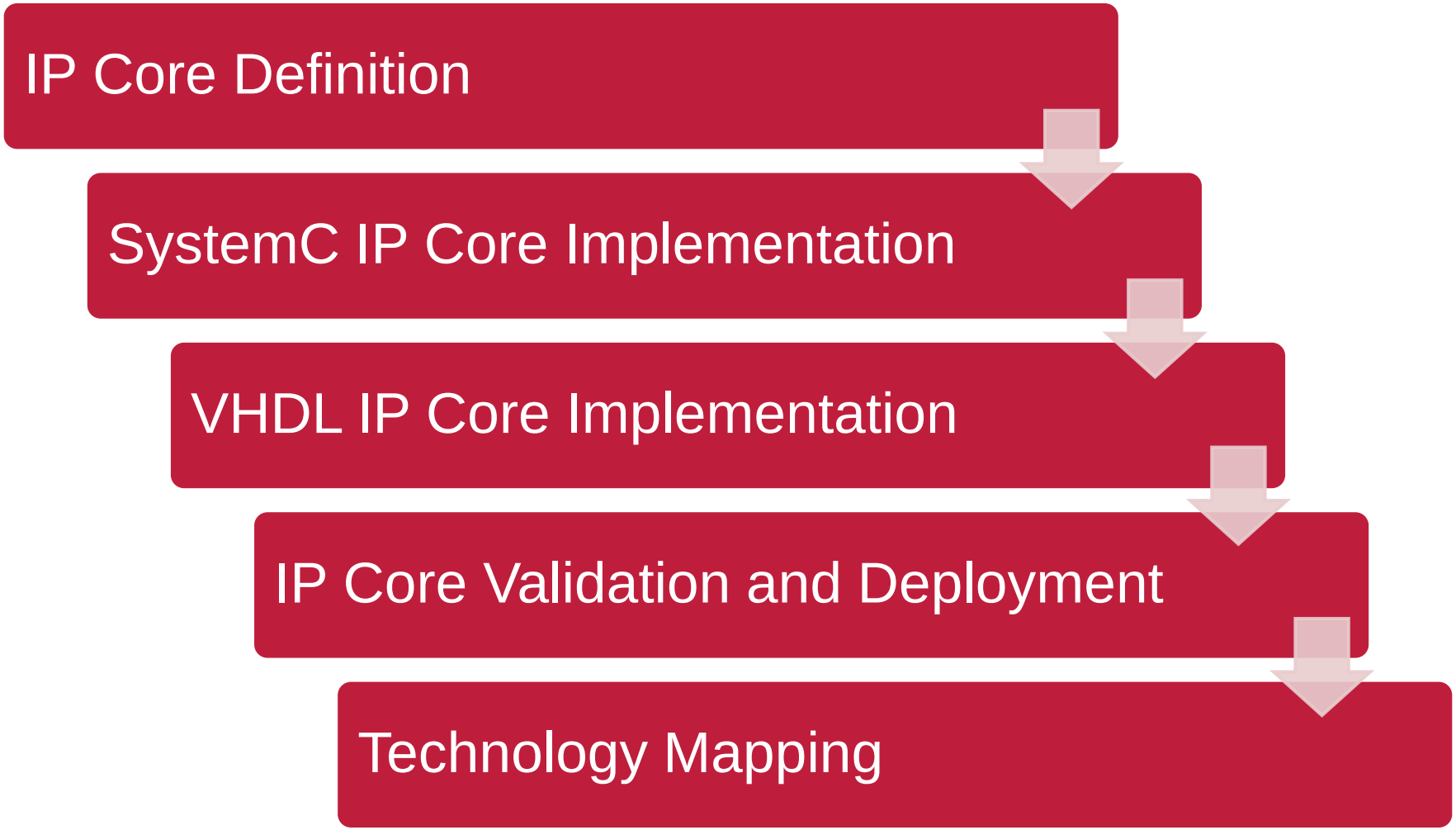
Technische Universität Braunschweig

Development of the CCSDS File Delivery Protocol IP Core

Norman Dankert, 25 October 2012

Overview On The Workflow Of The Study



Details On The Workflow Of The Study

IP Core Definition	• Features Selection • Hardware/Software Partitioning
SystemC IP Core Implementation	• Initial software and driver development • Hardware modeling on SoCRocket Virtual Platform
VHDL IP Core Implementation	• Final software and driver development • Hardware design based on SystemC models
IP Core Validation and Deployment	• Map to a RASTA compatible FPGA prototyping board • Connect board to GR-RASTA-101 compatible system for testing
Technology Mapping	• Map to FPGA technologies: Actel RTAX, RTSX, Pro-ASIC, Xilinx Virtex-5 • Map to ASIC technologies: DARE rad-hard library

The CCSDS File Delivery Protocol (CFDP)

Features Selected From The CFDP Standard

Features selected

- Class 1 – Unreliable Transfer
- Class 2 – Reliable Transfer
- Sender (data source) only
- Bounded files only (no stream data)
- Record boundaries inside files not respected
- Retransmission buffers released when finished

Configuration options

- Size of Local and Remote Entity IDs
