Ground Data Handling (Data Transmission Tests)

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AMS TIM

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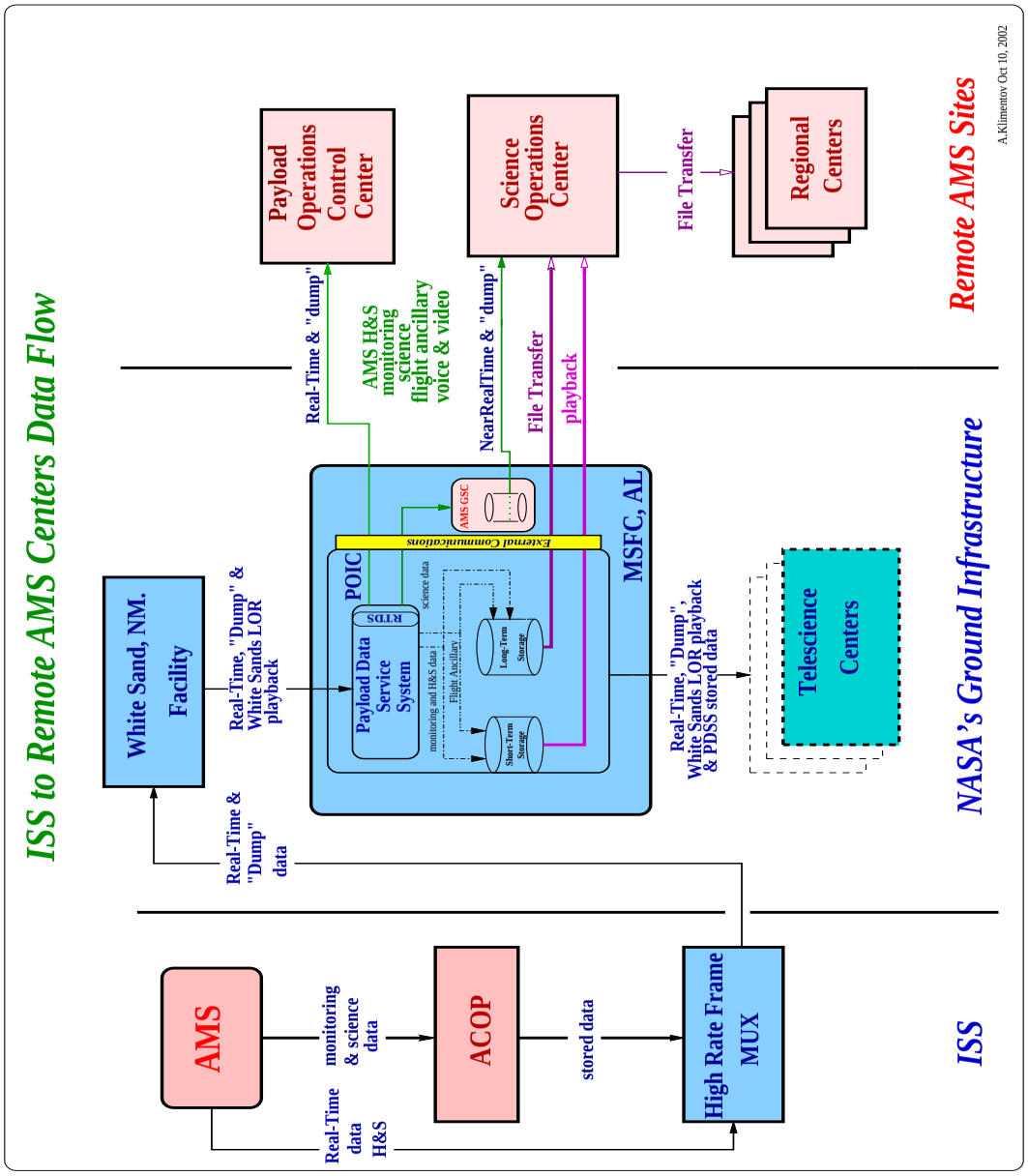
Outline

