FILE MANAGEMENT AND FILE TRANSFER CNES VIEWS

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FILES IN SPACE - SHORT INTRODUCTION

Many R&T studies have been conducted by CNES on Files usage:

- *"AGATA Use of files on-board the satellite"* in 2007-2008: first general concept analysis- TAS
- *"AGATA Smart TM & on-board files"* in 2009-2010: demonstrator development targeting autonomous on-board file management-TAS
- *"AGATA Autonomous board/ground link management"* in 2010-2011: concept consolidation with writing of optimized autonomous on-board algorithm for autonomous file handling -TAS
- *"File transfer system"* in 2011-2012: analysis of multiple file transfer protocols & implementation especially: CFDP with TAS and PUS large data transfer with AST
- *"File management system"* in 2012-2013: analysis of a generic file management system & implementation. TAS and Airbus DS. Final presentation February 2014.
- *" DTN over space packet protocol including SLE segment "* Experiment of a DTN link with an ISS test-bed in discussion with NASA for a beginning in 2014.

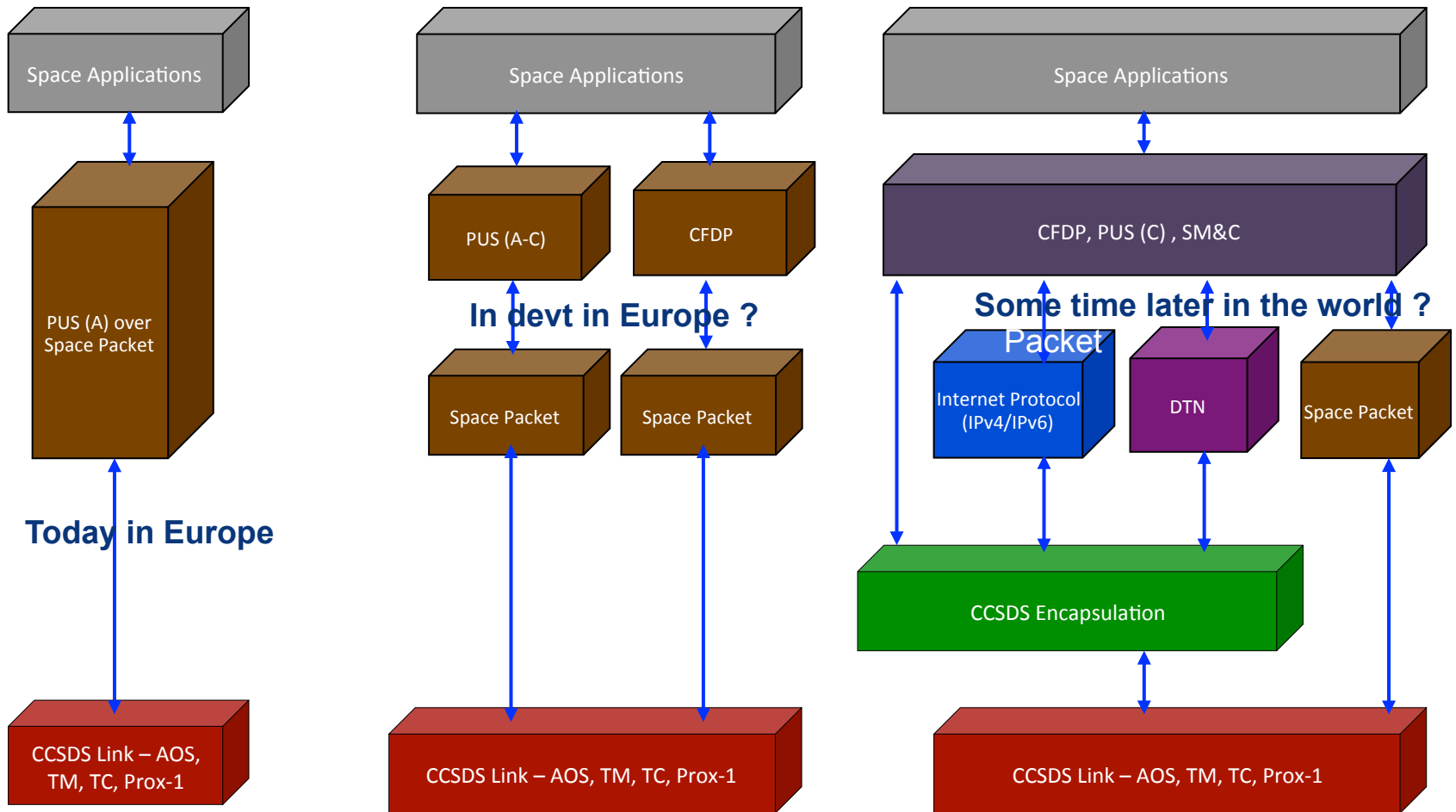Very broad studies, all focusing on satellite operations based on files OPS:

