JUMP–1
6&DL%P%9 ;EMM=q

#J#U#M#P!]#1@_7W%0%k!<%W

Revision History

1.0	'94 9/21	K. Hiraki, M. Goshima	6&DL;EMM:n@.
1.1	'94 9/22	K. Hiraki	8mjND{@5
1.2	'94 10/05	K. Hiraki	%"!<%S%H%l!<%7%g%sJ}<0$NJQ99
1.3	'94 10/20	K. Hiraki	%"!<%S%H%l!<%7%g%sJ}<0$ND{@5!"B>
1.4	'94 10/24	K. Hiraki	%"!<%S%H%l!<%7%g%s4X78$N%T%s:o8:
2.0	'95 5/5	K. Hiraki	packet <~jN@0M}!&E}9g
3.0	'95 6/12	K. Hiraki	?7#M#M#C;EMMXNBP1~$H>\:Y$N@_Dj
3.1	'95 6/29	K. Hiraki	8mjND{@5
3.2	'95 7/7	K. Hiraki	%3%^%s%II=$NDI2C!"0l1~$N40@.
3.3	'95 7/14	K. Hiraki	%(%i%9%F%#%C%/%P%j%"$NDI2C!"8m$j$ND{@5
3.4	'95 7/29	K. Hiraki, H. Nakashima	8mjND{@5, I,MW$J;EMM$NJQ99
4.0	'95 8/07	K. Hiraki	8mjND{@5!"EvLL$N:G=*HG
4.1	'96 1/25	K. Hiraki	8mjND{@5

JQ99$N%R%9%H%j

Version 1.1 1994.9.22 by J?LZ 7I

- 5-=R8mjND{@5
- init ;~$NI,MW%/%m%C%/?t$r #1$+$i#2#5#6$KJQ99
- WWE, X_ASTB_I/O $NAPJ}8~2=
- Elastic Barrier 4X78$N?.9f@~$NA}2C(X_EBCLR_I)
- SIZE $K4X$9$k5-=R$HI=$N8m$jD{@5
- ?^#3$r@5$7$/$9$k
- update_direct_req, update_via_home_req $KF14|$K4X9k5-=R$rDI2C
- reply 7O%Q%1%C%H$O7h$7$F%j%H%i%$$5lJ$$$3HrL@5-

Version 1.2 1994.10.5 by J?LZ 7I

- %"!<%S%H%l!<%7%g%sJ}<0$r!"%P%V%k$r:G>.K9$kJ}<0$KJQ99$7$?!#$=$NJQ99N?$a!"0J2<$NJQ99$r9T$JC?!#
  - %P%9$N?.9f@~$K!" X_ES !JEarly Send!K?.9f$rDI2C$7$?!# X_ES ?.9f$O!"%Q%1%C%H$N%l%7!<%P$,bO$d<u?.$rI,MWH7$J$$$3$H
    %P%9%A%C%W$KDLCN$9$k!#
  - %Q%1%C%HD9$,!"=>Mh#2%U%j%C%H$^$?$O#5%U%j%C%HG"C?3HKBP7!"D9$5#1$rDI2C7?!#$?$@$7!"D9$5#1$H#2$N:9$O!"#2%U
    L\$K%G!<%?$rE>Aw$9k+!"2?b7$J$$%P%9%5%$%/%k$rA^F~9k$+$G$"$k!#
  - %P%9%A%C%W!"%l%7!<%P$K%Q%1%C%HD9$rEAC#9k$?$a!"%"%I%l%9!&%U%j%C%HK*1k!J:#$^$GL$;HMQ$G$"$C$?CKH
    D9$rI=$9bN$KJQ99$9$k!#=>Mh;H$C$F$$$? BREQ_LEN ?.9f$rGQ;_$9$k!#
- >e5->r7o$rK~$?$9%"!<%S%H%l!<%7%g%sJ}<0$rL@3N2=7?!#5-=R$,$d$d>iD9$G$"$k$,!"%P%9%A%C%W$K$*$1$k%"!<%S%H%l!<%7%g%s2sO)$N
  hS3F%G%P%$%9$K$*$1$kE>Aw@)8f2sO)$N35MW$b=R$Y$?!#
- 3F%Q%1%C%H5-=R$K4^$^lk%Q%1%C%HD9$K4X$9$k5-=R$*hS%Q%1%C%H$N?^$rJQ99$7$?
- V1.1 $GAPJ}8~2=$7$? X_ASTB $r :F$S#1AH$NC1J}8~?.9f!" X_ASTB_I, X_ASTB_O $KJ,N%$7$?!#L5BL$J%P%V%k$r>JN,$9$k V1.2 K*$1
  $kE>Aw@)8f$G$O!" X_ASTB $,Dj$^iJ$$8B$jAPJ}8~%P%C%U%!$N@)8f$r9T$J$&$3H,IT2DG=G"k3H,860xG"$k!#
- X_BREQ $r2r=|$9$k%?%$%_%s%0$r!" X_BGRT $r<u$1HC$?<!$N%P%9%/%m%C%/$KJQ99$7$?!#
- M}2r$r=u$1k?$a!"B?$/$N%&%'!<%V%U%)!<%`?^$JIrIU$12C$($?!#

