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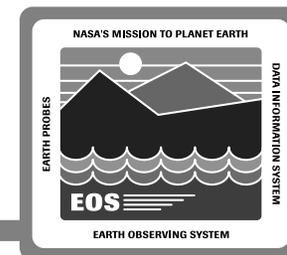
# CSS/MSS Sizing Models and Hardware Design

## Carl Wheatley

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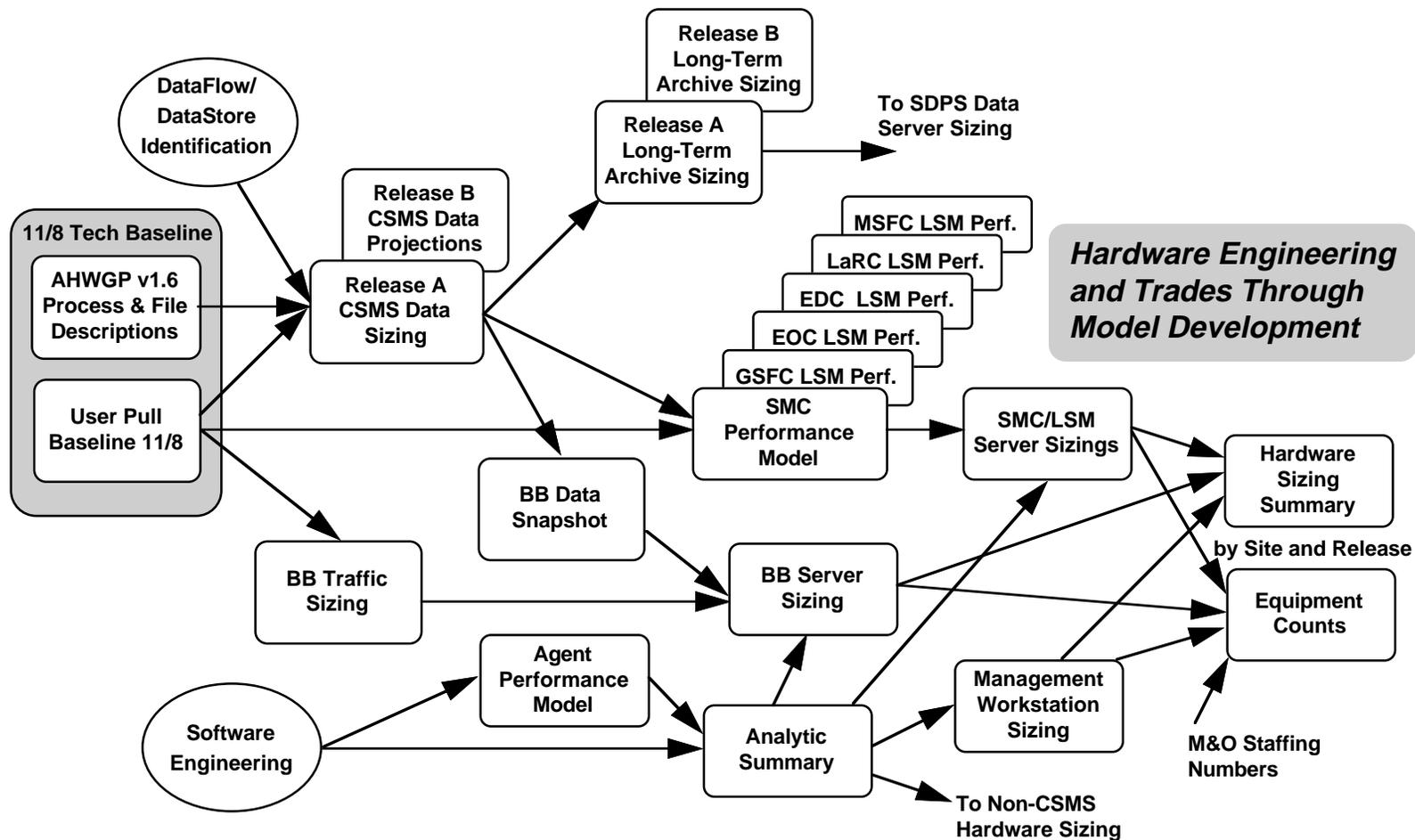
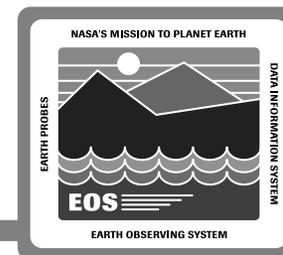
19 January 1995

# CSS/MSS Sizing Models and Hardware Design Agenda

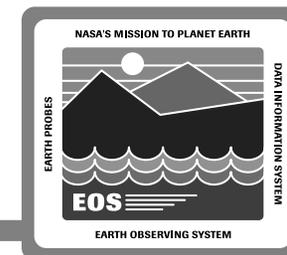


- **Performance and Sizing Analysis**
  - **Data Sizing**
  - **Server Performance**
  - **Analytic Analysis**
  - **Server Sizing**
- **RMA Analysis**
- **Hardware Design**
  - **Configuration Items**
  - **Key Hardware Decisions**
  - **CSCI/HWCI Mappings**
  - **DAAC and EOC LSMs Design**
  - **SMC Design**
  - **Impact to other ECS and non-ECS Hardware Designs**
  - **Hardware by Site and Release**
  - **Design Summary**

