission
  - Development status
- Exo Mars Rover
- Developments Feedbacks

Eurostar E3000 and Eurostar Neo

Telecom Payload Serial Bus

DEFENCE AND SPACE

AIRBUS

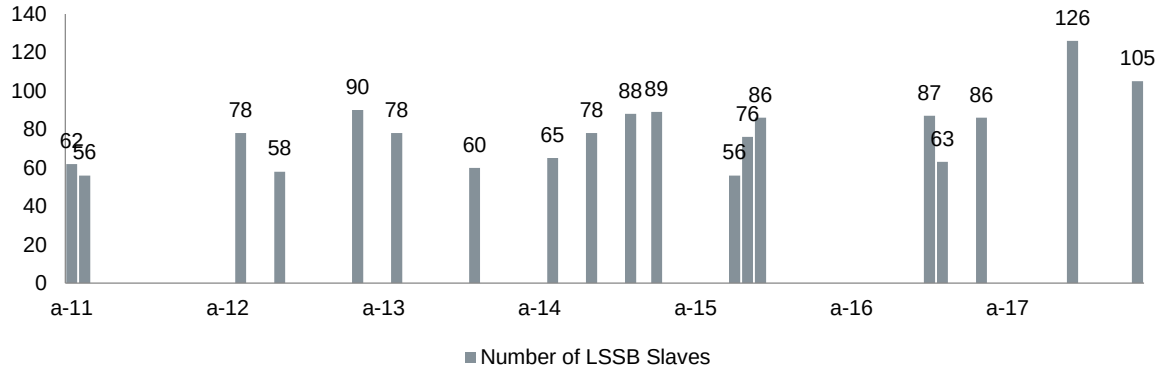
Payload Serial Bus

Aim and characteristics

Telecom Payload Serial bus saves discrete TM/TC links and harness
It brings improved commandability and observability of the repeater
It gives efficient operability of the payload

During decades Airbus used proprietary serial bus : LSSB
With drawbacks : limited data rate and number of nodes, non optimized harness (5 pairs per bus), proprietary definition leading to specific development effort on suppliers side.

CAN bus is replacing LSSB :
Improved data rate (250kb/sec),
node up to 64,
single pair per bus,
relying on established standard.



AIRBUS

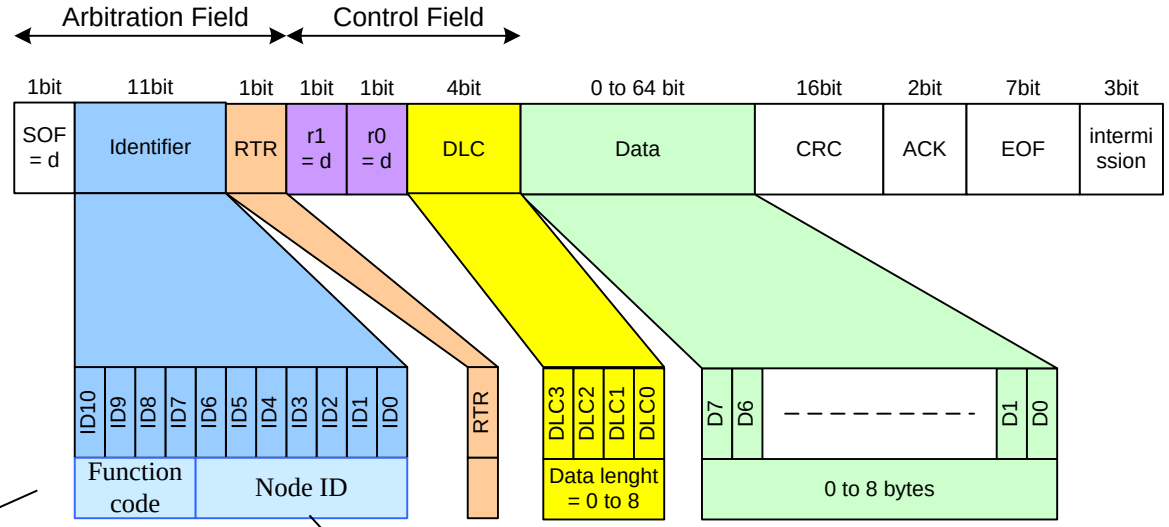
Payload Serial Bus

Higher Level Protocol

In the frame of Neosat and Artes 5.2 Protocol has been agreed with TAS,TESAT and Airbus DS