Version 1.3 1994.10.20 by J?LZ 7I

- V1.2 $G5,Dj$5lF$$$k%"!<%S%H%l!<%7%g%sJ}<0$O!"%G%C%I%m%C%/$rH/@8$9$k2DG=@-$,$"k?$a!"JQ99$7$?!#JQ99E@$O0J2<NDLjG"
  1. 0lC6 BREQ $,=P$?8e!"MW5a%l%Y%k$rJQ99=PMh$J$$5,DjGO!"%j%/%(%9%H$,2r7h$7$J$$$?$a!"LdBj$,H/@8$9$k!#=>CF!"G$0U$N
     $G?7$?$J%j%W%i%$7O$N%j%/%(%9%H$r<uM}9kI,MW$,$"$k!#
  2. %3%s%7%9%F%s%7@)8f$r0l4S$7$F9T$J$&$?$a!"0lC6G'$ail$?%j%W%i%$$O7h7F BRETRY ?.9f$G %j%H%i%$$7FOJi$J$$!J0l
     $J$$>u67$r:n$j=P9?$a!K
  3. =>CF!"<h$kF@$kJ}<0$O!"!J#1!K3F%G%P%$%9$,%"!<%S%?!<$NF0:n$r873J$K7CF*$j!"$IAi$,G'$ail$?$+H=CG$7!" BGRT $
     sert 5l$?;~E@$GAw$k%Q%1%C%H$r7hDj9k$+!" !J#2!K BGRT $r%j%/%(%9%H$N%l%Y%k$K1~$8$F!" H!" L #2K\MQ0U$9k3H,I,MW$
     $k!#
  4. >e5-N&$A!"!J#1!K$O!J#2!K$HHf3S$7FCx7$/4m81$G$"$k!#=>CF!"!J#2!K$NBP1~$r:NMQ9k!#
- 3Nh&K7$F!"=>Mh#1K\$G$"$C$? X_BGRT $rMW5a%l%Y%k$K1~8F!"$K3HBg$9$k!#
- 5-=RCf!"MW5a%l%Y%krJQ(il$J$$$H$$$&2U=j$r:o=|$9$k!#
- %a%s%F%J%s%9%3%s%H%m!<%i$NL>>N$r%a%s%F%J%s%9!&%3%s%H%m!<%i!&%$%s%?!<%U%'%$%9$KJQ99$9$k!J#M#C#I#F!K
- %P%9%A%C%W$N%P%9%A%C%W$H7F;H$&>l9g$N%A%C%WHV9f$r!" big endian $KJQ99$7$?!#$^$?!"#M#B#P$NBP1~$b#0$r%"%I%l%9>e0LB&H7$?!
- >e5-#M#C#I#F$O!"#18D$N%P%9%A%C%W$+$i$N>pJs$GF0:n9kI,MW$,$"k?$a!"%"%I%l%9%U%j%C%H$NG[CV$rJQ99$7$?!#
- %P%9%A%C%WFb$N Elastic Barrier 2sO)$r EBC $HL?L>$7$?!#
- MCIF $N@_7W$rMF0WH9k?$a!"DL?.@)8f$KI,MW$J%"%I%l%9%U%j%C%H>pJs$r#18D$N%P%9%A%C%W!J%P%9%A%C%W!t#0!KK^Ha!">pJs$N
  $N=gHV$rJQ$($?!#3lKO!"O@M}E*JQ99$OH<$o$J$$!K

Version 1.4 1994.10.24 by J?LZ 7I

- V1.3 K*$$$F!"%"!<%S%H%l!<%7%g%sJ}<0JQ99$KH<$$!"%G%P%$%9$NF~NO?.9f$,#1K\A}2C$7$?!#$3lO X_BGRT $r M%@hEY$K=>CF#2K\
  $?$+iG$"$k!#7+7J$,$i!"#M#B#PK*$$$FF~NO?.9fAm?t$N@)8B$,$-$D$$$?$a!" BGRT $O#1K\$G$"$k3H$,6/$/MW5a5lk3H,
  $?!#

