

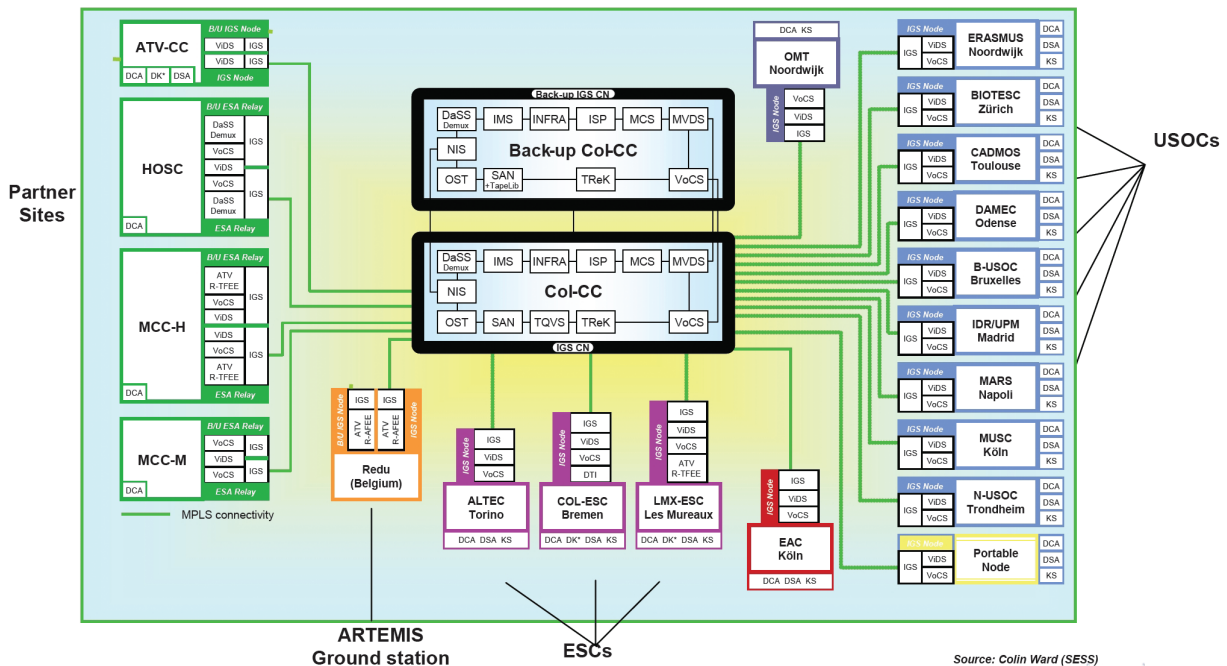
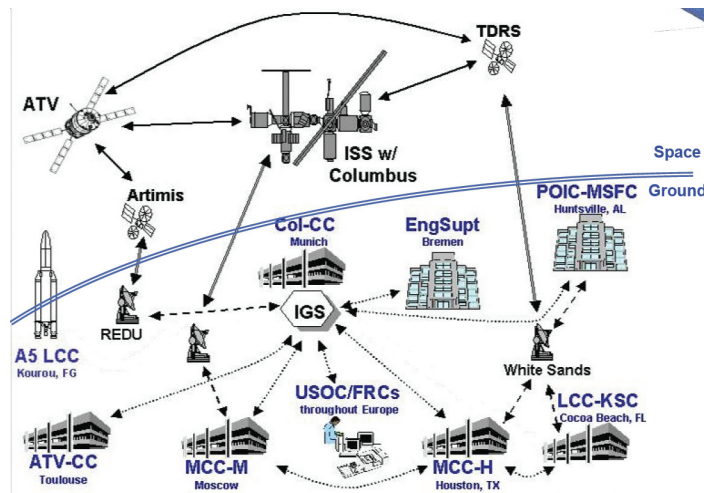
→ COLUMBUS CONTROL CENTRE (COL-CC) AND ITS COMMUNICATIONS INFRASTRUCTURE (CI)

The Columbus Control Centre (COL-CC) in Oberpfaffenhofen, near Munich (Germany) is responsible for Monitoring & Control (M&C) of the European Columbus laboratory at the International Space Station (ISS) and the support for decentralised operations of European payloads in Columbus, the US Lab and Russian Segment of the ISS.

The Communications Infrastructure (CI) provides links for service provisions to:

- Columbus Control Centre (COL-CC),
- Autonomous Transfer Vehicle Control Centre (ATV-CC),
- Engineering Support Centres (ESC),
- International Partners sites,
- Payload User Support Operations Centres (USOCs),
- REDU ground station for ATV up/downlink.

ATV-CC relies on NASA MCC-H & White Sands or REDU ground station for uplink/downlink of TC/TM: Columbus system and payload operations are performed via NASA MCC-H and White Sands ground station.