- Size of Transaction IDs
- Number of Remote Entities
- Number of Outstanding Transactions
- Timer granularity and length
- Maximum payload size
- Encapsulation Packet, Space Packet or raw CFDP PDUs

External Requirements Driving The Architecture

Performance

- ESA Euclid Mission
  - 67.5Mbit/s raw data
  - 168Mbit/s at telemetry link
- Next Generation Mass Memory
  - Average 1.5Gbit/s
  - Maximum 5Gbit/s
- Lunar Reconnaissance Orbiter
  - 100Mbit/s

Variability

- High Configurability
- Different CCSDS encapsulation formats
- Generic Filestore Interface
- CAD Tool & commercial library independence
- Embedding in the SoCRocket Virtual Platform

Hardware – Software Partitioning

Hardware

- Transaction and packet management
- Protocol state machines
- File checksum generation
- CRC calculation and validation

Software

- Configuration and control operations
- Split into Driver, Runtime & Client
- Filestore access

Ideas For The Virtual Filestore

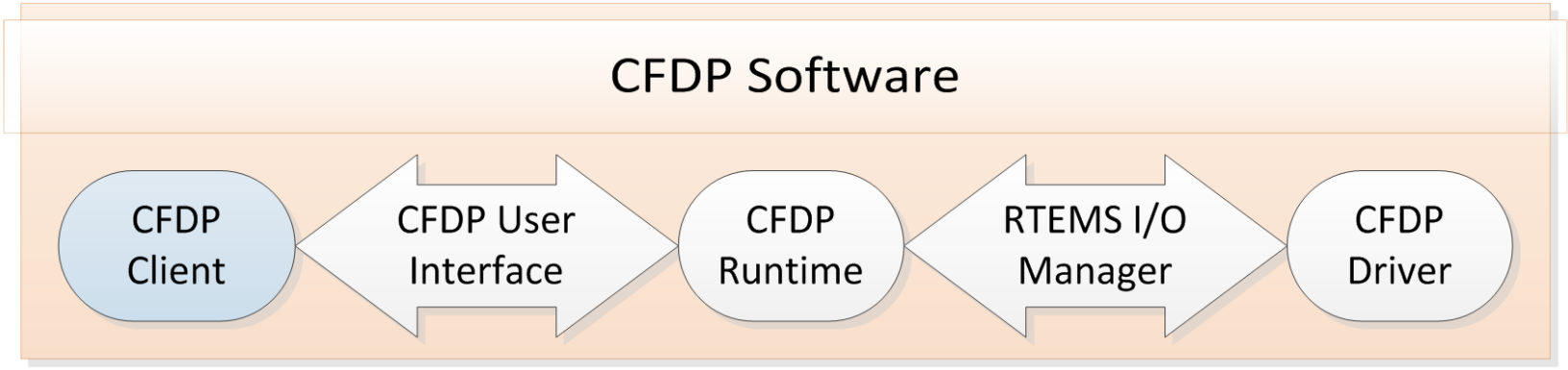
Problems

- No standard for a filestore exists
- Interface as generic as possible with room for improvements
- Support files bigger than physical memory (up to 4GB) and possibly streams
- Filenames (up to 255 Byte) are hard to handle in hardware