- Confirmation of Interest of files to enhance the autonomy & simplify satellite operations
- Study of existing file transfer protocols & development with mock-up implementation of a generic file management and file transfer system based on CFDP
- Analysis of the impacts on Avionics : no feasibility problem identified

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NEEDS AND OPS CONCEPT ASSOCIATED TO FILES TRANSFER AND MANAGEMENT

File structures are increasingly used on space missions both for payload science/observation data storage and for satellite telecommands and housekeeping telemetries.

- Payload and Science data TM downlink
  - ✦ Payload and sciences data are now often stored, managed on board as files. These files need to be also downloaded to ground as far as possible in a secure way and if possible using standardized protocols
- Satellites Monitoring and control TM and TC
  - ✦ Files are more and more used in ops concept even if there are not called files
  - ✦ TC link: upload and management of mission plan, OBCP, new on board S/W
  - ✦ TM link: download of on board files (log book, events, files, tables, smart TM, on board S/W, mission plan..)

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OVERVIEW OF AVAILABLE STANDARDS

Today in Europe

Space Applications

PUS (A) over Space Packet

CCSDS Link – AOS, TM, TC, Prox-1

In devt in Europe ?

Space Applications

PUS (A-C)   CFDP

Space Packet   Space Packet

CCSDS Link – AOS, TM, TC, Prox-1

Some time later in the world ?

Space Applications

CFDP, PUS (C) , SM&C

Packet

Internet Protocol (IPv4/IPv6)   DTN   Space Packet

CCSDS Encapsulation

CCSDS Link – AOS, TM, TC, Prox-1

We have also to add the SOIS standards and security TM/TC protocols

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CNES MISSION UNDER DEVELOPMENT STATUS

- Payload and Science data TM
  - ✦ Payload and sciences data are now stored, managed on board as files and stored in Mass memories ; All mass memories implement functional files management functions as read, write, suppress (Basket), download …..
  - ✦ Packet TM for transmission, simple file transfer protocol (if something is lost during the downlink of the file, the ground re-asks globally the downlink of the file if still available)
  - ✦ All these functions are customized and mission dependent but we think that there a potential interest for standardization
  - ✦ Use of CFDP has been analyzed but not selected. No real need for the current CNES Sciences mission and not useable for Earth Observation missions because payload data are globally encrypted including data to handle the protocol

- Satellites Monitoring and control TM and TC
  - ✦ Files are more and more used in ops concept even if they are not called files
  - ✦ TC link: upload and management of mission plan, OBCP, new on board S/W
  - ✦ TM link: download of on board files (log book, events files, on board S/W, mission plan..)
  - ✦ CNES missions use the existing PUS large data transfer service to transfer these "files". If we need to improve the objective is to use CFDP (feasibility demonstrated). No need for a new protocol.

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CNES MISSION COMMUNICATION CONCEPT RATIONAL (MAINLY FOR EARTH OBSERVATION)

- Parallel S-band and X-band

- S-band links: Housekeeping TM and TC uplink based on TM/TC packets standard and PUS services. CFDP can be used if PUS large data transfer services are not sufficient

- X-band: Download of recorded Payload and sciences data from Payload MMU base today on CCSDS packet (move to CFDP and/or DTN when necessary) but we have to cope with an encrypted link

- Challenges for the future :
  - ✦ Higher data volume and data rate in X band (Optical and Ka bands under study)
  - ✦ Minimum loss of data and quick time recovery if data loss especially for Payload and science TM
  - ✦ Encrypted TM (X and S band) and authenticated TC (s band)

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OPEN POINTS
WHICH MUST BE WORKED OUT AND COULD BE HARMONIZED

- Need for a common definition of a set of Standardized On board files management services. Results available from last TAS and AirbusDS CNES R&T study and Work in progress in the frame of PUS C WG.

- Overlaps between DTN and CFDP and SOIS standards must be clearly identified and solved. Clear design rules must be established and if possible, standards should be harmonized to solve conflicts . A clear separation between communication services layers and application services is suitable.

- The CFDP standard must be commonly tailored for simple missions with only secured point to point needs (major CNES missions today)

- When TM and TC links are encrypted, interaction between communication protocols and encrypted function must be studied especially when there are several nodes in the link (store and forward..). What could be decentralized in the station ? Could we only protect application data and not protocol data?

- Interest for a generic architecture definition for the science/payload TM chain including storage, compression, encryption and communications functions ?

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