- 3NLdBj$r2r7h$9k?$a!"%P%9%A%C%W>e$N%"!<%S%?K*$$$FMW5a$,G’<1$5lk;~E@$rL@3N2=$7!"$=$N;~E@K*1k:G$b9b$$MW5aKBP
$,JV$kJ}<0$KJQ99$7!" BGRT $r#1K\2=$7$?!#
- 8=;~E@GO!"%"!<%S%?K*$$$FMW5aO9YF!" X_BGRT $N#1%/%m%C%/A0$KG’<1$5$lk3Hr2>Dj9k!#=>CF!"3F%G%P%$%9$G$O X_B
$r<uM}$9kH!"$=$N#1%/%m%C%/A0$K=PNO$7$F$$$k:G9bM%@hEY$NMW5a$,<uM}5l$?$bNH9k!#
- $=$NI{:nMQH7$F!"%j%W%i%$7O$, BUSY $G!"%j%/%(%9%H7O$, BUSY GJ$$;~!"N>J}$N%j%/%(%9%H$r=P7F$$$k%G%P%$%9$N%j%/%(%9%H
7h7FA*Br5l$J$$$3H,5s2ilk!#7+7J$,$i!"3lKO<B:]E*LdBjE@$OB8:_$7$J$$$bNH9M$($ilk!#
- ;EMM=q>e$NJQ99E@$O!" ?.9f@~5-=R$N X_BGRT, X_BREQ $rJQ99$7!"$^$?!"%P%9%A%C%W$N%"!<%S%H%l!<%7%g%s$K4X9k5-=R$rJQ99$7$?

Version 2.0 1995.1.14 by J?LZ 7I

- %Q%1%C%H$N%"%I%l%9%U%j%C%H$N%S%C%H9=@.$rJQ99$7$?!#$3lO RDT %M%C%H%o!<%/$+$i$N%Q%1%C%H>pJs$H>l=jr=m(k?aG$"$k!#
- %V%m%C%/E>AwK*1k RWAIT %9%F!<%H$NB8:_$,!" V1 GO %"%I%l%9%U%j%C%HCf$N BLKWT %S%C%H$GEA$($?$,!"3F%G!<%?%U%j%C%HC
WWE0 %S%C%H$rMQ$$$FEA$($kh&$KJQ99$7$?!#$3lO%j%W%i%$%Q%1%C%H$@1JNG!" WWE HN6&MQ$,2DG=$G$"$k!#
- %/%m%C%/$NA[Dj<~GH?t$r#6#0#M#H z $K2<$2$?!#;HMQM=Dj$N CPU $NJQ99$KH<$&$bNG$"$k!#
- WWE0/1 ?.9f@~$N0UL#$,J(DP2)5l$?!#%j%W%i%$7O%Q%1%C%HGO!"Ev3:%G!<%?G\8l$K78$o$k RWAIT %U%i%0$r1?$V!#%"%I%l%9%U%j%C
%H$H%j%/%(%9%H7O%Q%1%C%H$K$*$1$k%G!<%?%U%j%C%H$G$N0UL#$OITJQG"$k!#
- %G%C%I%m%C%/2sHr$K4X$9$k[#Kf@-$rGS=|9k$?$a!"#1@a$r2C$($?!#FC$K!"%-%c%C%7%e%a%b%jK*$$$F=hM}Cf%V%m%C%/$N07$$$KCm0U$
$"$k!#

