

Global Precipitation Measurement

System Requirements Review

Data Communications Concept/Requirements



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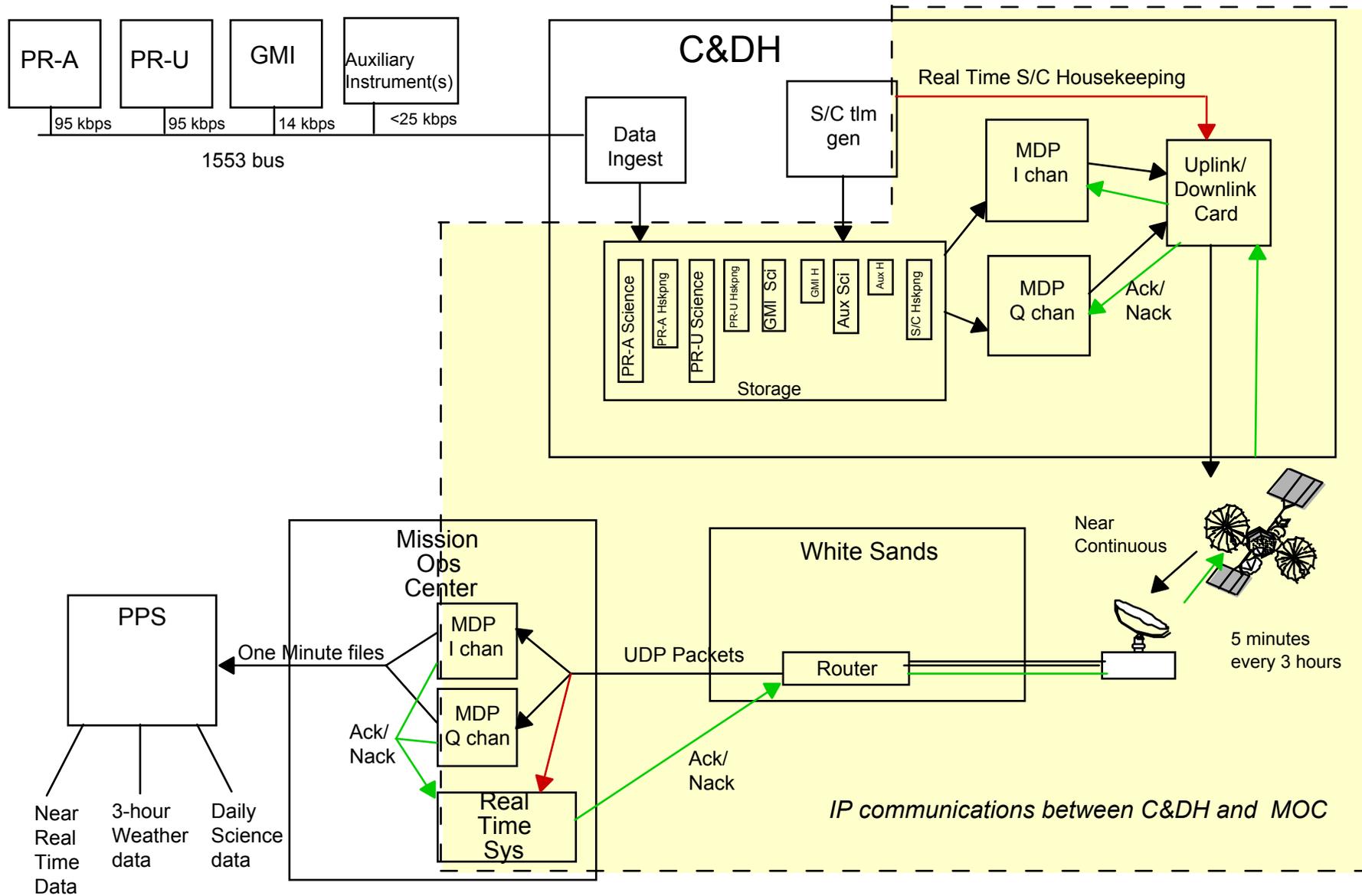
- *Use Internet data format and protocols between space and ground*
- *Rationale*
 - *Standard Internet protocol software is part of the operating system, both onboard and on the ground*
 - *Allows NASA to use proven solutions to a wide variety of communications problems*
 - *Elimination of custom Level Zero Processing functions reduces life cycle costs*
- *This presentation provides an end-to-end overview of current concepts*
 - *Not requirements*
 - *Implementation details will evolve in the design phase*



Current Practice	IP Concept
Coded virtual channel data units (error correction)	HDLC messages with checksums (error detection)
Telemetry Packets	UDP packets
Level Zero Processing	Equivalent function provided by protocol
COP protocol for commanding	tcp/ip for commanding
Bypass commands	UDP commanding
CFDP (under development) for command/software loads and dumps	ftp for command/software loads and dumps
CFDP (under development) for recorded data dump	MDP (requires adaptation of existing software) for recorded data dump

- *IP accomplishes the same functions as current practice*
- *Except for MDP, the protocols uses are universally supported*