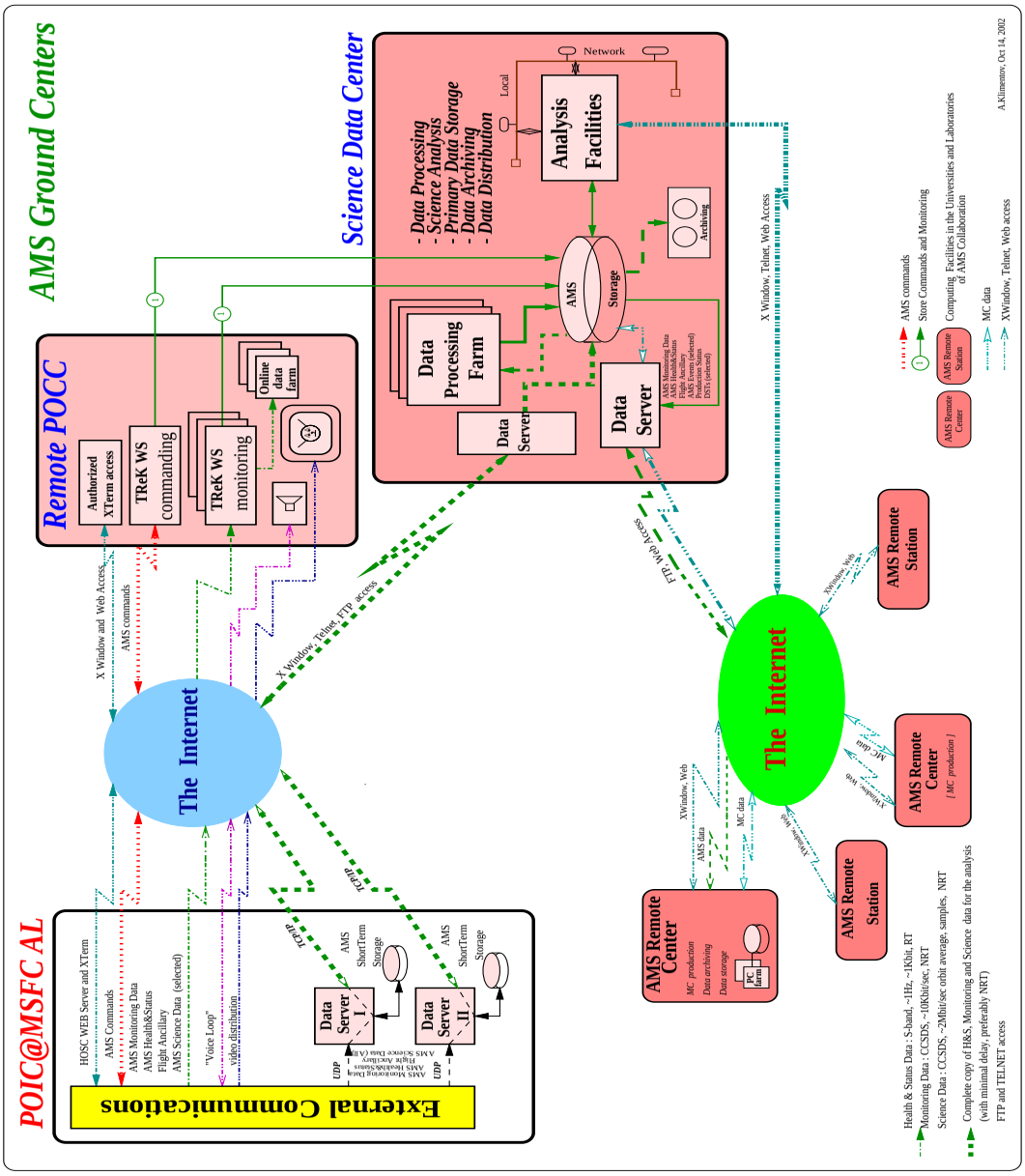
- **AMS Ground Centers** [1]
- **Network Architecture**
- **Requirements to AMS data transmission**
- **Choice of software**
- **Transmission tests**
- **Conclusions and future directions**
- **Implementation plan and milestones**