Version 3.0 1995.6.9 by J?LZ 7I

- %T%s$*$h$S%G!<%?E>Aw5!G=$N4X78$+$i!"6&DL%P%9%A%C%W$+$i%(%i%9%F%#%C%/!&%P%j%"5!G=$r:o=|$7$?!#$3lOJL FPGA $G<BAu$5lk
$"$k!#
- 6&DL%P%9$K@\B3$5lF$$$k%a%s%F%J%s%9MQ8}$rGQ;_$9$k!#6&DL%P%9$K@\B3$5$l$F$$$k%G%P%$%9$XNFI_=q$-$O#M#B#P<gBN$G9T$J$&
- 6&DL%P%9>e$N%Q%1%C%H$N<oN‘$r<c43@0M}E}9g$7$?!#FC$K!"%Q%1%C%H$r8+$1$P%a%b%jB&$G$N=hM}>r7o$,H=L@9kh&$KJQ99$7$?!#
- PEND $O!"6&DL%P%9$N?.9fGO$J$$$,!"4X78$,?<$$$?$a>\:Y$J;EMM$r5-=R$7$?!#
- %Q%1%C%H$N%U%)!<%^%C%H$rJQ99$9$k
- %V%m%C%/$N read waiting rd$a!" r-wait %U%i%0 $rI,$:D1$F reply 9kh&K7$?!#
- F14|4X78$N;EMM$r@0M}E}9g7?
- %9%L!<%W$r9T$J$&$+I&$+$OA4$F%Q%1%C%H<o$G7hDj5lkh$&$KJQ99$7$?!#<~JU2sO)$rC1=c2=$9k?$a
- read_request $+$i non-coherent-read-request $rJ,N%$7$?!#$3lO>>K\;a$NMW5a$KhkbNG"$k!#
- read_request $+$i allread_request $rJ,N%$7$?!#$3lO>>K\;a$NMW5a$KhkbNG"kH6&$K!"@)8f$r4JC12=9k$?$aG"$k!#
- write_request $+$i non-coherent-write-request $rJ,N%$7$?!#$3lO>>K\;a$NMW5a$KhkbNG"$k!#$3$N7k2L!"DL>o$N write-request
$OI,$:%9%L!<%WF0:n$r9T$J$&!#
- A4%Q%1%C%H$N%3%^%s%I%S%C%HLOMM$r7hDj7?!#J*!"3l$K4XO"$7$F%Q%1%C%H$N<oN‘$,B?>/JQ2=$7$?!#

Version 3.1 1995.6.29 by J?LZ 7I

- V3.1 $O V3.0 K*1k8mjr=$@5$9kHHb$K!" V3.0 KBP9$k0U8+$rH?1G7?bNG"$k!#
- enumerate 4D6-$N%P%0$r fix(increment $,68$C$F$$$?!K
- P.8, WWE %U%#!<%k%I$K4X$9$k R-WAIT >r7o$r5U$KD{@5!JFI$_=P7rBT$D!"$GOJ$/!"=q$-9~$_$rBT$D!K
- P.11, X_PEND ?.9f$K ACK %U%#!<%k%I$Khk@)8f$N5-=R$rDI2C
- P.26, X_RETRY $K4X$9$kBh#59‘L\$K!">r7o$rL@3N2=$9k?aK9‘L\$rDI2C!#
- P.26, X_RETRY $K4X$9$kBh#89‘L\$r0lHL2=
- P28, FbMF$OJQ2=$7$J$$$,!"5-=R$rDI2C
- P29, FbMF$OJQ2=$7$J$$$, CLSH $N5-=R$rDI2C
- P.30, ACK %U%#!<%k%I$r;HMQ$7$J$$%Q%1%C%HGO#0%/%j%"9kI,MW$,$"$k!"$H$N5-=R$rDI2C
- P.30, INJ_MASK %U%#!<%k%I$O allread_reply 7O%Q%1%C%H$@$1$GM-8z$G$"$kHN5-=R$rDI2C
- P.31, DATA %U%#!<%k%ICf$N!" Byte, Half word, word $O>o$K%"%I%l%9$G;XDj$5l? double word Fb0LCVKCV+lk!"HN5-=R$rDI2C
- P.31 DATA Flit $N WWE %U%#!<%k%I$N5-=R$rDI2C
- P.32 resolve_req $*$h$S m_reply_s %Q%1%C%H$rGQ;_
- P.32, swap_req $rI|3h$5$;$k!#
- P.32, control_write_req $N PCMD %3!<%I$rD{@5

- P.32, interrupt_req $N PCMD %3!<%I$rD{@5
- P.33, swap_reply $,I|3h$9$k
- P.33, m_reply_s $rGQ;_
- update_reply, invalidate_reply $r request %l%Y%k$KJQ99!JLa$9!K!#L>A0$b update_req, invalidate_req Ey$KJQ99!JJ6$io7$$$N$GCm0U 7F2<$5$$!K
- allread_req $K %-%c%C%7%e%a%b%j$,%j%W%i%$$9$k>l9g!">o$K INJ_MASK $K#1#1#1#1$rN)$F!"%$%s%8%'%/%7%g%s2DH9$k!# MBP $,%j%W
%$$9$k>l9g$O!" MBP $N@UG$$G INJ_MASK $rN)$F$k