# Performance and Sizing Analysis: Modeling Overview



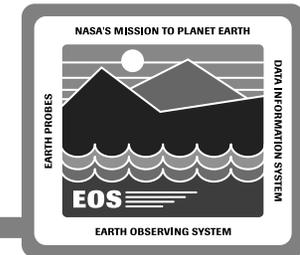
# Performance and Sizing Analysis: Data Sizing Models



## LaRC DAAC R-B Analysis

<u>Data Store Name</u>	<u>Partition Type</u>	<u>Record Length,bytes</u>	<u>Sizing Driver</u>	<u>Total Raw Size, bytes</u>	<u>Comments</u>
Accounting Database	partitioned	1000	500	500000	500 tracked items
Configuration Management Database	partitioned	5000	1000	5000000	1000 managed objects
Directives/Replies History	partitioned	256	215040	55050240	14 days; 1 cmd&rply every hour
Directory Information Base	replicated	200	1706072	341214400	
Security Information Base	replicated	200	1706072	341214400	
Existing Requests Database	partitioned	480	17920	8601600	same as schedule
Inventory Database	partitioned	1000	1000	1000000	1K inventoried objects
Logistics Database	partitioned	1000	1000	1000000	1K items (spare parts)
Mail Store	partitioned	500	100000	50000000	
Maintenance Database	partitioned	1000	1000	1000000	1K directives
Management Information Base	replicated	1000	1000	1000000	
Resource Requirements Database	replicated	1000	100	100000	
Schedule Database	partitioned	480	17920	8601600	2 items/machine/day, 28 days
Standard Message/Report Templates	replicated	1000	100	100000	
Uploaded Object History Log	partitioned	128	108620	13903421	14 days: 5 r/pgn; 3/sto; 5r/usrs
Uploaded Object History Log Text	partitioned	128	10862	1390342	
<b>LaRC DAAC Total, R-B</b>				<b>829676003</b>	

# Performance and Sizing Analysis: Server Performance Models



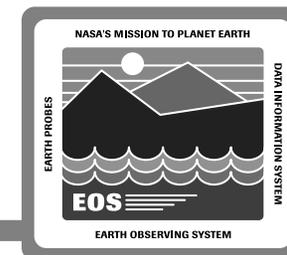
## LaRC DAAC LSM Raw Data Rates

<u>dataflow</u>	<u>flags (0)</u>	<u>transactions per day</u>	<u>bytes per ave. transaction</u>	<u>effective hours/day</u>	<u>logical peak hourly data rate (B/hr)</u>	<u>physical DBMS blocks/sec</u>	<u>physical file blocks/sec</u>	<u>physical I/O blocks per second</u>
history log upload from agents	R	4,800	31,325	24	6,265,049	2.12		2.12
directives/replies logging	R	4,800	768	24	153,600	0.05		0.05
history/DR log upload to SMC	R	4,800	42,791	24	8,558,199	2.90		2.90
perf-mgmt queries	R	200	15,301,244	24	127,510,363	43.24		43.24
security-audit queries	R	100	15,301,244	24	63,755,182	21.62		21.62
misc. queries	R	100	15,301,244	24	63,755,182	21.62		21.62
sanity events	R	28,800	384	24	460,800	0.16		0.16
mail services (incl file xfers)	N	1,308	20,000	12	2,180,000		0.30	0.30
directory services	R	3,507	800	24	116,893	0.04		0.04
DIB update (see SMC model)	R	1	120,000,000	24	5,000,000	1.69		1.69
report generation	R	20	640,000	24	533,333	0.18		0.18
scheduling (R-B period)	R	1	1,000,000	24	41,667	0.01		0.01
miscellaneous	R	10	500,000	24	208,333	0.07		0.07
aggregates (where they make sense)					278,538,601	93.70	0.30	94.00

## physical machine requirements (all before doublings per 3SMC-00300, -00310)

	<u>raw</u>		<u>w/ doubling</u>	
data transfer rate (backplane, disk controller)	2.94	Mb/s	5.87	Mb/s
disk accesses (no caching assumed)	94.00	accesses/sec	187.99	accesses/sec
CPU requirement (before doubling per 3SMC-00300)	5.63	MIPS	11.26	MIPS

# Performance and Sizing Analysis: Analytic Summary



<u>Software CI</u>	<u>Storage, R-A</u> <u>MBytes</u>	<u>Storage, R-B</u> <u>MBytes</u>	<u>RAM</u>	<u>R-A CPU</u> <u>MIPS</u>	<u>BOE</u>
<b><i>MSS-MCI Server</i></b>					
DBMS Client	1.5	1.5	3	6	engrg. judgement
DBMS Server	15	15	20	60	engrg. judgement
Management Engine	25	25	96	60	EPs, OpenView Exp.
Management Apps	20	30	20	30	engrg. judgement
Word Processor	3	3	1	1	engrg. judgement
Spreadsheet	3	3	1	2	engrg. judgement
Graphics Package	5	5	0.5	1	engrg. judgement
<b><i>MSS-MLCI</i></b>	10	10	5	6	Clearcase Exp.
<b><i>MSS-MACI</i></b>	5	5	0.5	6	engrg. judgement
<b><i>CSS-DCCI Client</i></b>					
DCE Client	10	10	16	6	EPs, OSF DCE Exp.
Mail User Interface	3	3	0.5	1	engrg. judgement
Other Services	5	5	2	0.4	engrg. judgement
<b><i>CSS-DCCI Comm Server</i></b>					
DCE Server	20	20	64	60	EPs, OSF DCE Exp.
DCE DevKit	25	25			EPs, OSF DCE Exp.
Other Comm Services	20	25	36	30	some EPs, engrg. jdmt.
<b><i>ISS-INCI</i></b>	0	0.3	0.5	1	
Operating System	0	35	12	6	engrg. judgement
User Space	150	150	10	12	engrg. judgement

