PRELIMINARY

System90/X5 Bus Configuration Rules

Revision 0.5

INTRODUCTION

Bus configuration rules are required for a number of reasons. Rules are required to ensure a balance of system resources that minimize performance bottlenecks. Rules are required to ensure that each module is installed in a bus slot with enough priority to prevent module starvation in the event of bus resource overload. Rules are required by cabling restraints that require that certain modules be installed in certain slots. And rules are required to ensure that the power supply is not overloaded.

This paper covers configuration rules that deal with the balancing of system resources and the assignment of modules to CSS and CSS/XA Bus slots.

ARBITRATION PRIORITY

The Bus Arbiter allocates CSS or CSS/XA Bus resources to requesters according to requester priority. The priority of a requester is determined by the bus slot it is installed in. Priorities are assigned to bus slots by the bus arbiter.

The 8/2 Bus Arbiter provides the bus arbiter function for the 8-slot CSS Bus and assigns priorities to CSS Bus slots as shown in the following table. For configuration purposes, slots 4 thought 7 are considered HIGH priority slots and slots 0 through 3 are considered LOW priority slots.

Arbitration Priority	CSS Bus Slot(s)
Highest	7
	6
	5
	4
	3 and 0
Lowest	2 and 1

8/2 Bus Arbiter Priority Assignments

There are two Bus Arbiters that can provide the bus arbitration function for the 16-slot CSS or CSS/XA Bus, the 16/2 Bus Arbiter and the 16/4 Bus Arbiter. The 16/2 Bus Arbiter is the original design and may be used as the CSS Bus arbiter in systems with no more than six 68020 Processor Modules or two 68040 Dual Processor Modules. The 16/4 Bus Arbiter provides more even priority for slots 0 through 7 and is required as the CSS Bus arbiter in systems with more than six 68020 Processor Modules or two 68040 Dual Processor Modules. Either arbiter may be used for the CSS/XA Bus.

The 16/2 and 16/4 Bus Arbiters assign priorities to CSS Bus slots as shown in the following table. For

configuration purposes, slots 8 thought 15 are considered HIGH priority slots and slots 0 through 7 are considered LOW priority slots.

Arbitration Priority	CSS or CSS/XA Bus Slot(s)	
	16/2 Bus Arbiter	16/4 Bus Arbiter
Highest	15	15
	14	14
	13	13
	12	12
	11	11
	10	10
	9	9
	8	8
	7 and 0	7, 4, 3 and 0
	6 and 1	6, 5, 2 and 1.
	5 and 2	
Lowest	4 and 3	

16/2 Bus Arbiter and 16/4 Bus Arbiter Priority Assignments

CONFIGURATION PRINCIPLES

The configuration rules are based on the following principles:

1. Every system must have a Service Processor Module paired with an Asynchronous Communications/Real World Interface (90/25) or Real World Interface (90/45 or 90/85) and at least one Processor or Dual Processor Module, Memory Module and I/O Processor Module paired with a device board with at least one SCSI port.

2. There should be one Memory Module for every 2.0 to 2.5 68020 Processor Modules. A larger ratio of 68020 Processor Modules to Memory Modules will result in measurable memory contention and reduced system performance.

3. There should be two Memory Modules for every 68040 Dual Processor Module. A smaller ratio of Memory Modules to 68040 Dual Processor Modules will result in measurable memory contention and reduced system performance.

4. Bus Arbiter 16/4 must be used as the CSS Bus arbiter if more than six 68020 Processor Modules or two 68040 Dual Processor Modules are installed.

5. An I/O Processor Module paired with an Asynchronous Communications Device Board (ACDB) and three Asynchronous Communications Extenders (ACE) can support 64 users with each user typing continuously at 100 wpm and receiving a 1920 character display update every 6 seconds. If a higher average display update rate is required, the number of users must be reduced proportionately.

6. Processor, Dual Processor, Memory and Service Processor modules must be installed on the CSS Bus. I/O Processor and adapted controller modules may be installed on the CSS Bus or a CSS/XA Bus.

7. Memory Modules must be assigned to high priority CSS Bus slots. They should be assigned to the highest priority slots to minimize read response time and maximize read bandwidth.

8. Command issuing modules (Service Processor, Processor, Dual Processor, I/O, I/O Processor and adapted controller modules) should be assigned to bus slots according to the sustained demand they can make on bus resources. The greater the sustained demand a module can make on bus resources, the lower the priority of the slot it is assigned to.