[1] P.F and A.K. AMS Note 2001_05_01; V.C., A.K. and M.P "Computing Facilities for AMS-02 ISS mission"

ISS to AMS Ground Centers Data Flow



AMS Ground Centers



AMS Ground Support Computers

- At Marshall Space Flight Center, Huntsville Alabama
- Receives Data from NASA Payload Operation and Integration Center (POIC)
- Buffers data until retransmission to the AMS Scientific Operations Center (SOC) and if necessary to AMS Payload Operations and Control Center (POCC)
- Runs unattended 24h/day, 7 days/week
- Must buffer about 2 weeks of data (600 GByte)

AMS Payload Operations Control Center

- usual source of AMS commands
- receives H&S, monitoring, science and NASA data in real-time mode
- receives data from POIC (MSFC Al)
- monitor the detector state and performance
- run quality control programs
- process about 10% of data in near real mode to provide fast information to the shift taker.

AMS Science Operations Center

- receives the complete copy of data
- data reconstruction and processing, generates event summary data (ESD) and event classification
- science analysis
- archives ALL raw, reconstructed, H&S and meta-data
- data distribution to AMS Universities and Laboratories
- MC production

The SOC will provide all functioning and will give the possibility to process and analyze all data. SOC computing facilities should be enough to provide data access and analysis for all members of the collaboration

Data Transmission

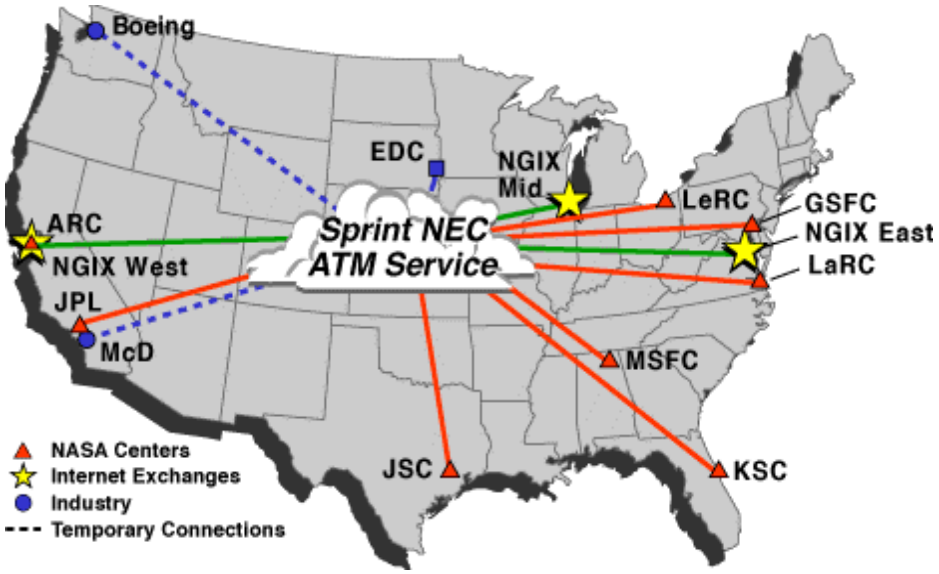
High Rate Data transfer between MSFC and AMS Ground Centers will become a paramount importance.

- Will AMS need a dedicated line to send data from MSFC to the ground centers or the public Internet can be used?
- How reliable is transatlantic line between USA and Europe?
- What SW must be used for a bulk data transfer and how reliable is it ?
- What data transfer performance can be achieved ?