1. For server, baseline assumption is not more than six functions are in active memory at any time, (six largest RAM-values taken) and five concurrent processes (five highest MIPS value taken).
2. For workstations, baseline assumption is not more than three functions are in active memory at any time, (three largest RAM-values taken) and no background processes (only highest MIPS value taken).

# Performance and Sizing Analysis: Server Sizing Models

## R-B Static Model Summary (all numbers doubled)

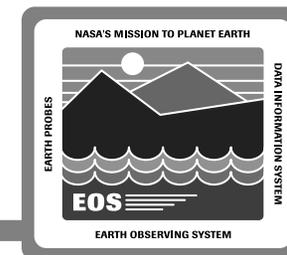
	<u>Worst Case</u> <u>Storage, MB</u>	<u>Xfer Rate</u> <u>MB/Sec</u>	<u>Disk Access,</u> <u>4K Blocks/s</u>	<u>CPU,</u> <u>MIPS</u>	<u>2nd Store,</u> <u>MB</u>	<u>RAM,</u> <u>MB</u>
<i>GSFC SMC</i>	38002	13.11	419.43	25.10		
<i>GSFC LSM</i>	4750	74.40	2380.81	142.84		
<i>GSFC EOC</i>	2416	74.03	2369.04	142.14		
<i>EDC LSM</i>	3512	77.83	2490.54	149.42		
<i>LaRC LSM</i>	2902	269.21	8614.81	516.87		
<i>MSFC LSM</i>	2124	60.44	1934.11	116.04		

## R-B Analytic Summary (all numbers doubled)

	<u>Worst Case</u> <u>Storage, MB</u>	<u>Xfer Rate</u> <u>MB/Sec</u>	<u>Disk Access,</u> <u>4K Blocks/s</u>	<u>CPU,</u> <u>MIPS</u>	<u>2nd Store,</u> <u>MB</u>	<u>RAM,</u> <u>MB</u>
<i>MSS-MCI Server</i>						
DBMS Client	3			6	3	6
DBMS Server	30			60	0	40
Management Engine	50			60	0	192
Management Apps	60			30	0	40
Word Processor	6			1	6	2
Spreadsheet	6			2	6	2
Graphics Package	10			1	10	1
<i>MSS-MLCI</i>	20			6	0	10
<i>MSS-MACI</i>	10			6	10	1
<i>CSS-DCCI Client</i>						
DCE Client	20			6	20	32
Mail User Interface	6			1	6	1
Other Services	10			0.4	10	4
<i>CSS-DCCI Comm Server</i>						
DCE Server	40			60	0	128
DCE DevKit	50				0	0
Other Comm Services	50			30	0	72
<i>ISS-INCI</i>	0.6			1	0.6	1
Operating System	70			6	70	24
User Space	300			12	600	20
Totals*	741.6			240	741.6	504

\* Baseline assumption is not more than six functions are in active memory at any time, (six largest RAM-values taken) and five concurrent processes (five highest MIPS value taken).

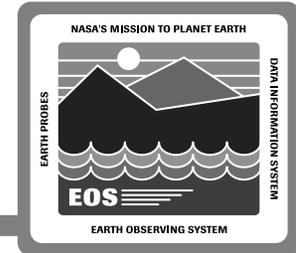
# CSS/MSS Hardware Sizing Summary



## MSS/CSS Minimum R-B Sizing Projections

Site/ Server	Disk Storage, <u>MByte</u>	Disk i/o <u>4K B/s</u>	Peri. Storage, <u>MByte</u>	RAM, <u>MByte</u>	CPU, <u>MIPS</u>	Traffic <u>Mb/s</u>
GSFC/SMC	19371.8	209.7	370.8	252.0	132.6	6.6
GSFC/LSM	2745.8	1190.4	370.8	252.0	191.4	37.2
GSFC/EOC	1578.8	1184.5	370.8	252.0	191.1	37.0
EDC/LSM	2126.8	1245.3	370.8	252.0	194.7	38.9
LaRC/LSM	1821.8	4307.4	370.8	252.0	378.4	134.6
MSFC/LSM	1432.8	967.1	370.8	252.0	178.0	30.2
GSFC/BB	2233.4	209.7	340.3	128.0	74.6	7.2
Any/Wks	300.8	N/A	N/A	31.0	10.0	low

# RMA Analysis: RMA Measures



## **MSS RMA Measures**

- **1:2 Warm Standby redundancy with CSS Server**
- **Cross-strapped critical storage with CSS Server**
- **LSM continues to function in event of ESM and/or agent failure**
- **Agents continue to function in event of LSM failure**