Solution

- Decouple details of the filestore from CFDP IP using a generic interface:
  - Open/close file
  - Request file segments (optionally seek first)
- Use small (16-bit) handles instead of long filenames
- Read segments in PDU sized chunks from address returned by file segment request

Details On The Software Architecture



Client (optional)

- Command line tool for testing and debugging
- Automated testbench

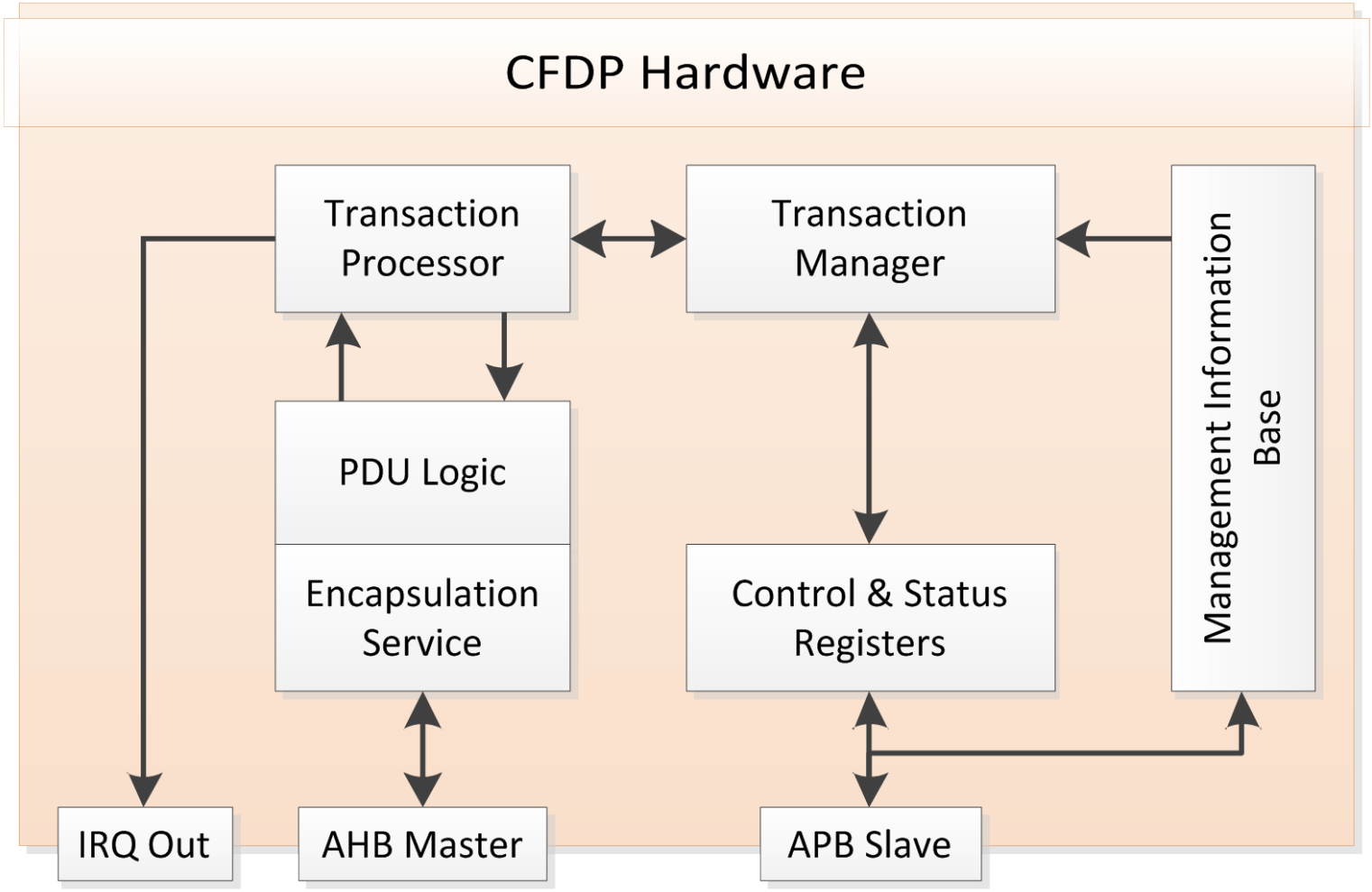
Runtime

- Middleware
- API for client(s)
- Handles interrupts

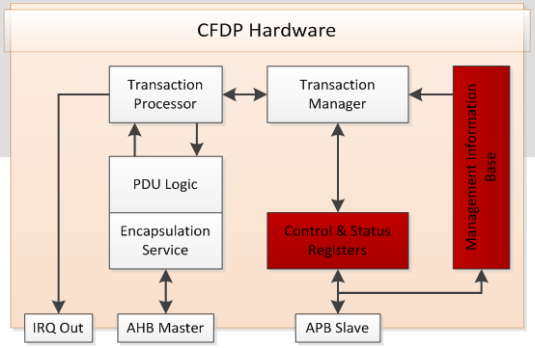
Driver

- Bare hardware access

Details On The Hardware Architecture



Details On The Hardware Architecture