NASA Centers connectivity to Internet

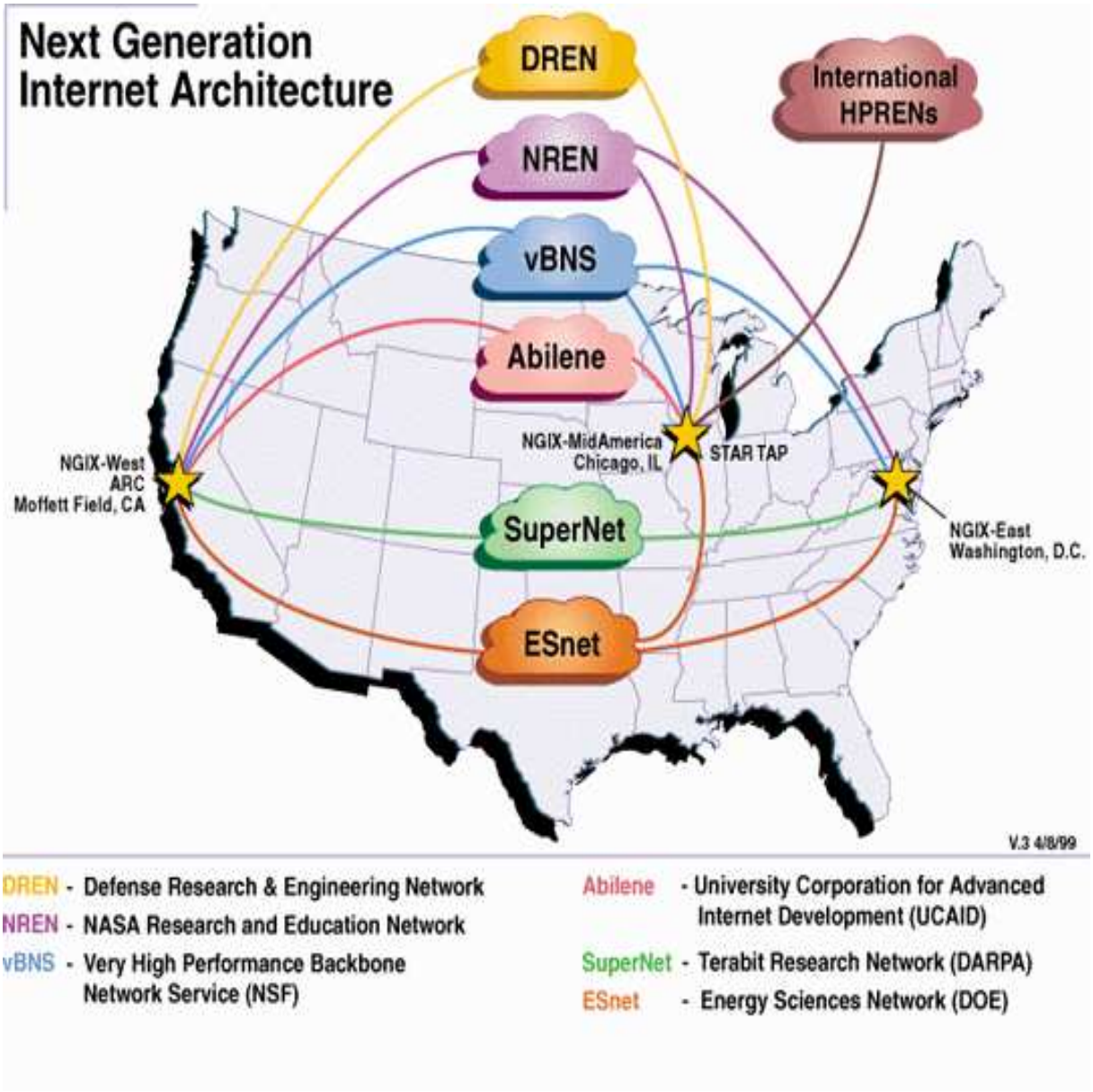
NASA Centers connectivity to Internet

NREN Configuration Map



ARC	**Ames Research Center, Moffett Field, CA**	**OC3c**	**@ 155 Mbps**
GSFC	**Goddard Space Flight Center, Baltimore, MD**	**OC3c**	**@ 155 Mbps**
JPL	**Jet Propulsion Laboratory, Pasadena, CA**	**OC3c**	**@ 155 Mbps**
JSC	***Johnson Space Center, Houston, TX***	***OC3c***	***@ 155 Mbps***
KSC	***Kennedy Space Center, Cape Canaveral, FL***	***OC3c***	***@ 155 Mbps***
LaRC	**Langley Research Center, Hampton, VA**	**OC3c**	**@ 155 Mbps**
LeRC	**Lewis Research Center, Cleveland, OH**	**OC3c**	**@ 155 Mbps**
MSFC	***Marshall Space Flight Center, Huntsville, AL***	***OC3c***	***@ 155 Mbps***

Network Configuration Map



Data Transmission Tests

- **Jul-Sep 2002 :**
  - **AMS : G.Carosi, A.Elin, P.Fisher, A.Klimentov, K.Scholberg**
  - **NASA : N.Bornas (MSFC HOSC OPI), R.Sanchez (JSC-SM)**

MIT team (G.C., P.F., K.S.)
installed AMS GSC prototype @MSFC Al.