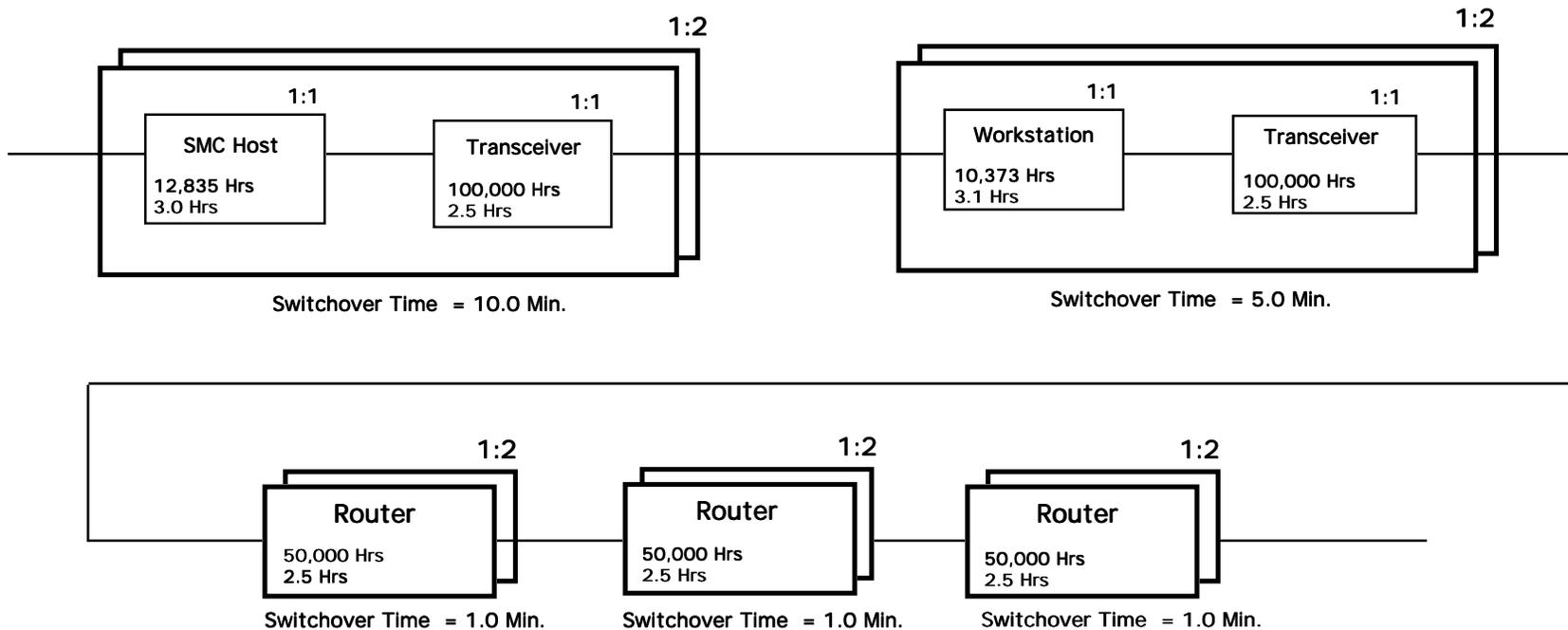
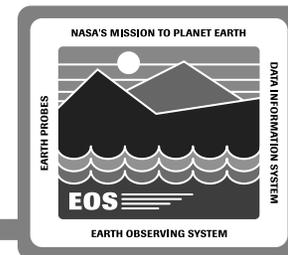
## **CSS RMA Measures**

- **1:2 Warm Standby redundancy with MSS Server**
- **Cross-strapped critical storage with MSS Server**
- **Distribution/Replication of critical security and directory information**
- **Cache critical server information locally at client for high RMA users**
- **Chaining/referral of directory and security services throughout ECS**

## **ISS RMA Measures**

- **Dual-attached FDDI and full fault tolerant FDDI networks**
- **Routing table updates distributed for reconfiguration around faults**
- **Redundant connections of critical links with automated rerouting**

# RMA Analysis: EOSD 4030 String Analysis



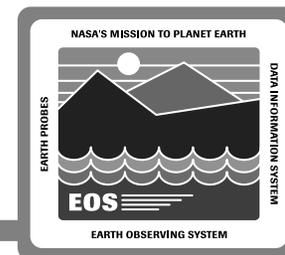
**EOSD 4030:** Required Ao = .9980000, MDT = 20 Min or less  
 Predicted Ao = .9999938, MDT = 4.2 Min.  
 Goal Ao = .999998, MDT = 5 Min.

**LEGEND:**

# Required : Total	
Item	Description
MTBM	Mean-Time-Between Maintenance (Hrs)
MDT	Mean-Down-Time (Hrs)

BN 11/16/94

# CSMS Hardware Configuration Items



## MSS Management Hardware CI (MHCI)

*includes the following configurations:*

**Enterprise Monitoring Server**

*enterprise-wide (ECS-wide) monitoring and coordination*

**Local Management Server**

*local management of ECS sites*

**Management Workstation**

*shared workstation pools in DAACs and EOC for domain mgrs. and in SMC for enterprise monitors; bulletin board administration*