Source: Colin Ward (SESS)

	PROJECT:	International Space Station	
	TITLE:	COL-CC and CI	DOCUMENT N°: ESA-HSO-COU-032
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COL-CC infrastructure and infrastructure deployed by Col-CC at other sites encompass 20 sites. Remote deployment includes communication nodes (IGS nodes), data distribution S/W and H/W (DaSS), voice and video equipment.

Columbus Ground Segment Architecture

The Columbus Ground Segment Architecture relies on scalable and redundant components for its Data Services. The CD-MCS provides a standard client implementation for all USOCs.

DATA SYSTEM ARCHITECTURE:

- Redundant Kernel at COL-CC serving local or remote client connections.
- API implementation at each remote site of Client Service (Path TM, processed Data distribution), and optionally a Server Service (commands, process data contribution).
- TM Distribution according to CCSDS APID.

DASS DATA SERVICES:

- CCSDS Packet Data Delivery (up to 500 packets/sec)
- Processed Parameter Delivery (up to 5000 param./sec)
- CCSDS Command Forwarding
- Command Echo
- High Rate Bitstream Data Delivery (up to 32 mbps)

CD-MCS CLIENT SUPPORT

- Y
- Y
- Y
- Y
- Y
- Y

DATA MODES

- Real-time (OPS, Sim, Test) Y
- Playback (from DaSS archive) Y
- External playback Y
- Direct delivery of Bitstream Y
- Deferred and rate-adjusted (bitstream) Y

The COL-CC Architecture relies on scalable and redundant components for its Voice system and to a lower extent for its Video System.

VOICE SYSTEM

- The Voice System provides conference loops to all participants. It's architecture is based on:
- Redundant Matrices at COL-CC connecting remote matrices at Partner sites ATV-CC, MCC-H, HOSC, MCC-M, EAC.
 - Dedicated Keysets at COL-CC.
 - Dedicated Keysets at User sites via ISDN connection.

VOICE SERVICES

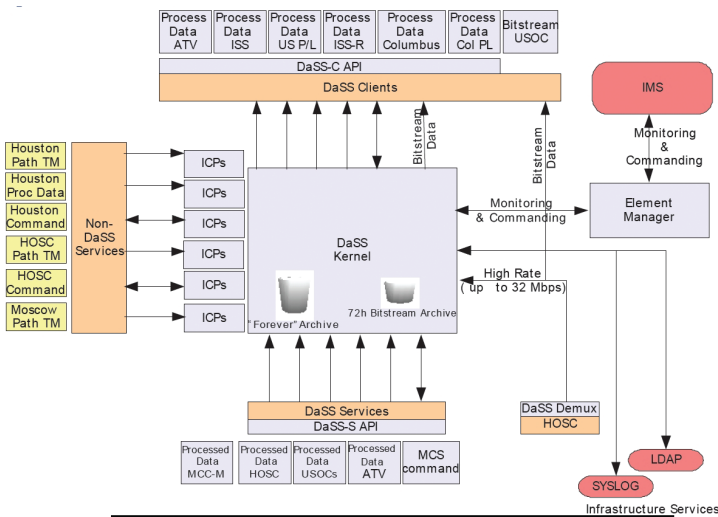
- Provision of 150 Voice keysets (internal and external).
- Voice channels and conferences (up to 1000).
- Voice recording & retrieval.

VIDEO SYSTEM

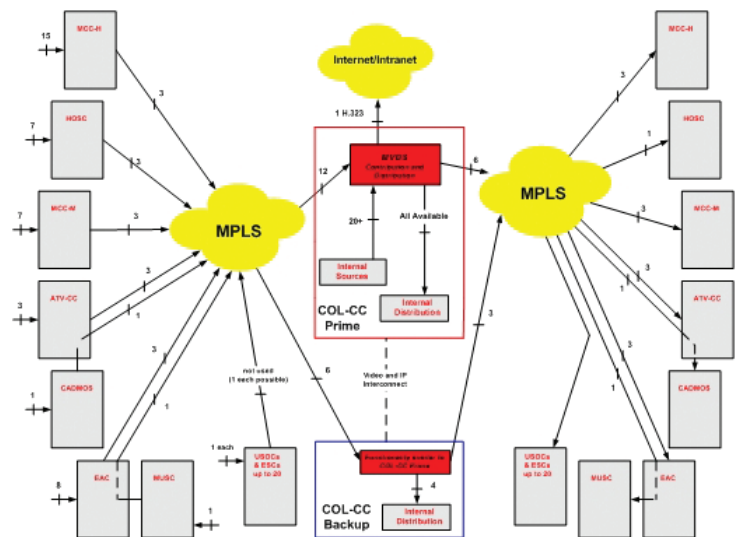
The Video System provides distribution of video channels across the Ground Segment.