MSFC Huntsville Al → CERN
MSFC Huntsville Al → MIT
CERN → MIT

amsgse1.msfc.nasa.gov
→ UOA LAN(USOC, MSFC)@100MBit/s
→ NISN WAN
→ STARTAP (Chicago)
→ CERN STARTAP(Chicago)
→ CERN – USA@2x255MBit/sec
→ CERNbackbone
→ CERN B892LAN @100MBit/s
→ pcamsf0.cern.ch

Data Transmission SW

- Telescience Resource Kit (**TReK**) - written by MSFC team (M.Schneider et al.), proposed for payloads as a commnading and monitoring tool (*SSP 50304, Payload Operations Integration Center (POIC) Remote Operations Capabilities*)[2]
- BBFTP - for files transferring
  - source code from IN2P3 Lyon, adopted for AMS (A.Elin, A.Klimentov)[3], developped for data transferring from SLAC to Lyon, used also for AMS MC data transferring from Lyon to CERN.
  - faster than file transfer programs like *ftp, ncftp* (using "parallel streams");
  - encrypts sensititve data (password)
  - runs in batch mode

[2]P. Fisher, A. Klimentov "Ground Data Handling for the AMS02 ISS mission", AMS note 2001_01_02
[3]A. Elin, A. Klimentov "Data transmission programs for the AMS02 ISS mission.", AMS note 2001_01_04;

Data Transmission Tests

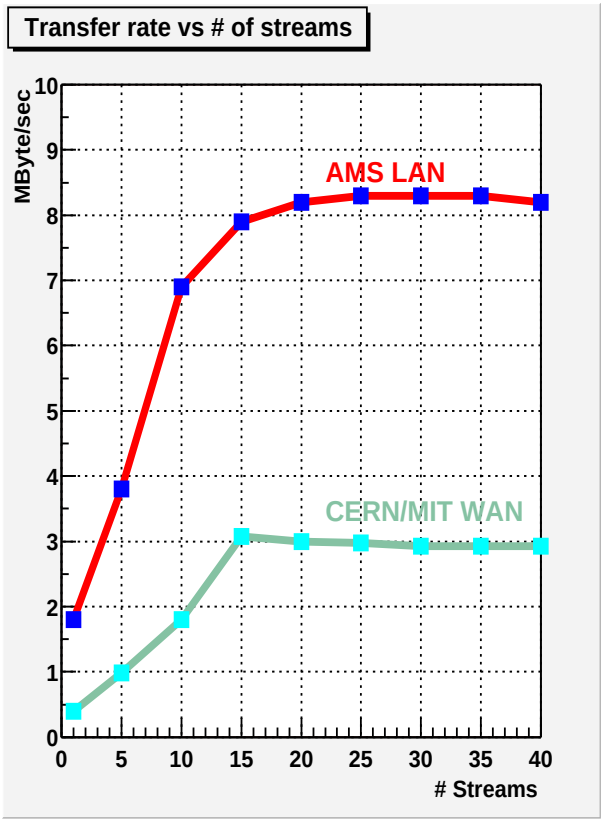
source	destination	Test Duration (hours)	Nominal BandWidth LAN [WAN] LAN MBit/sec	iperf (pathchar) (MBit/sesc	bbftp throughput (MBit/sec)
CERN I	CERN II	24	10	10	7.8
CERN II	CERN II	24	100	100	66.4
CERN II	MIT	12x3	100 [255] 1000	26	24.6
CERN II	MSFC Al	24x2	100 [255] 100	16	9.5
MIT	CERN II	12x3	1000 [255] 100	26	24.6
MSFC Al	**CERN II**	24x2	100 [255] 100	16	**9.5**