**Printer**

## CSS Distributed Communications Hardware CI (DCHCI)

*includes the following configurations:*

**Enterprise Communications Server**

*enterprise-wide communications server*

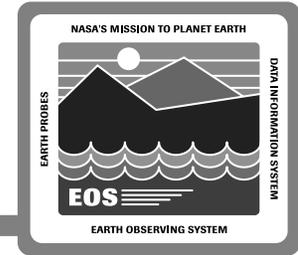
**Local Communications Server**

*local communications server*

**Bulletin Board Server**

**Terminal Access (Dialup) Server (Release B)**

# CSMS Hardware Configuration Items (cont.)



## ISS Internetworking Hardware CI (INHCI)

*includes DAAC LANs with many components:*

**Routers (connectivity between users, ECS subnets,  
externals - some routers GFE)**

**Hubs (connectivity between users, ECS subnets,  
externals)**

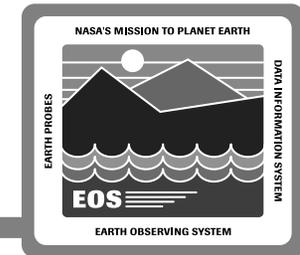
**Plant Cabling**

**LAN Analyzers**

***MANs and WANs are GFE***

# Key Hardware Decisions

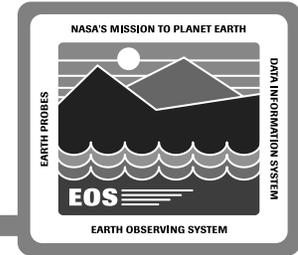
*(Underlined italics indicate approach selected)*



- Standalone network & systems management vs. *enterprise management*
- Dedicated archive of management data vs. *use of ECS data server archive*
- Management workstation pools slaved to server DBMS vs. *workstation pools with DBMS server capability*
- *Standalone bulletin board server* vs. bulletin board integrated with comm Server
- *Self-registration and toolkit/documentation distribution by users* vs. SMC staff handling
- Separate comm and management servers vs. *integrated comm and management servers*
- *Use of ECS isolation cell for public user access security* vs. single cell per DAAC with shared scientist and public user access



# CSCI/HWCI Mappings



**MHCI Enterprise  
Monitoring Server**

**MHCI Local  
Management Server**

**MHCI Mgmt.  
Workstation**

**SDPS/FOS  
Hardware**

**MCI Ent. Monitor  
MLCI Ent. Logistics  
MACI Agent  
DCCI Client**

**MCI Local System Mgr.  
MLCI Local Logistics  
MACI Agent  
DCCI Client**

**MCI selected subset  
MLCI selected subset  
MACI Agent  
DCCI Client**

**MACI Agent  
DCCI Client**

**DCHCI Enterprise  
Communication Server**

**DCHCI Local  
Communication Server**

**DCHCI Bulletin  
Board Server**

**non-ECS  
Hardware**

**DCCI DCE Server  
DCCI Email Server  
MACI Agent  
DCCI Client**

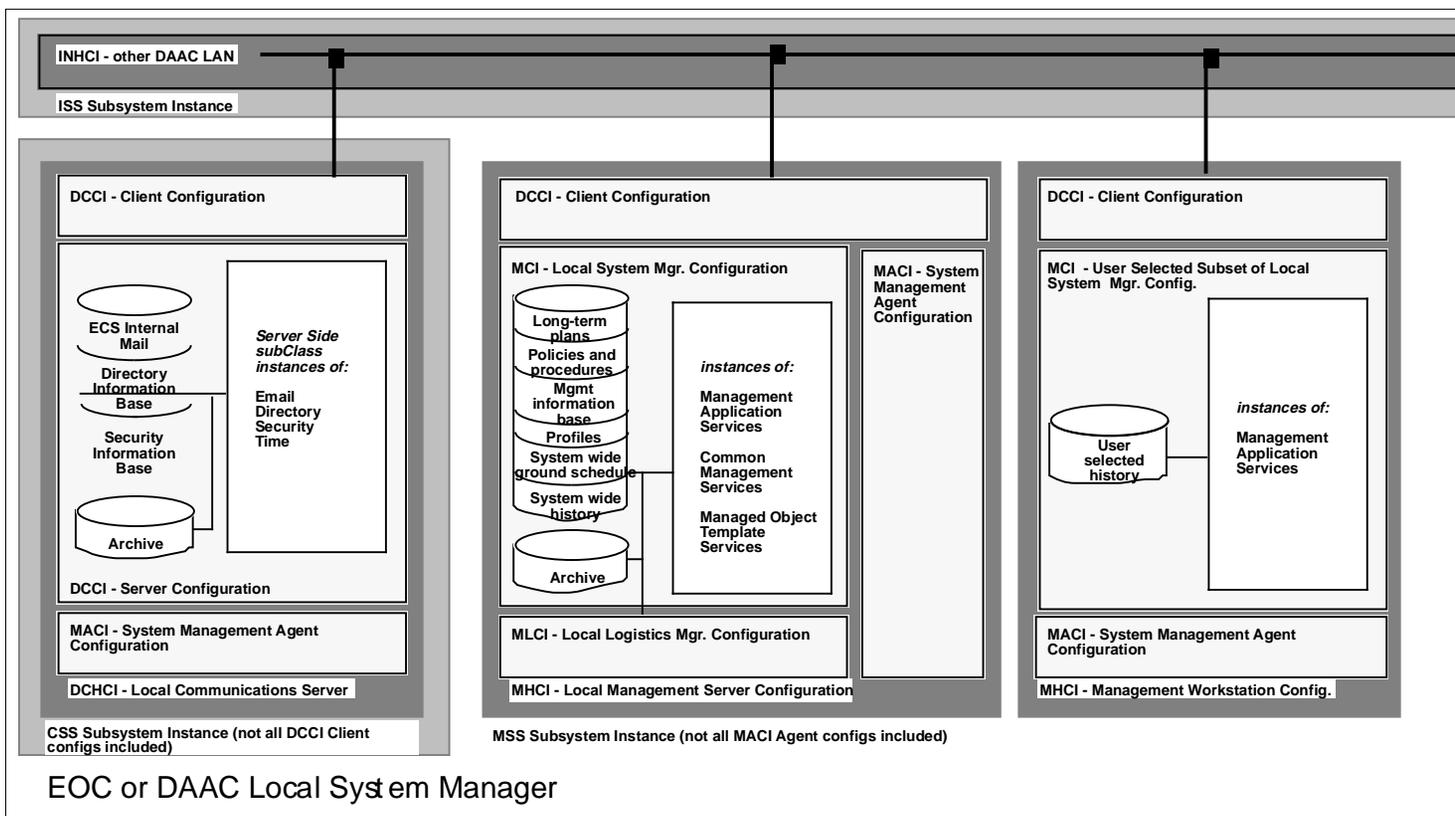
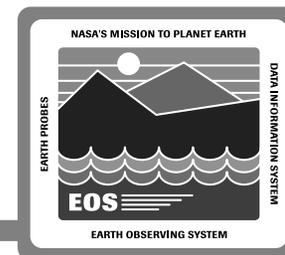
**DCCI DCE Server  
DCCI Email Server  
MACI Agent  
DCCI Client**