9. Processor and Dual Processor Modules can make the greatest sustained demand on CSS Bus resources and must be assigned to the lowest priority CSS Bus slots.

10. All Dual Processor 68040 Modules must have the same effective Priority.

11. The Service Processor Module should be assigned to a CSS Bus slot whose priority is at least as high as that of the highest priority Processor or Dual Processor Module. This is mandatory when Dual Processor Modules are present.

12. I/O Modules must be assigned to high priority slots.

13. I/O Processor Modules should be assigned to high priority slots.

14. I/O Processor Modules paired with Dual SCSI Device Boards should be assigned to relatively high priority slots to maximize device board to main memory DMA performance.

SYSTEM90/25 CSS BUS CONFIGURATION RULES

The configuration rules for the CSS Bus of a System90/25 with an 8/2 Bus Arbiter are:

1. The Service Processor Module (SPM) paired with an Asynchronous Communications/Real World Interface (ACRW) must be installed in slot 0 for cabling reasons.

2. A system may have a maximum of three 68020 Processor Modules (PM20). These must be installed in slots 1, 2 or 3. The first PM20 is installed in slot 1, the second is installed in slot 2 and the third is installed in slot 3.

3. A system may have only one 68040 Dual Processor Module (DPM40). The DPM40 should be installed in slot 1.

4. Memory Modules (MM) must be installed in slots 4, 5 or 6.

5. I/O Processor Modules (IOPM) paired with Dual SCSI Device Boards (DSDB) that connect to internal devices must be installed in slots 6 or 7 for cabling reasons. The first IOPM/DSDB is installed in slot 7; the second IOPM/DSDB is installed in slot 6.

6. I/O Processor Modules paired with LAN/WAN Device Boards (LWDB) must be installed in slots 4 or 5 and must be lower in priority than Memory Modules.

7. I/O Processor Modules paired with Asynchronous Communication Device Boards (ACDB) must be installed in slots 3, 4, 5 or 6.

SYSTEM90/45 CSS BUS CONFIGURATION RULES

The configuration rules for the CSS Bus of a System90/45 with a 16/2 Bus Arbiter are:

1. The Service Processor Module (SPM) paired with an Real World Interface (RWI) must be installed in slot 0 for cabling reasons.

2. The system may have a maximum of six 68020 Processor Modules (PM20) or two 68040 Dual Processor Modules (DPM40). The 68020 Processor Modules must be installed in slots 1 through 6. The first and second PM20's are installed in slots 3 and 4, the third and fourth are installed in slots 2 and 5 and the fifth and sixth are installed in slots 1 and 6. The 68040 Dual Processor Modules must be installed in slots 3 and 4.

3. Memory Modules (MM) should be installed in the highest priority CSS Bus slots. The sole exception to this rule is that an I/O Processor Module (IOPM) paired with an Asynchronous Communications Device Board (ACDB) and one or more Asynchronous Communications Extenders (ACE) may be installed in a slot with higher priority than that of a slot occupied by a Memory Module. This allows the Extender(s) to use the otherwise unused device board space behind the Memory Module(s).

4. I/O Processor Modules (IOPM) should be installed in slots 8 through 15.

5. I/O Processor Modules (IOPM) paired with Dual SCSI Device Boards (DSDB) should be installed in the highest priority slots that are lower in priority than the priority of any slot occupied by a Memory Module.

6. I/O Processor Modules paired with LAN/WAN Device Boards (LWDB) should be installed in the highest priority slots that are lower in priority than the priority of any slot occupied by an IOPM paired with a DSDB.

The configuration rules for the CSS Bus of a System90/45 with a 16/4 Bus Arbiter are the same as those for a System90/45 with a 16/2 Bus Arbiter with the following exception:

1. The system may have a maximum of seven 68020 Processor Modules (PM20) or two 68040 Dual Processor Modules (DPM40). The 68020 Processor Modules must be installed in slots 1 through 7. The first and second PM20's are installed in slots 2 and 5, the third and fourth are installed in slots 1 and 6, the fifth and sixth are installed in slots 3 and 4 and the seventh is installed in slot 7. The 68040 Dual Processor Modules must be installed in slots 2 and 5.