Master/Slave + Time Triggered

Message coding is CANopen



Master (PIU) -> Slave		Slave -> Master (PIU)	
PDO Label	Function Code	PDO Label	Function Code
RPDO1	bx0100	TPDO1	bx0011
RPDO2	bx0110	TPDO2	bx0101
RPDO3	bx1000	TPDO3	bx0111
RPDO4	bx1010	TPDO4	bx1001

Message type	Direction	PDO	Data	Comment
TM Request	Master -> Slave	RPDO1, 2, 3, 4	Optional	
Data Transmission	Slave -> Master	TPDO1, 2, 3, 4	Yes	Shall always be initiated by TMReq
Unconfirmed Command	Master -> Slave	RPDO1, 2, 3, 4	Optional	

Connector address

AIRBUS

Payload Serial Bus

Bus Management

Slave implementation :
Slave Nodes are CPU-less units
Cost Driven ⇒ simplest implementation, simplest validation
- No CPU added to manage CAN bus
- Single CAN bus Controller with bus selection allowed in order to minimize logic resources

Master implementation :
Master CAN bus manager is also hardware implemented
Telemetry polling via frames :
- Cyclic
- Generic
- Deterministic

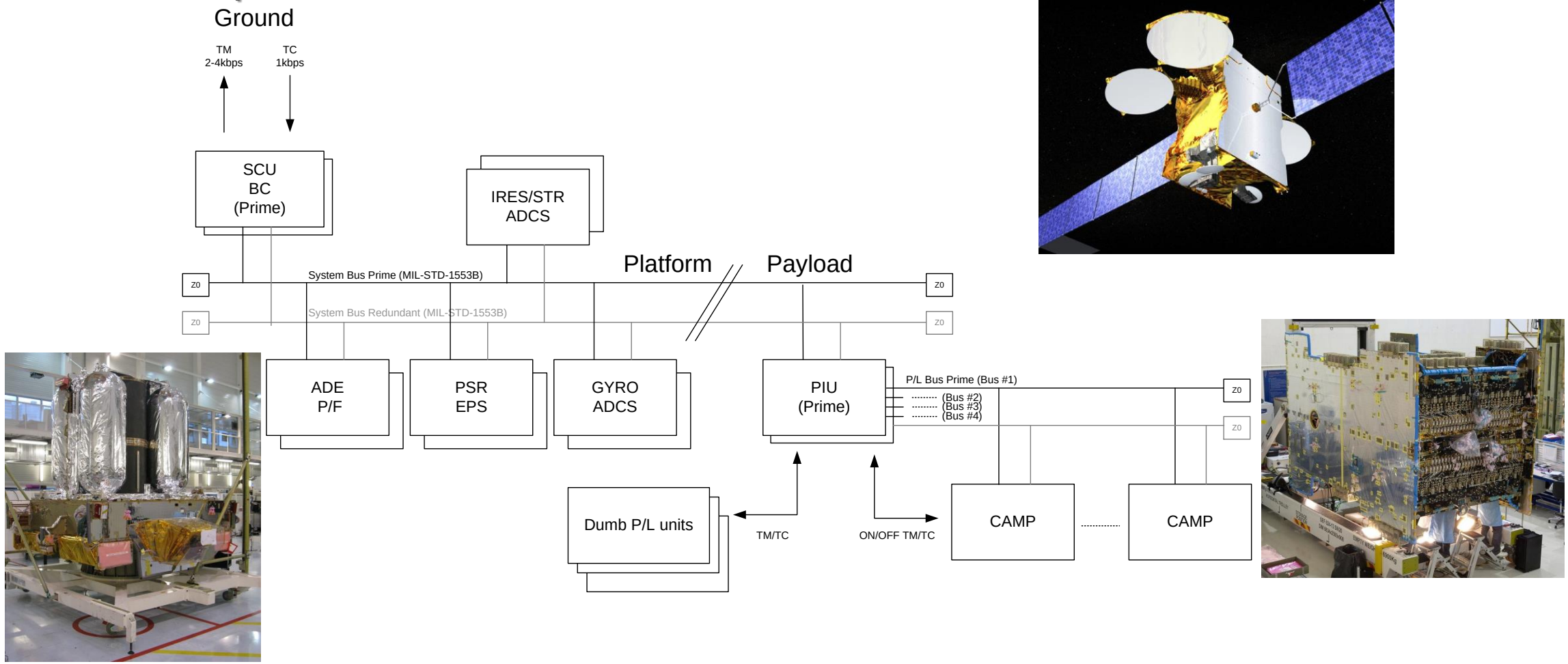
⇒ Shrink Validation Time

Slave Nodes send messages only on Master Request

Payload Serial Bus

- P/L buses managed by PIU/RTU
- Decentralized management
- Minor and major deterministic frames
- P/L Data available every 1second for CSW