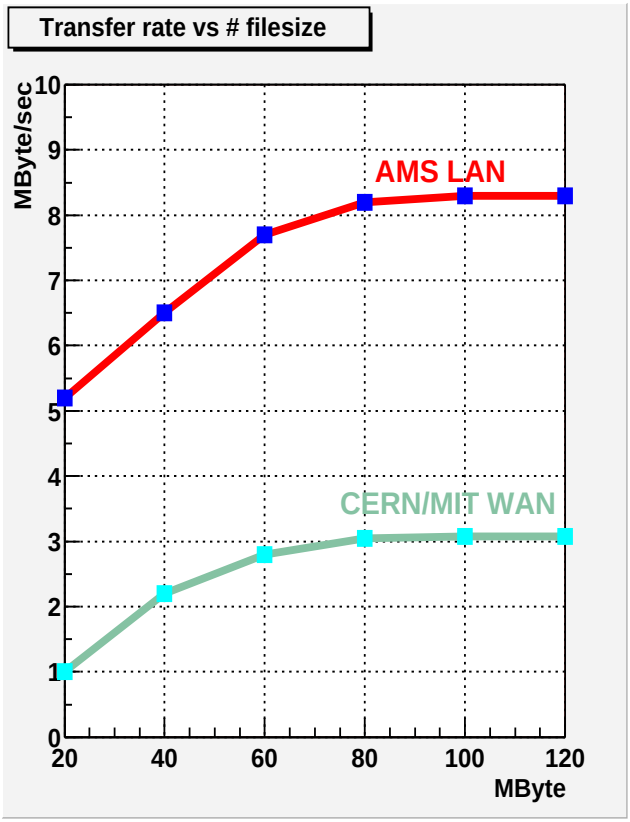
bbftp data transmission rate

bbftp : AMS01 data and NT, Avg. File Size 80 0MB, number of streams 15-20;
(Setup time (connection and authentication) is included in bbftp numbers.
iperf and pathchar are tools for measuring of performance of network.

Data Transmission Tests

'amsbbftp' tests CERN/MIT, Oct 2002





Transfer rate achieved with bbftp between two computers on AMS LAN at CERN is 8.3 MByte/sec, for CERN/MIT is 3.1 MByte/sec. The 15 streams and 80MB+ files size are optimal for the current version of bbftp. The bbftp performance is within a few percent of that achieved with pathchar and iperf for CERN/MIT WAN.

Conclusions and future directions

- CERN and MIT connectivity to Internet satisfies requirements of MSFC Ground Support Department;
- In its current configuration, the **Internet provides sufficient bandwidth** to transmit AMS data from MSFC Al to AMS ground centers at rate approaching 9.5 MBit/s;
- **bbftp** is able to transfer and store data on a high end PC reliably with no data loss, the bbftp performance is comparable of what achieved with network monitoring tools;
- **bbftp** can be used to transmit data simultaneously to multiple cites with little reduction in performance up to 5%;
- AMS will need guaranteed bandwidth of **15 MBit/s** of CERN/US transatlantic line starting from launch date.

- *MSFC/AMS discussion of RTDS/POIC data access is needed*
- *MSFC specification of telemetry data stream*
- *Up-to-date copies of SSP 50304, SSP 50305*
- *Tests between POIC facilities and AMS GSC@MSFC*

Implementation plan and milestones

Year	Action
Q2 2002	AMS/NASA meeting at MSFC and test-bed GS computer (provided by MIT) installation at MSFC
Q3 2002	MSFC→MIT, MSFC→CERN data transmission tests Approval GSC@MSFC concept by the AMS Collaboration
Q2 2003	put AMS information into POIC database POIC → AMS GSC tests
Q4 2003	POIC → AMS GSC → MIT/CERN tests
2004 (tbc)	ACOP→ POIC → AMS GSC → MIT/CERN tests
L-6 months	Final version of AMS GSC and SW installation at MSFC