VIDEO SERVICES

- MPEG-2 over ASI (1 to 8Mbps)
- MPEG2 over IP (2 to 8 Mbps)
- Channel Selection
- Extraction of Video From High Rate downlink
- Archiving, recording, retrieval, playback



- CD-MCS implementation provides:
- Similar SW as in COL-CC (MCS, DaSS)
 - Central configuration with one Mission Database
 - Centrally maintained
 - Processed Data exchange between USOCs via COL-CC



Overview Communications Service

COMMUNICATIONS ARCHITECTURE:

Redundant central node connecting to all sites remote Nodes in a hybrid topology (star from COL-CC + direct connectivity for ATV related sites) via redundant MPLS (sites part of the core network).

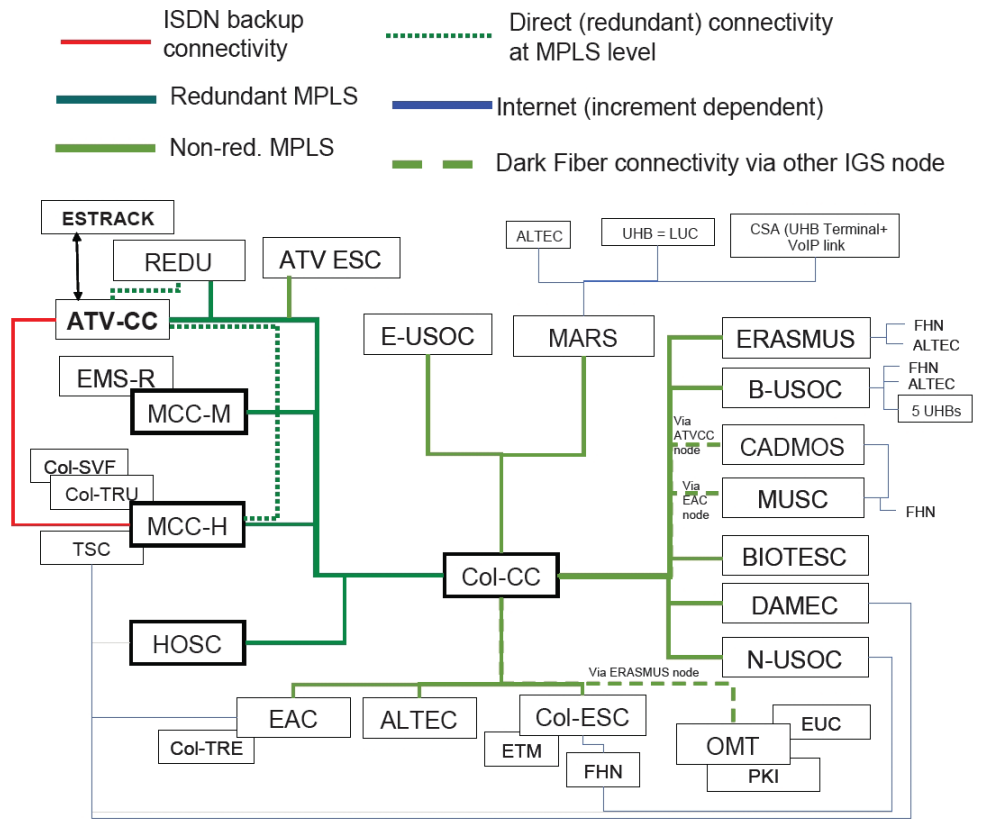
COMMUNICATIONS SERVICES:

- MPLS
- Direct IP connectivity (e.g. ATV TM/TC from Toulouse to Houston)
- Comms link Protection (e.g. VPN for ATV)
- Data, Voice, Video Services
- FTP between COL-CC and remote sites
- Timing
- Domain Name Service

COMMUNICATIONS PERFORMANCE

Bandwidth controlled by local loop type (ISDN PRIs, E1, E3, STM1 and Gigabit Ethernet) and CAR (Committed Access Rate)

- Col-CC maintains 6 PRIs (2Mbps/s) used for IP connectivity between ATV-CC and Col-CC and Col-CC and MCC-H (second backup for ATV TM/TC link). PRIs are used also to trunk BRI lines for remote management of IGS nodes.
- Gigabit Ethernet: Col-CC.
- STM1 (155 Mbps) is installed in MCC-H, HOSC, ATV-CC (+CADMOS), ERASMUS (+OMT), EAC, MARS, Col-ESC.
- E3 (34 Mbps) is installed in: MCC-M, MUSC, ALTEC, B-USOC, N-USOC, DAMEC, BIOTESC, E-USOC.
- CARs (Committed Access Rates) allow a portion of the local loop bandwidth to be used (and can be changed according to needs). The payment scheme is based on bandwidth not volume.
- Different QoSs are implemented through the MPLS work corresponding to the various types of traffic. QoSs are defined by BER, delay and jitter and routing.