Eurostar E3000 implementation



AIRBUS

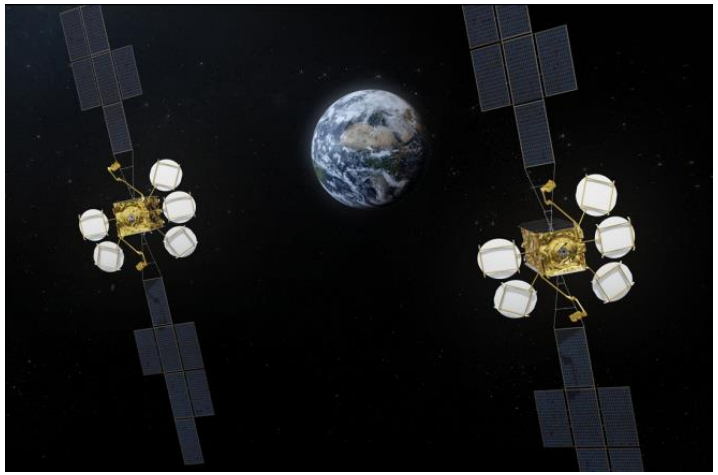
Payload Serial Bus

Eurostar Neo implementation

CAN bus definition :

- Same as E3000
- 64 nodes
- 40 meters
- 250 kb/sec

- P/L buses managed directly by OBC
- 4 buses available
- P/L data available every 1 sec @ OBC



Payload Serial Bus

Development Status

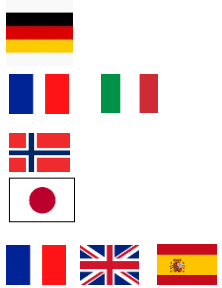
CAN Bus has now supplanted LSSB and is baselined for all new programs

Several units implement CAN bus interface :

- Up/down flexible converters
- Channels amplifiers
- Stable Oscillators
- Telemetry transmitters
- Telecommand receivers
- …

From Several suppliers :

- Tesat
- Thales Alenia Space
- Kongsberg Norspace
- NEC Space Technologies, Ltd.
- Airbus DS



Payload Serial Bus

CAN bus will fly soon on Eurostar :

Program 1 : launch planned 15/10/2019 – 15/11/2019
Program 2 : launch planned 01/2020
Program 3 : launch planned Q1/2020
Program 4 : launch planned 05/2020
Program 5 : launch planned 01/2021
Program 6 : launch planned 06/2021
Program 7 : launch planned 12/2021
Program 8 : Eurostar Neo, OGD 05/2021
Program 9 : Eurostar Neo, OGD 11/2021
…

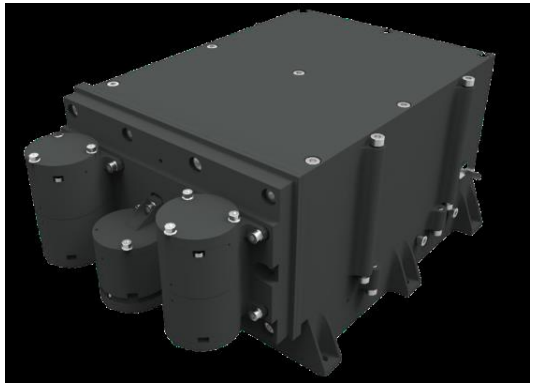
Payload Serial Bus

CPU based CAN nodes an emerging trend?