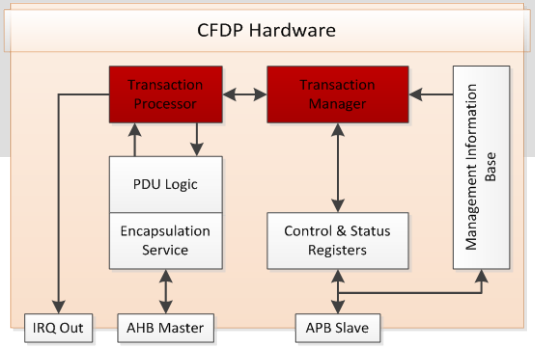
Management Information Base

- Contains configuration for local and all remote CFDP entities
- Only writeable once on startup or hardcoded

Control & Status Registers

- Software utilizes control registers to issue commands
- Hardware uses status registers for indications

Details On The Hardware Architecture



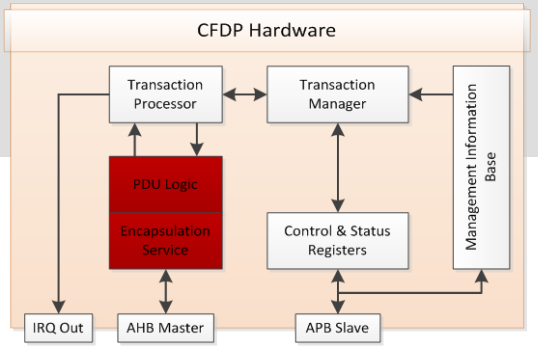
Transaction Manager

- Handles creation, scheduling and deletion of transactions
- Stores transaction contexts
- Buffers incoming PDUs

Transaction Processor

- Executes transaction using state machine
- Requests file data
- Creates outgoing PDUs