Version 3.2 1995.7.7 by J?LZ 7I

- V3.2 $O V3.1 KBP7$F5~ETK*1k#67n#2#9F|%_!<%F%#%s%0$N7k2L$rH?1G5;$?bNG"$k!#
- %j%H%i%$$K4X9kCm0U$NBh#69`L\$K%-%c%C%7%e$K4X$9$k invalidate $NNc30$r:n@.7?!#J*=$@5FbMF$O!"%_!<%F%#%s%0K*1kbN$
$j!" invalidate Cf$N read, rdinv $O<uM}$9k3HH7?!#
- %j%H%i%$$K4X7F!"%-%c%C%7%e$O<+J,$,=P7?%j%/%(%9%H$,#M#B#P$K<uM}5l!"%-%c%C%7%e$,%j%W%i%$$rJV5J$$%1!<%9GO!"Ev3
%/$K4X$9$k%-%c%C%7%e$+iN%j%/%(%9%H$r%j%H%i%$$9kI,MW,$"$kHN9`L\$rDI2C7?!#
- %"%I%l%9%U%j%C%H$N CLSH %S%C%H$N2r<a$K!" write_req $NFCNc$r5-=R7?!#9JoA!"DL>o%-%c%C%7%e(global/local)$,EV~
$k CLSH %S%C%H$G$"$k$,!" write_req GO CPU $+$i$N%3%^%s%I$r%G%3!<%I7?bN$,$O$$$k3H!K
- FI$_=P$7%G!<%?$N=g=x$K4X9k5-=R$rDI2C!#%"%I%l%9%U%j%C%HCf$N ADDR %U%#!<%k%I$N5-=R$H FEBIT %U%#!<%k%I$N5-=R$rJQ99!#MW
$K!"%Q%1%C%H$,;}$D%G!<%?$N%5%$%:$,%V%m%C%/$N>l9g!"%"%I%l%9$O double word C10LG"$j!"%"%I%l%9$G;XDj7?8l$+$i>:=g$G mod
<hC?=gHV$G=PNO$5lk!#
- CPU $+$i$N%"%/%;%9$H!"%P%9%Q%1%C%HHNBP1~%F!<%V%k$rDI2C$7$?!#
- read_F_req $,GQ;_$5l?
- $=$N$[$+!"%Q%1%C%H3FO@$N5-=R$rJd$$!"407k7?bNH7$?!#

Version 3.3 1995.7.14 by J?LZ 7I

- V3.3 $O %(%i%9%F%#%C%/%P%j%"$K4X9k5-=R$rDI2C$9kHHb$K read_reply $*$h$S rdinv_reply Ey$K$*$1$k!" wait >pJs$N07$$$rJQ99$7$
bNG"$k
- V3.2 $^$G!"%j%W%i%$%Q%1%C%H$K$*$$$F R-WAIT >pJs$r%G!<%?$H6&$K WWE %U%#!<%k%I$rMQ$$$FE>Aw7?$,!"$3lO8mjG$"$C$?!# V
0J9_GO W-WAIT >pJs$r%j%W%i%$%Q%1%C%H$N WWE %U%#!<%k%I$KD1$FE>Aw$9$k!#

Version 3.4 1995.7.28 by J?LZ 7I

- V3.3 $^$G$N5-=R$G$O!"%S%C%H!"%P%$%H!"%o!<%I!"%@%V%k%o!<%I$H%S%C%H8F>N$JIN$"$$$@$G[#Kf$JE@$,$"C?!#L@3N$J5-=R$rIU$1B-
bK!"0J2<$NE@$rL@3NK7$?

    1. 35@b$N>O$K Endian $K4X$9$k@a$r@_1F!"$"$$$^$$$5rJ$/$7$?
    2. %P%9%]!<%H#M#B#PBP1~$G!"#M#B#P#0$r6v?t%Z!<%8B&!"#M#B#P#1$r4q?t%Z!<%8B&$H9k!#
    3. $r **WORD1** $N%i%$%H%$%M!<%V%k$K $r **WORD 0** $N%i%$%H%$%M!<%V%k?.9f$H7?!#
    4. $r %V%m%C%/Cf double word 0, $r %V%m%C%/Cf double word 1, $r %V%m%C%/Cf double word 7, $N full/empty
%S%C%HH7$?!#