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MOST OTHER SUBSYSTEMS IMPLEMENT HIGH AVAILABILITY ARCHITECTURES

NIS

- provides the Network Infrastructure for discriminated areas: OPS, OPS SUPPORT, and OFFICE internal NIS Services include:
- Connectivity, Traffic separation (VLANs), Network Security,
- Gigabit ethernet backbone.

IMS

- Integrated Management System, Connects to all sub-systems Element Managers via SNMP, gather equipment status, some level of control of the Element Managers:
- Ground Network overview,
 - Trouble Ticket System,
 - Data, Voice, Video sub-systems overview.

INFRA_SAN

- provides servers to host most sub-systems, and storage & backup, based on redundant NFS servers and a mirrored configuration for high availability. Storage capacity is 55 TB and can be increased.

INFRA_GEN

- Implements Timing, Syslogs, User Rooms Workstations, security LDAP architecture connecting to ESA PKI (Public Key Infrastructure) located at ESTEC/OMT: 3 control rooms. A ground control room and several user rooms (configurable).

MCS

- Monitoring and Control s/s provides a Central TM and Command server, and peripheral WS. CTM hosts the Mission Database (MDB) and a Result Database (TRDB). 3 MCS instances each hosting up to 16 workstations.

TQVS SERVICES

- Simulation of Columbus and GS TM,
- Simulation of TC response.

OTHER GS FACILITIES AND INFRASTRUCTURE

TRAINING AND OTHER SIMULATORS:

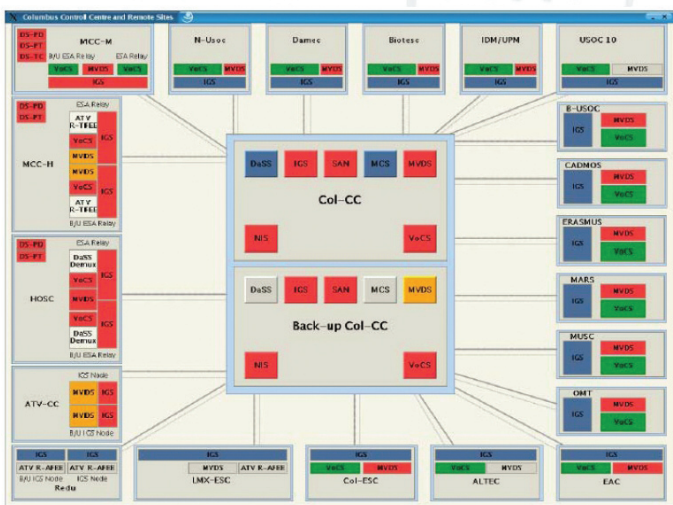
- Col-TRE: training simulator deployed at EAC
- Col-TRU: training simulator deployed in Houston
- Col-SVF: SW verification facility deployed in Houston

INFRASTRUCTURE AT USOCS:

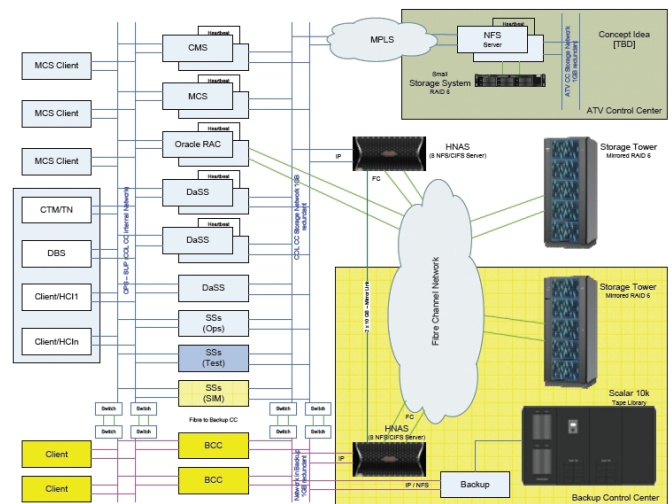
- CD-MCS (M&C SW and HW)
- HRDP (High Rate data front-end processing SW and HW)
- Columbus emulator (interface to P/L engineering models)
- UHB terminal SW (for scientists interfacing with USOCS)

SECURITY INFRASTRUCTURE:

- Central Public Key Infrastructure (at ESTEC)
- External and Internal Firewalls at USOCS and other sites
- Security workstations at USOCS
- Virus control SW (via EMIS in Bremen)



Overview provided by the Integrated Management System



Storage Architecture