**DCCI DCE Server  
DCCI BB Server  
MACI Agent  
DCCI Client**

**DCCI Client (subset)**

**Note: ISS TCP/IP protocols, Network Interface Cards, and Operating System are allocated to individual h/w platform procurements**

# DAAC and EOC LSMs - Physical Design



## Release A Hardware Architecture

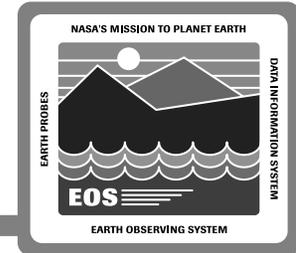
### Legend

- Software CI
- Hardware CI
- Subsystem Instance
- Multiple Occurrences

### Notes:

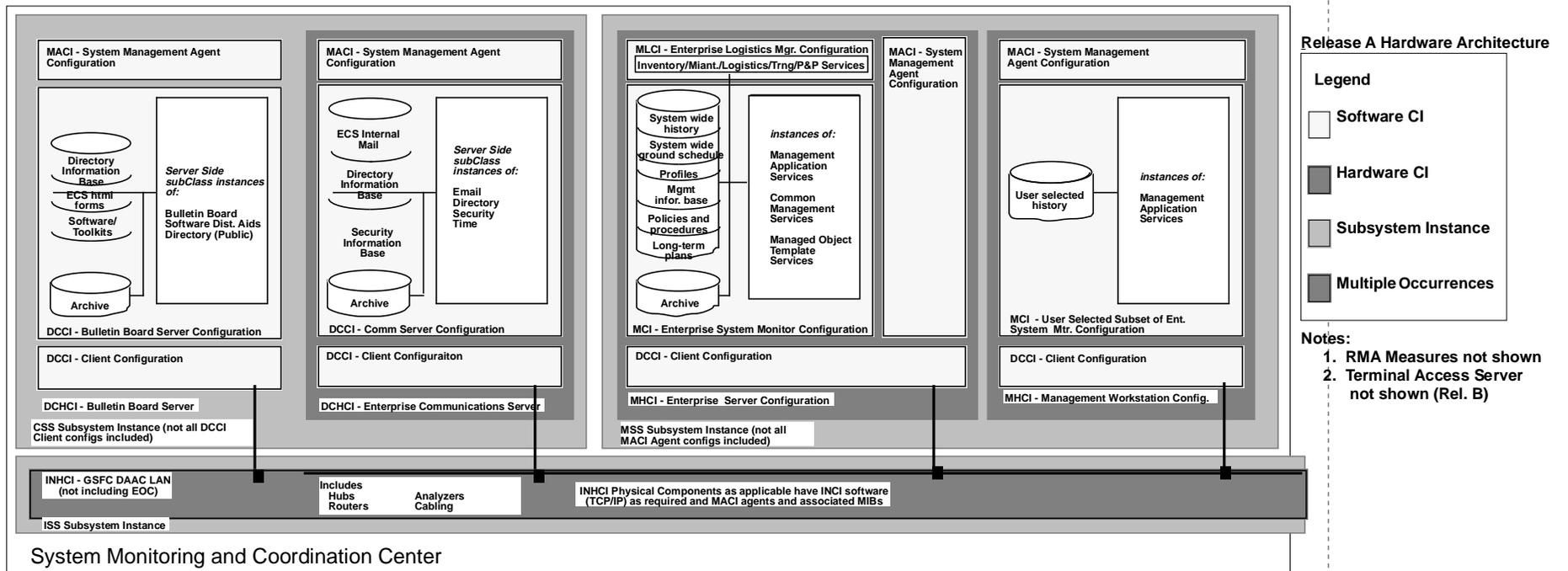
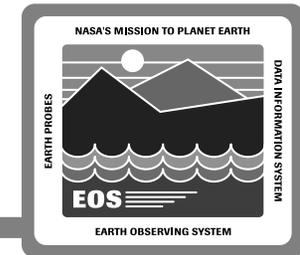
1. RMA Measures not shown
2. Terminal Access Server not shown (Rel. B)