SYSTEM90/85 CSS BUS CONFIGURATION RULES

The configuration rules for the CSS Bus of a System90/85 with a 16/2 Bus Arbiter are the same as those for a System90/45 with a 16/2 Bus Arbiter with the following exceptions.

1. The Memory Modules should be installed to the highest priority CSS Bus slots with no exceptions.

2. I/O Modules (IOM) should be installed in slots whose priority is between that of Memory Modules and that of I/O Processor Modules paired with Dual SCSI Device Boards.

3. I/O Processor Modules paired with Asynchronous Communications Device Boards should be installed on the CSS/AX.

The configuration rules for the CSS Bus of a System90/85 with a 16/4 Bus Arbiter are the same as those

for a System90/85 with a 16/2 Bus Arbiter with the following exception.

1. The system may have a a maximum of eight 68020 Processor Modules (PM20). These must be installed in slots 1 through 8. The first and second PM20's are installed in slots 2 and 5, the third and fourth are installed in slots 1 and 6, the fifth and sixth are installed in slots 3 and 4, the seventh is installed in slot 7 and the eighth is installed in slot 8.

SYSTEM90/85 CSS/XA BUS CONFIGURATION RULES

The configuration rules of the CSS/XA Bus of a System90/85 with either a 16/2 or 16/4 Bus Arbiter are:

1. The I/O Subsystem Bus Adapter (IOSBA) should be installed in slot 15.

2. I/O Processor Modules paired with Asynchronous Communications Device Boards should be installed in slots with higher priority than I/O Processor Modules paired with LAN/WAN Device Boards or Dual SCSI Device Boards.

3. I/O Processor Modules paired with LAN/WAN Device Boards should be installed in slots with higher priority than I/O Processor Modules paired with Dual SCSI Device Boards.

SYSTEM90/25 SAMPLE CONFIGURATIONS

8/2 Bus Arbiter, 2-PM20, 1-MM, 2-DSDB, 1-LWDB, 88 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	IOPM	DSDB
5	MM	
4	IOPM	LWDB
3	IOPM	ACDB
2	PM20	ACE
1	PM20	ACE
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 2-PM20, 1-MM, 1-DSDB, 2-LWDB, 88 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	MM	
5	IOPM	LWDB
4	IOPM	LWDB
3	IOPM	ACDB
2	PM20	ACE
1	PM20	ACE
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 2-PM20, 1-MM, 2-DSDB, 0-LWDB, 120 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	IOPM	DSDB
5	IOPM	ACDB
4	MM	ACE
3	IOPM	ACDB
2	PM20	ACE
1	PM20	ACE
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 2-PM20, 1-MM, 1-DSDB, 1-LWDB, 120 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	IOPM	ACDB
5	MM	ACE
4	IOPM	LWDB
3	IOPM	ACDB
2	PM20	ACE
1	PM20	ACE
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 2-PM20, 2-MM, 2-DSDB, 0-LWDB, 88 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	IOPM	DSDB
5	MM	
4	MM	
3	IOPM	ACDB
2	PM20	ACE
1	PM20	ACE
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 2-PM20, 2-MM, 1-DSDB, 1-LWDB, 88 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	MM	
5	MM	
4	IOPM	LWDB
3	IOPM	ACDB
2	PM20	ACE
1	PM20	ACE
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 3-PM20, 2-MM, 1-DSDB, 0-LWDB, 88 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	MM	
5	MM	
4	IOPM	ACDB
3	PM20	ACE
2	PM20	ACE
1	PM20	
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 3-PM20, 2-MM, 2-DSDB, 0-LWDB, 40 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	IOPM	DSDB
5	MM	
4	MM	
3	PM20	
2	PM20	
1	PM20	
0	SPM	ACRW
		ACE
		ACE

8/2 Bus Arbiter, 3-PM20, 2-MM, 1-DSDB, 1-LWDB, 40 Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
7	IOPM	DSDB
6	MM	
5	MM	
4	IOPM	LWDB
3	PM20	
2	PM20	
1	PM20	
0	SPM	ACRW
		ACE
		ACE

SYSTEM90/45 SAMPLE CONFIGURATIONS

16/2 Bus Arbiter, 4-PM20, 2-MM, 2-DSDB, 1-LWDB, 128-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	IOPM	ACDB
14	MM	ACE
13	MM	ACE
12		ACE
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	ACDB
7		ACE
6		ACE
5	PM20	ACE
4	PM20	
3	PM20	
2	PM20	
1		
0	SPM	RWI