- ?7$7$$%3%^%s%I read_xxxx_A_req JI$r:n@.$9$k!#FbMF$O$$$:lK$;$h DSP 8FS@7N$?$a!":n@.$OMF0W
- %(%i%9%F%#%C%/%P%j%"$N@a$r99?7$7!" 1:2 $ND9J}7A$^$G5v$9
- rdinv_req $K ACK %U%#!<%k%I$rDI2C9k
- PEND ?.9f$N%?%$%_%s%0%A%c!<%H$r:n$kHHbK!" PEND,RETRY $N%?%$%_%s%0$K4X$9$k#1@a$r@_1k
- retry 5,B'$r2~D{$7$?!#
- %P%9$+$i%Q%1%C%H$r<h$j9~$`>r7o$r!" all $^$?$O DID $N0lCW$HL@3N2=9k!#$^$?!" non cacheable Gb all $G=P$9
- INJ_MASK $O$$$:lN read 7O%j%W%i%$%Q%1%C%H$G$bM-8z$H9k
- CLSH=0 $N update 7O%j%/%(%9%H %Q%1%C%H$r MCC/MBP $O5[F~$7$J$$$3HrL@5-
- read_req $K!" global shared clean $G%-%c%C%7%e$,JVEzrJV9$3$H$,$"k3HrL@5-
- ACK %U%#!<%k%I$N0LCV$O!" ACK rI,MWH7J$$%Q%1%C%HGO#0H9k3HrL@5-
- read_reply Ey$N DID %G%P%$%9$O!"$=$N%j%W%i%$$HJk860x$N%j%/%(%9%H$r=P7?bNGJ$/$FOJiJ$$!# cache injection $ONc30
- invalidate_via_home_req $O %j%/%(%9%H$NH/?.<T$r DID H9$k rdinv_reply Kh$jH/?.<T$KEA$($ilk!#
- reply %Q%1%C%H>e$N R-WAIT $r , W-WAIT $r $K:\$;kh$&$K;EMM$r3NG'$9$k

- ?7$?$K injection_req $r:n@.$9$kF0:n$O allread_reply $HF1$8G"k,%j%H%i%$$,2DG=G"$k!#$3lO MMC $@$1$,H/@8$5$;$k!# DSP $O
3NH/@8KEv?CF!"Ev3:%V%m%C%/$K4X$7$F<+J,$,Jz$($F$$$k;E;v$r%A%'%C%/$9$k
- writeback_reply $r?7@_$9$k!#F0:n$O write_req $HF1$8!#%j%/%(%9%HMQ write_req $O non cacheable req MQ$H7F;D$9
- %j%H%i%$$N5,B'#3$r0J2<$Nh&$KJQ99$9$k!Vrequest 7O%Q%1%C%H$O<u$1<h$k%G%P%$%9$N0l;~E*860x$G%j%H%i%$2DG=G"$k!#$?$@$7!$%
%$$N860x$O2?$b6&DL%P%9$+$i%Q%1%C%H$r<u$1Hi$:!$$^$?!Vrequest 7O%Q%1%C%H$rAw$j=P$5J/Fb!W;~4V$N7P2a$HHb$K2r7h$9$kI,
$k!#!W

Version 4.0 1995.8.7 by J?LZ 7I

- V4.0 $O!"2>#M#B#P$rMQ$$$?<BAuK?$$$9$k0l1~$N:G=*HG$rL\;X$9bNG"$k
- V4.0 $G?75,$JE@OJ$/!":Y$+$$%P%0$r=$@5$7$?!#FC$K!"%j%H%i%$$?.9f!" X_PEND ?.9f$N%?%$%_%s%0$K4X$o$k5-=R$K4X9k[#Kf$JE@$r
7?

Version 4.1 1996.1.25 by J?LZ 7I

- V4.1 $O!"%P%9%A%C%W$N%]!<%H3djIU1$K4X$9$k #P#8$N8mC?5-=R$rD{@5$7$?$bNG$"$k!# %-%c%C%7%e%]!<%H$N3d$jIU1O!"A4%S%C
7F9TJolk3H$,@5$7$$5-=RG"$k!#

1 350@

1.1 %/%i%9%?$N9=@.