Details On The Hardware Architecture



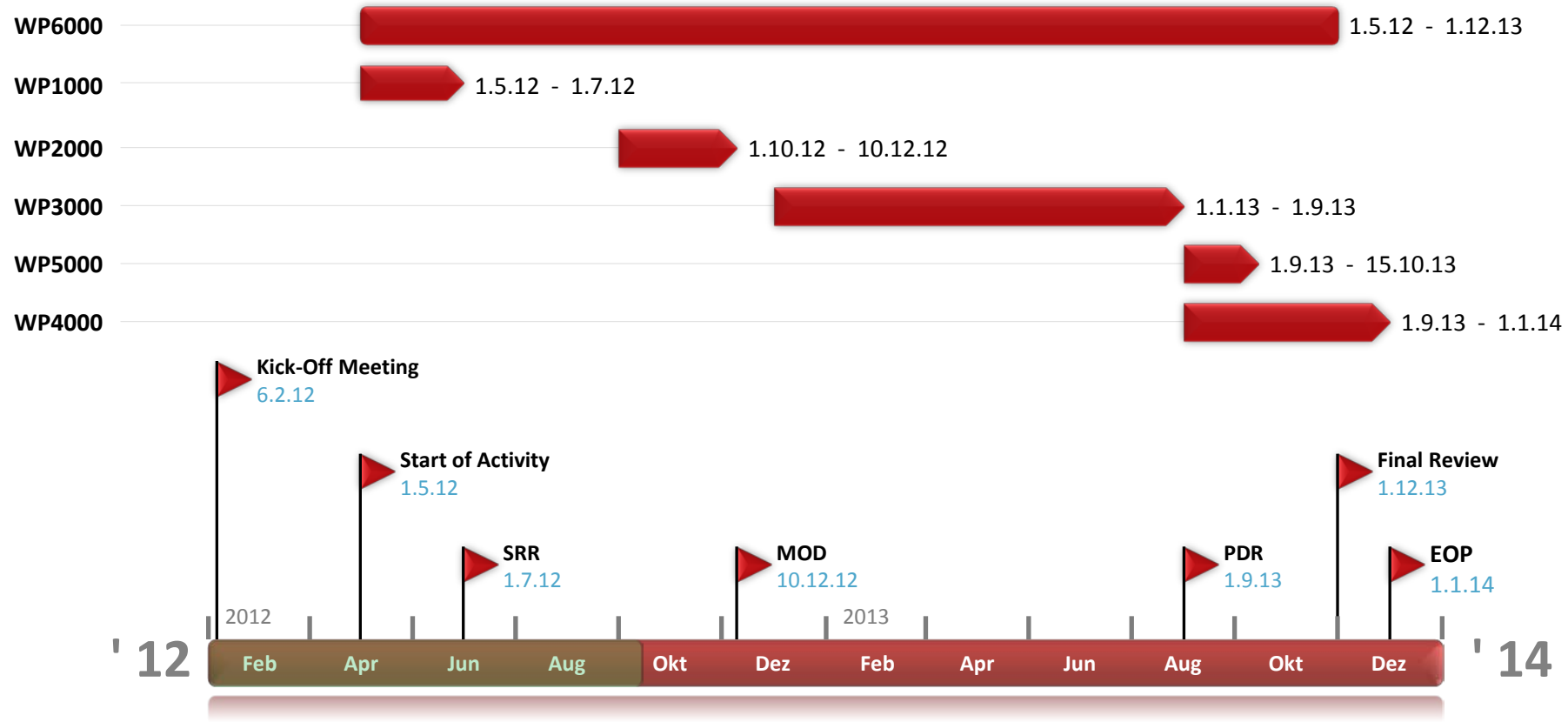
CRC Engine (optional)

- 16-bit standardized CCSDS CRC code at the end of PDUs
- Calculates and attaches code for outgoing PDUs
- Validates code for incoming PDUs

Encapsulation Service

- Supports Space and Encapsulation Packets
- Wraps outgoing PDUs
- Unwraps incoming PDUs
- Bypass possible (sends and receives raw PDUs)

Updated Schedule For The Study



The End

Thank you for your attention!

Any questions?