# DAAC and EOC LSMs - Hardware Design Benefits

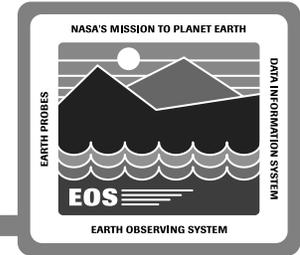


- Provides robust site and EOC autonomy of operations
- Provides management of all DAAC or EOC objects
- Configurable to policy by software mechanisms
- Cross-stapped storage of local communications and management servers provide warm standby server operation
- Critical mission-related data replicated through ECS
- Storage hierarchy matched to M&O expectations
- Compatible SMC storage provides flexibility in data distribution
- Server communications data is locally cached by client to minimize client/server dependency, improves performance
- Management workstations interoperates with the Local Mgmt. Server
- Pool of management workstations assures workstation availability
- Management workstations are backed up by non-Mgmt workstations
- Workstation RDBMS server off-loads servers from administrator analysis of data and provides better performance
- Management Agents gather management data even if server fails

# SMC Physical Design



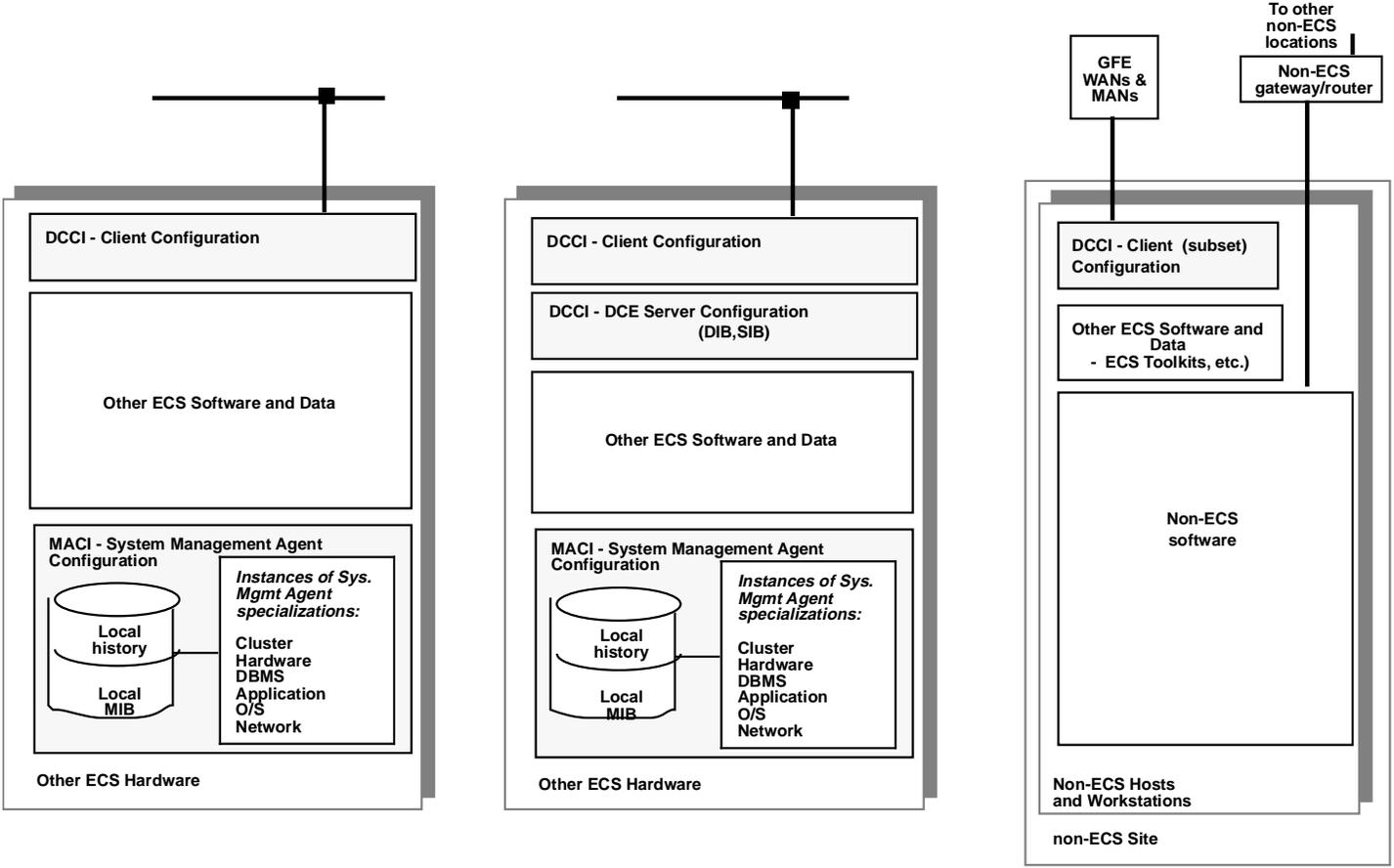
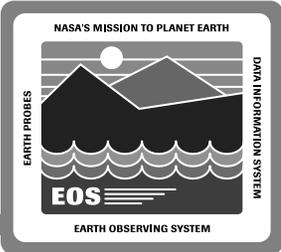
# SMC Hardware Design Benefits