EREMS is developing two different CAN nodes implementing GR712 Microprocessor in collaboration with CNES
Satcom hosted payloads on payload serial bus

- Instrument interface and processing electronic will fly on E3000 platform
- ICARE Radiation monitor will fly on Eurostar Neo platform

cnes CENTRE NATIONAL D'ÉTUDES SPATIALES EREMS



cnes CENTRE NATIONAL D'ÉTUDES SPATIALES EREMS

Eurostar Neo

Platform Modules Communication Bus

DEFENCE AND SPACE

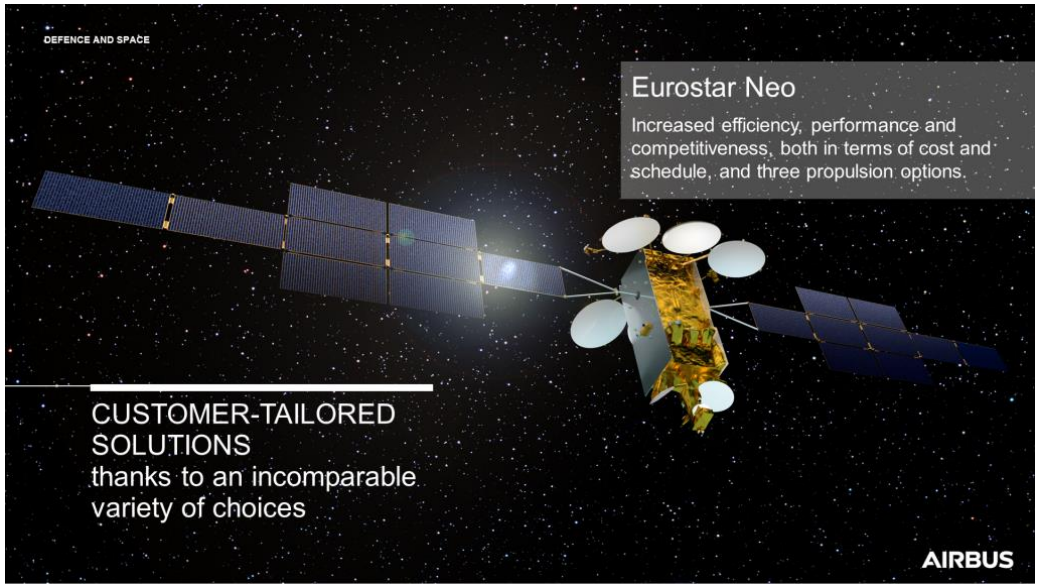
AIRBUS

Platform Modules Communication Bus

Aim and characteristics

- Eurostar Neo Telecom platform now in production
- DHS units use CAN bus to connect I/O modules to the processor

- Data rate : 1Mb/sec
- Most distant nodes : <= 15 meters
- Nodes : <= 44



Platform Modules Communication Bus

Developpement Status

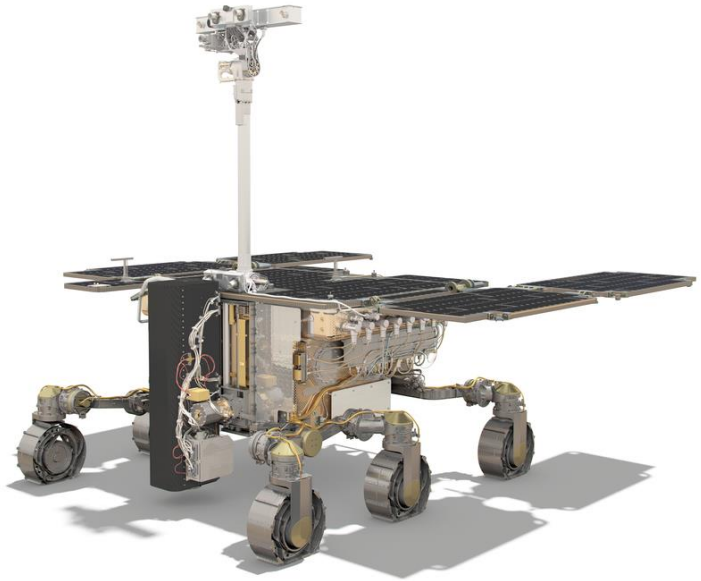
- Physical Layer validation : completed
- System functional validation : completed
- 1st specimen AIT : completed (Quantum)
- First launch End : Q1 2020 (Quantum) – Q3 2021 (Eurostar Neo)