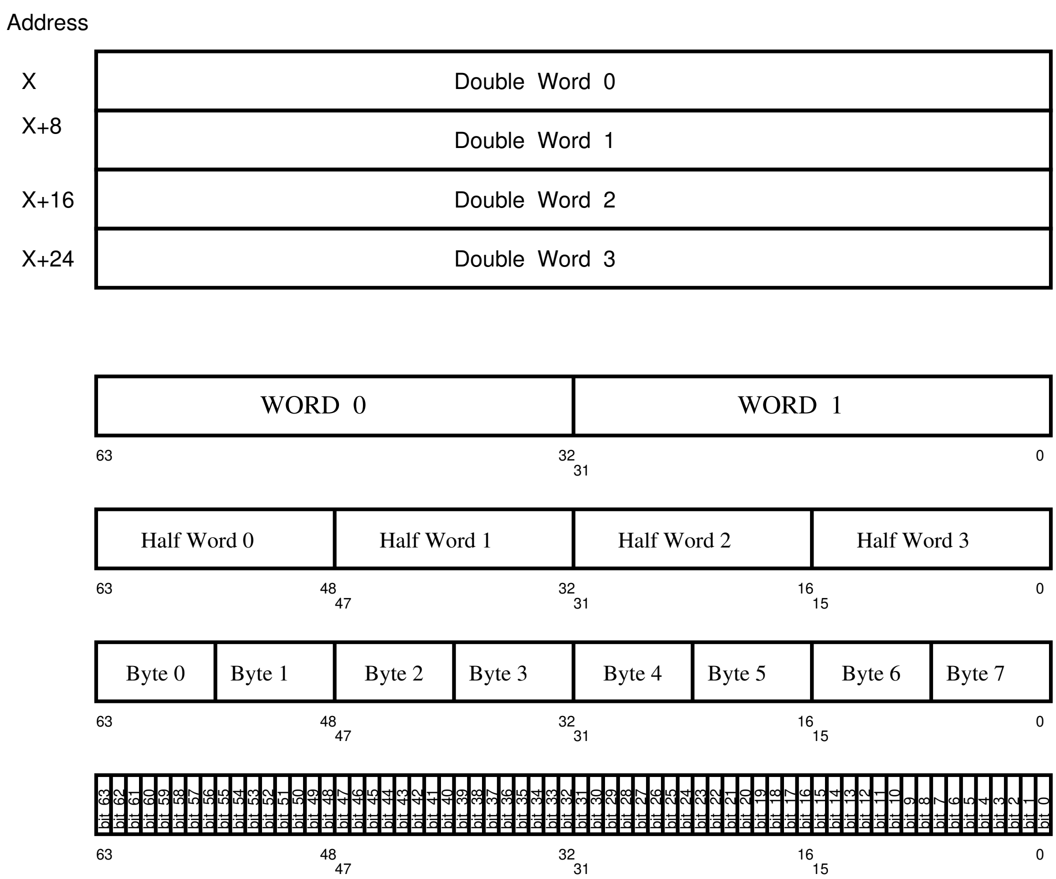
JUMP-1 6&DL%P%9!J0J8e!" CBus $HN,$9$k!K$O!$JBNs7W;;5! JUMP-1 $N=hM}%/%i%9%?Fb$N%f%K%C%H$rAj8_@\B 9k%P%9G"$k!#K\;EMM=q$O!" CBus $N9=@.!" CBus K*1kE>Aw<j=g$N>\:Y!" CBus >e$G$N%-%c%C%7%e$*h %b%j@)8fJ}<0$r5,Dj$9kbNG$"$k!#

JUMP-1 $N%/%i%9%?$O0J2<$N%f%K%C%H$+iJ$k!'

- MWAG%W%m%;%C%5 SuperSPARC ×4
- Fs<!%-%c%C%7%e (E-Cache) ×4
- %-%c%C%7%e!&%3%s%H%m!<%i (CC) ×4
- Memory-Based Processor (MBP) ×2
- %/%i%9%?!&%a%b%j!&%P%s%/ ×2
- #R#D#T%M%C%H%o!<%/!&%k!<%? ×1

CBus $N4pK\5!G=$O!$ 4 DN CC!$ 2 DN MBP $rD>@\@\B3$9k3HG$"$k!#J*!"2>#M#B#P$rMQ$$$?<BAuG #2DN#M#B#PN+oj$K#1$D$N#M#M#C!J%a%b%j%3%s%H%m!<%i!K$,@\B3$5$l!"%/%i%9%?%a%b%j$r%"%/%;%9$9$k@) 8=7F$$$k!#

#M#M#C$N>\:Y$K$D$$$F$O#M#M#C;EMM=q$r;2>H9k3H!#



?^ 1: JUMP-1 %G!<%?!?%"%I%l%9$NI=8=7A<0

1.2 4pK\E*;v9`

1.2.1 Endian

JUMP-1 $O!" CPU!"%a%b%j!"%P%9EyA4FN9`L\$K$D$$$F!" SPARC Architecture $K=>$&$HF1$80UL#$N Big Endian %"%I%l%9IU$1$rMQ$$$k!#9JoA!" **byte, half word, word** KD$$$F$O!" **Big Endian** G"$j!" **bit** $*$h $S **double word** 0J>e$NBg$-$5KD$$$F$O **Little Endian** G"$k!#$^$?!" word Fb%S%C%H$O>o$K MSB !J>l9g$K hCFO sign bit!K$, :GBg$N%S%C%H8F>NG"$j!" LSB $,:G>.$N%S%C%H8F>NG"$k!#=>$C$F!"%S%C%H%"%I%l%9$, 5l$k5-=R$G$O!"%S%C%H8F>N$H!"%S%C%H%"%I%l%9$,0lCW$9$k!#?^ 1 $O!"#J#U#M#P!]#1$K$*$1$k%S%C%H8F>N!"%S %I%l%9!"%P%$%H%"%I%l%9!" half word %"%I%l%9!" word %"%I%l%9!" double word %"%I%l%9$r<($9bNG"$k!#