## All LSM Hardware Design Benefits plus:

- Preserves site and EOC autonomy of operations
- Provides monitoring of ECS enterprise objects
- Provides management of all ECS WANs
- Bulletin Board offers user self-registration and toolkit distribution, general public information source about ECS
- Bulletin Board decouple from communications server to off-load comm server and augment ECS security
- DCE isolation cell protects ECS resources, integrates DAACs as a cooperative federation

# CSMS Impact to Other ECS and Non-ECS Hardware Designs

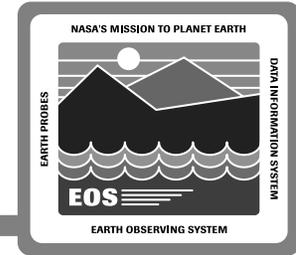


**SDPS/FOS Hardware**

**SDPS Specializations:  
Advertising and Data  
Management Servers**

**Non-ECS Hardware  
w/DCE (w/o DCE)**

# CSMS Impact to Other ECS and Non-ECS Hardware Designs (cont.)



## Analytic Model Summary - All unix boxes

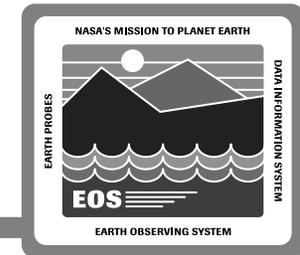
	<u>Storage, MB</u>	<u>RAM, MB</u>	<u>CPU, MIPS</u>
SDPS/FOS Hardware	23	19.0	13.4
SDPS Adver. & DM Servers	48	82.5	72.4
non-ECS Hardware w/DCE	11	17.5	6.2
non-ECS Hardware w/o DCE	1	1.0	0.2

(w/o DCE requires kerberos w/wrapper code, use standard Internet tools not furnished by ECS)

## Design Benefits

- Secure, robust communications throughout ECS
- Middleware for non-ECS use accommodates DCE and non-DCE solutions

# Servers /Workstations by Site and Release

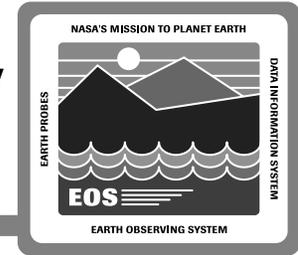


<u>SITE</u>	<u>S/S</u>	<u>R</u>	<u>QTY</u>	<u>CONFIGURATION</u>	<u>SIZE CATEGORY</u>
EDF	CSS	IR-1	1	Ent. Comm Server	Medium File Server
EDF	MSS	IR-1	1	Ent. Mtr. Server	Medium File Server
EDF	MSS	IR-1	2	Mgmt. Workstation	Small Workstation
EDF	CSS	IR-1	1	Bulletin Board Server	Medium File Server
EDF	CSS	IR-1	1	Printer	N/A
GSFC	MSS	IR-1	1	Local Mgmt Server	Small File Server
GSFC	CSS	A	1	Local Comm Server	Small File Server
GSFC	MSS	A	2	Mgmt. Workstation	Small Workstation
GSFC	CSS	IR-1	2	Printer	N/A
GSFC-EOC	CSS	A	1	Local Comm Server	Small File Server
GSFC-EOC	MSS	A	1	Local Mgmt Server	Small File Server
GSFC-EOC	MSS	A	2	Mgmt. Workstation	Small Workstation
GSFC-EOC	CSS	IR-1	1	Printer	N/A
EDC	MSS	IR-1	1	Local Mgmt Server	Small File Server
EDC	CSS	A	1	Local Comm Server	Small File Server
EDC	MSS	A	2	Mgmt. Workstation	Small Workstation
EDC	CSS	IR-1	1	Printer	N/A
LARC	MSS	IR-1	1	Local Mgmt Server	Small File Server
LARC	CSS	A	1	Local Comm Server	Small File Server
LARC	MSS	A	2	Mgmt. Workstation	Small Workstation
LARC	CSS	IR-1	1	Printer	N/A
MSFC	MSS	IR-1	1	Local Mgmt Server	Small File Server
MSFC	CSS	A	1	Local Comm Server	Small File Server
MSFC	MSS	A	2	Mgmt. Workstation	Small Workstation
MSFC	CSS	IR-1	1	Printer	N/A

Note: 1. EDF Equipment is transferred to GSFC EMC in Release A  
 2. IR-1 Servers at sites host ClearCase for Algorithm AIT

# CSS/MSS Hardware Design Summary

## Server/Workstation Categorizations



### CANDIDATE COTS Equipment Platforms

Medium File Server	Small File Server	Small Workstation
HP 9000 Model H50 SPARCcluster 1 IBM RS/6000 Model 58H DEC Alpha Server 2100 4/275 SGI Challenge L	HP 9000 Model E35 SPARCserver 1000 IBM RS/6000 Model 25S DEC Alpha Server 2000 4/200 SGI Challenge M	HP 9000 715/33 SPARCclassic IBM RS/6000 Model M20 DEC Alpha AXP Model 300LX SGI Indy R4000 PC