Exo Mars Rover

DEFENCE AND SPACE

AIRBUS

ExoMars Rover



CAN Bus implementation:

- 1 P/F + 1 P/L bus
- 1000 kbps
- RS 485 (DS16F95)
- Higher level protocol : CANopen (HurriCANe/CCIPC)

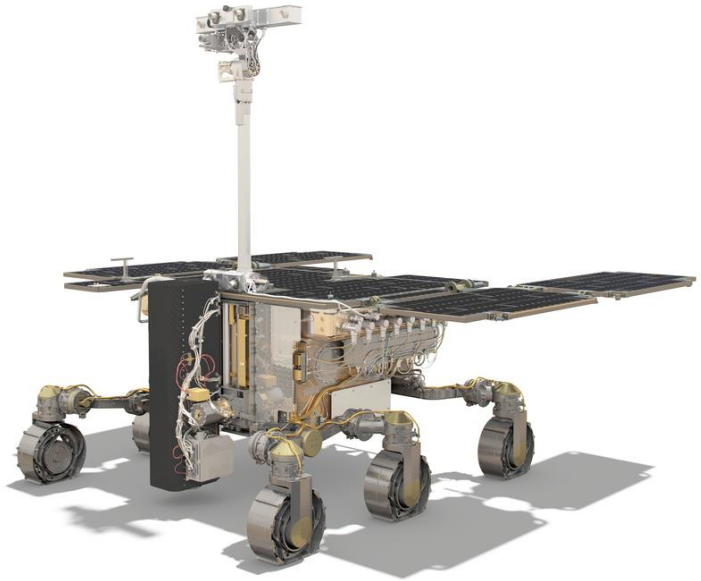
Platform :

- Lengths :7m between most distant nodes 8,5m total.
- 10 nodes per bus

Payload :

- Lengths : ~ 3.8 m between most distant nodes.
- 8 nodes per bus

ExoMars Rover



Current status:

Testing on the ETM (Engineering Test Model)

- On-going activity that will continue for the rest of the year.

LVM (Locomotion Verification Model)

- On-going testing of the locomotion aspects of the Rover (e.g. ability to drive in different terrains)

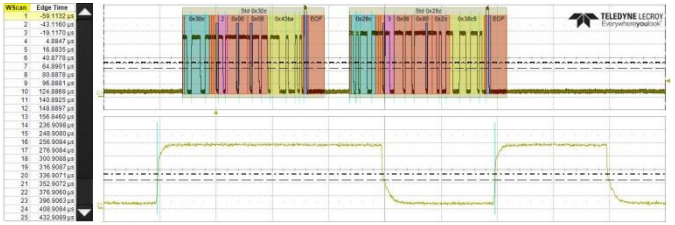
Integration of the FM Rover.

- Service Module is now completely integrated
- Analytical Laboratory Drawer is mechanically integrated and is being electrically integrated this week and next.
- Integration is planned to be complete at the end of July
- Environmental testing to be carried out in Toulouse August to December.
- End of December Rover is delivered to Cannes (TAS) for integration into the carrier module.