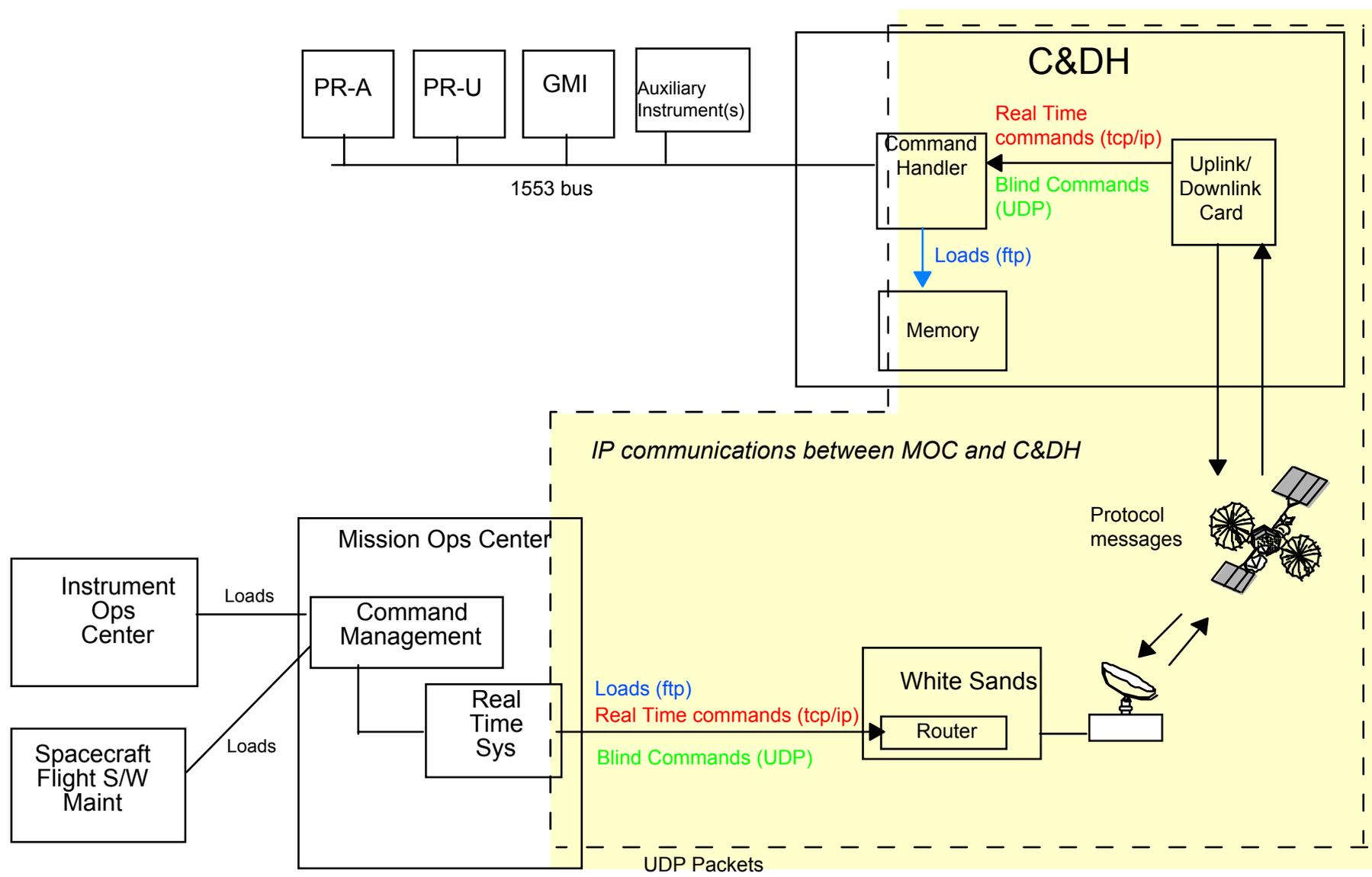


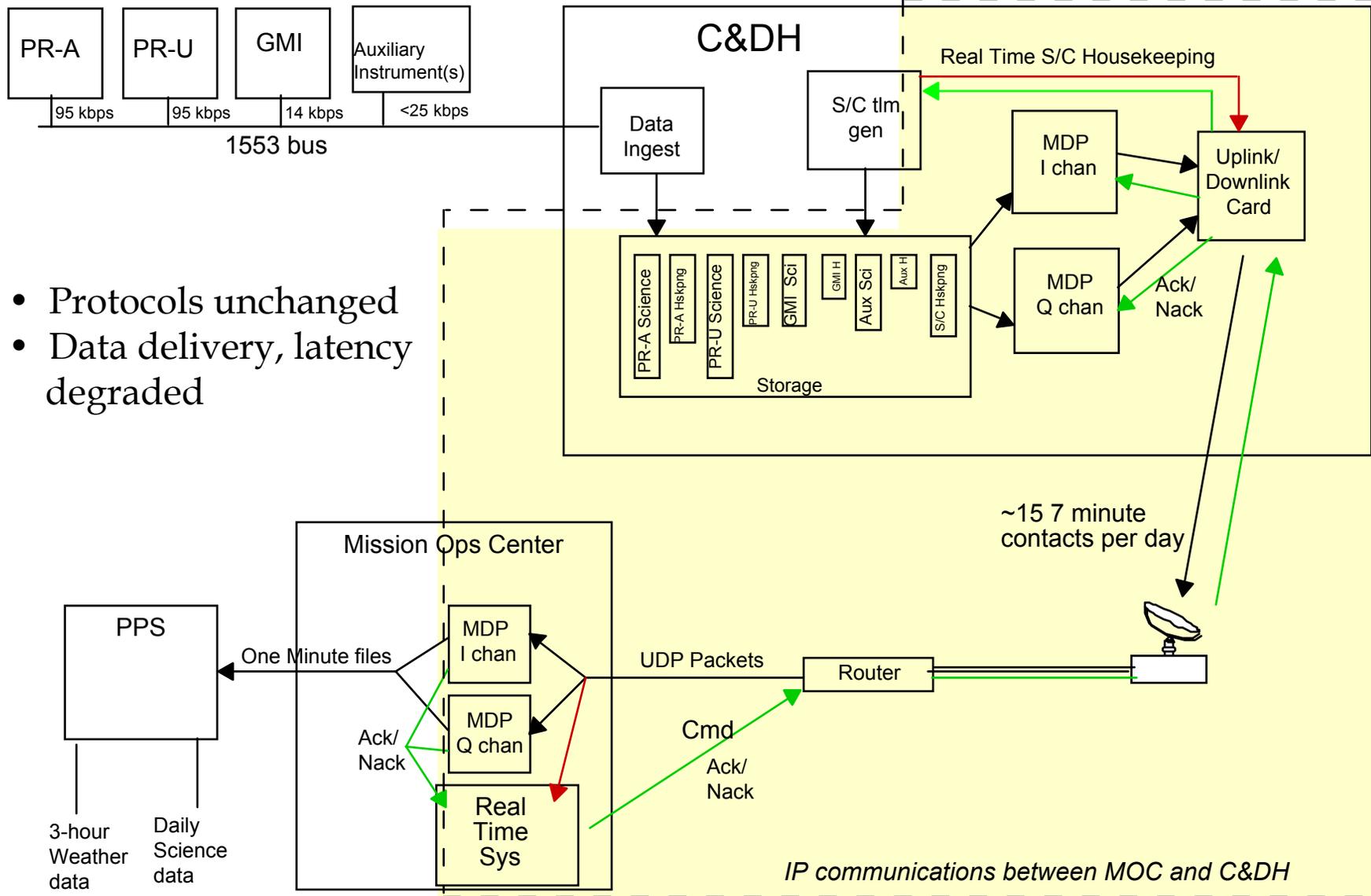
- *Provides reliable file transfer for asymmetric, infrequently bi-directional communications link*
 - *Developed by NRL and used commercially*
 - *Internet standard (RFC) under development*
- **GPM Concept**
 - *Collect instrument data into 1 minute files*
 - *Send files to ground*
 - *Hold data during scheduled outages (for example, TDRS handover)*
 - *MOC accumulate acks and nacks on the ground*
 - *Schedule forward link every 3 hours (prior to weather forecaster delivery)*
 - *Either Multiple Access or Single Access*
 - *Send acks and nacks*
 - *Onboard system deletes acknowledged files and retransmits nacked data*
 - *MOC sends complete files to PPS*
 - *PPS distributes data to users*
 - *Near real time*
 - *Weather forecasters (3 hours)*
 - *Science users (within 72 hours)*



- *System sized to accommodate the loss of an entire TDRS pass (35 minutes) without operator interaction*
 - *Data will be recovered within 12 hours*
- *S-band Single Access contacts will be scheduled to recover larger outages*
- *Expected performance*
 - *Nominal conditions - BER of 10^{-8} 99% of the time*
 - *95% of data available in near real time*
 - *1 to 2.5 minutes after data generated*
 - *>99% of the data available for 3 hour weather forecaster delivery*
 - *>99.98% of the data available for science processing within 6 hours*







- Protocols unchanged
- Data delivery, latency degraded

- **No technical risks**
 - All protocols have been or soon will be used on spaceflight missions
 - MDP used on CANDOS, a shuttle payload flying this summer
- **Challenge to GPM is to implement IP cost effectively**
 - Define the solution end-to-end, considering impacts to all components
 - Implement IP for both nominal and contingency cases
 - Realize the benefit of off-the-shelf software



- **CANDOS** *Communication and Navigation Demonstration on Shuttle*
- **CFDP** *CCSDS File Delivery Protocol*
- **COP** *Command Operating Procedure*
- **FTP** *File Transfer Protocol*
- **HDLC** *High Level Data Link Control*
- **IP** *Internet Protocol*
- **MDP** *Multicast Dissemination Protocol*
- **TCP** *Transmission Control Protocol*
- **UDP** *User Datagram Protocol.*