16/4 Bus Arbiter, 4-PM20, 2-MM, 2-DSDB, 1-LWDB, 128-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	IOPM	ACDB
14	MM	ACE
13	MM	ACE
12		ACE
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	ACDB
7		ACE
6	PM20	ACE
5	PM20	ACE
4		
3		
2	PM20	
1	PM20	
0	SPM	RWI

16/2 or 16/4 Bus Arbiter, 6-PM20, 3-MM, 2-DSDB, 1-LWDB, 128-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	IOPM	ACDB
14	MM	ACE
13	MM	ACE
12	MM	ACE
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	ACDB
7		ACE
6	PM20	ACE
5	PM20	ACE
4	PM20	
3	PM20	
2	PM20	
1	PM20	
0	SPM	RWI

16/2 or 16/4 Bus Arbiter, 6-PM20, 3-MM, 3-DSDB, 2-LWDB, 0-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	MM	
14	MM	
13	MM	
12	IOPM	DSDB
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	LWDB
7		
6	PM20	
5	PM20	
4	PM20	
3	PM20	
2	PM20	
1	PM20	
0	SPM	RWI

16/2 Bus Arbiter, 1-DPM40, 2-MM, 2-DSDB, 1-LWDB, 128-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	IOPM	ACDB
14	MM	ACE
13	MM	ACE
12		ACE
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	ACDB
7		ACE
6		ACE
5		ACE
4		
3	DPM40	
2		
1		
0	SPM	RWI

16/4 Bus Arbiter, 1-DPM40, 2-MM, 2-DSDB, 1-LWDB, 128-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	IOPM	ACDB
14	MM	ACE
13	MM	ACE
12		ACE
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	ACDB
7		ACE
6		ACE
5		ACE
4		
3		
2	DPM40	
1		
0	SPM	RWI

16/2 Bus Arbiter, 2-DPM40, 4-MM, 2-DSDB, 2-LWDB, 0-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	MM	
14	MM	
13	MM	
12	MM	
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	LWDB
7		
6		
5		
4	DPM40	
3	DPM40	
2		
1		
0	SPM	RWI

16/4 Bus Arbiter, 2-DPM40, 4-MM, 2-DSDB, 2-LWDB, 0-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	MM	
14	MM	
13	MM	
12	MM	
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	LWDB
7		
6		
5	DPM40	
4		
3		
2	DPM40	
1		
0	SPM	RWI

SYSTEM90/85 SAMPLE CONFIGURATIONS

16/2 or 16/4 Bus Arbiter, 6-PM20, 3-MM, 1-IOM, 2-DSDB, 2-LWDB, 0-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	MM	
14	MM	
13	MM	
12	IOM	
11	IOPM	DSDB
10	IOPM	DSDB
9	IOPM	LWDB
8	IOPM	LWDB
7		
6	PM20	
5	PM20	
4	PM20	
3	PM20	
2	PM20	
1	PM20	
0	SPM	RWI

16/4 Bus Arbiter, 8-PM20, 4-MM, 2-IOM, 1-DSDB, 0-LWDB, 0-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	MM	
14	MM	
13	MM	
12	MM	
11	IOM	
10	IOM	
9	IOPM	DSDB
8	PM20	
7	PM20	
6	PM20	
5	PM20	
4	PM20	
3	PM20	
2	PM20	
1	PM20	
0	SPM	RWI

16/2 Bus Arbiter, 2-DPM40, 4-MM, 2-IOM, 2-DSDB, 0-LWDB, 0-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	MM	
14	MM	
13	MM	
12	MM	
11	IOM	
10	IOM	
9	IOPM	DSDB
8	IOPM	DSDB
7		
6		
5		
4	DPM40	
3	DPM40	
2		
1		
0	SPM	RWI

16/4 Bus Arbiter, 2-DPM40, 4-MM, 2-IOM, 2-DSDB, 0-LWDB, 0-Async Ports

CSS Bus Slot	CSS Bus Module	Device Board
15	MM	
14	MM	
13	MM	
12	MM	
11	IOM	
10	IOM	
9	IOPM	DSDB
8	IOPM	DSDB
7		
6		
5	DPM40	
4		
3		
2	DPM40	
1		
0	SPM	RWI