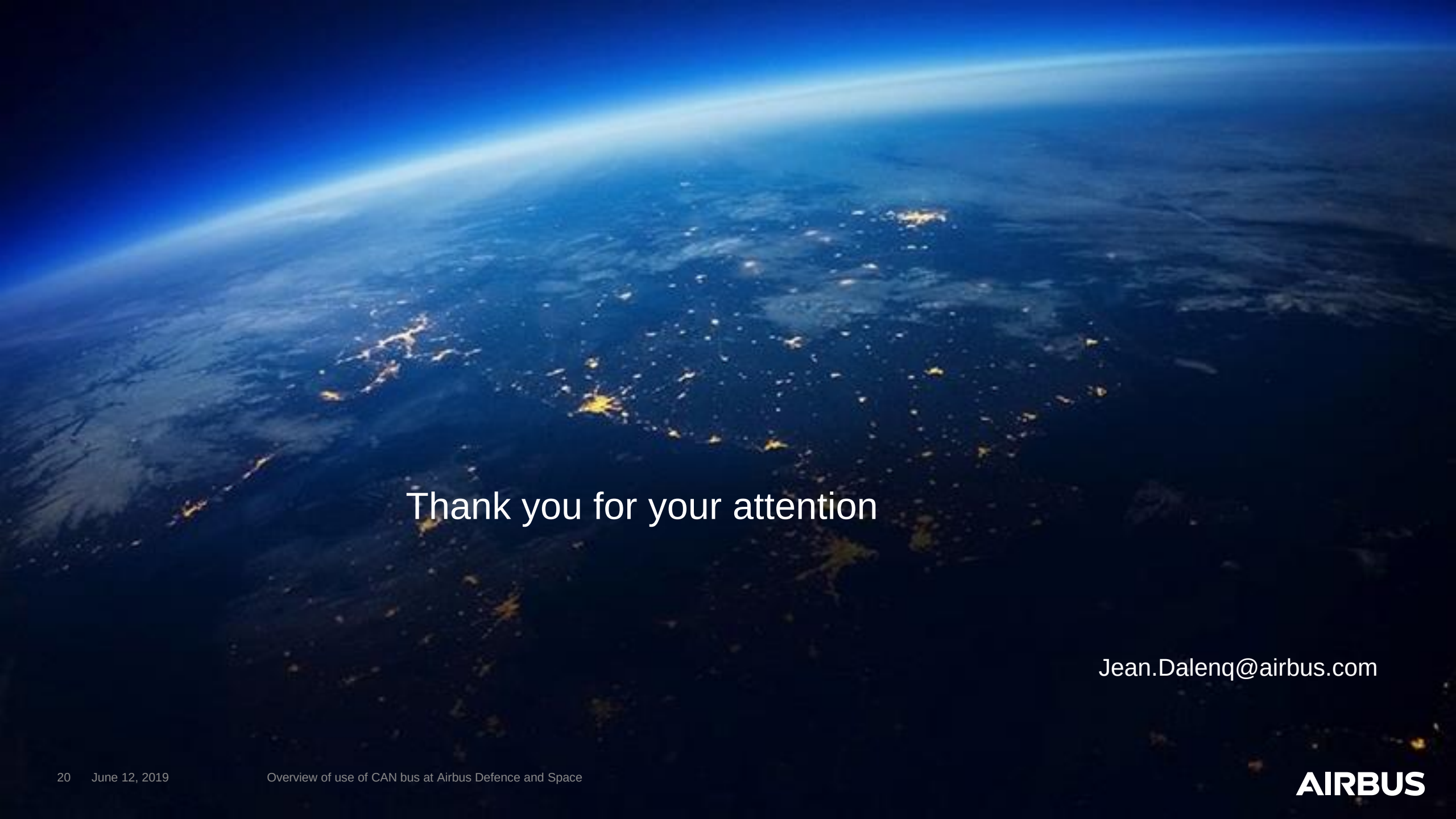
Launch : 2020

Developments Feedbacks

Developments Feedbacks



- Bit timing management went well on Eurostar with the dogma : Sampling point : the later the better.
- Waveforms checked during spacecraft AIT: conform with predictions
- Identifier mask : on Most Significant Byte on GR712 while Node address is on 7 less significant bits on CAN Open
- Push further the bus length : 40 meters can be extended @ 250kbps, 15 meters hard limit @ 1000kbps -> need for faster transceivers ?
- Spacecraft Thermal Vacuum test : CAN buses are remotely monitored through repeaters
- Can CAN bus be implemented without external oscillators ? State of the art of internal oscillators accuracy ?
- Is there some initiative to integrate transceivers on µC ? Failure propagation management ?


Thank you for your attention
Jean.Dalenq@airbus.com