K\;EMM=q@bL@CfGO!":.MprHr1k?$a!"%S%C%H8F>N$K$O !N!O$G0O$_!"%S%C%H0LCV!"%P%$%H0LCVJI$O0O $$?t;z$G5-=R$9$k!#$^$?!"%S%C%H%U%#!<%k%I$N;XDj$OA4$F%S%C%H8F>N$GE}0l$7!"!N!OFbNJBS=g$O #X!N#A!’#E !N#B!’#A!O$rA4$/:.F1$7$F;HMQ$7$F$$$k!#

1.3 %G%P%$%9HV9f

<!$K!"%G%P%$%9HV9fKD$$$F$N convention rDja$k!#%-%c%C%7%e%3%s%H%m!<%i$NHV9f$O!" CPU HV9f$HF10l$ $k!#

%P%9%A%C%W$O#48D$KJ,3d5lk,!"HV9f$O %O!<%U%o!<%I$N%"%I%l%9=g$H0lCW$9$k!"$9Jo$A%G!<%? double $N MSB B&$, %P%9%A%C%W #0G"$j!" LSB B&$,%P%9%A%C%W#3G"$k!#

#M#B#P$O!"%Z!<%8HV9f$N6v4qKh$j6hJL$5lk!#6v?t%Z!<%8$O #M#B#P#0!"4q?t%Z!<%8$O#M#B#P#1$G=hM}$5 ;HMQ9k%Z!<%8$, #4#K%P%$%H$N%9%b!<%k!&%Z!<%8$N>l9g!"%"%I%l%9$, ADDR[12] = 0 $N>l9g!"#M#B#P#0$G$"$ ADDR[12]= 1 $N>l9g!"#M#B#P#1$G$"$k!#F1MM!"%i!<%8!&%Z!<%8$N>l9g!" ADDR[18] = 0 $N>l9g!"#M#B#P#0$G$ $j!" ADDR[18] = 1 $N>l9g #M#B#P#1$G$"$k!#

J*!"2>#M#B#P$r;HMQ$9$k>l9g$O!"#18D7+$J$$$?$a!"A4$F$N%j%/%(%9%H$O#M#B#P #0$,BP>]$G$"$k!#

1.3.1 ?.9fL>

K\;EMM=q$G07$&?.9f@~L>$N5-K!$H7F!"4pK\5!G=L>$r SIG_NAME H9kH!"O@M}$N6K@-$r@\F,<- !JIiO@M}' $G<B8=$9$k>l9g X_SIG_NAME $HL?L>!K!"?.9f$NJ}8~@-$r@\Hx<-!JF~NO?.9f$r SIG_NAME_I !"=PNO?.9f$r SIG_NA Ey$HL?L>!KH7$?47MQ$r;HMQ9k!#

?.9f$N5-=R$O!"A4$F%P%9%A%C%W$r<gBNH7$F8+$F$$$k!#9JoA!"%G%P%$%9$+$i%P%9%A%C%W$X$N?.9f$,F~N $j!"%P%9%A%C%W$+$i%G%P%$%9XN?.9f$,=PNO$G$"$k!#$^$?!"@5O@M}$O#H$,??G"$j!"IiO@M}$O#L$,??$G$"$k!#

2 J*M}E*9=@.

CBus $O JUMP-1 %/%i%9%?FbIt$rAj8_7k9g9k6&DL%P%9G"k,!"J*M}E*%$%s%W%j%a%s%F!<%7%g%s$H7F$O%
GOJ/#L#S#I$rMQ$$!"#48D$N%P%9%A%C%W$KJ,3d7F<B8=5l$k!#$7$+$7J,$i!"K\@a$G$OM}2r$rMF0WH9$k
8D$N%P%9%A%C%W$G<B8=5l$F$$$kbN$H2>Dj$7$F@bL@$9$k!#J,3d$7$?<B8=J}<0$O<!@a$r;2>H$N3H!#

35@bGb=RY?h&$K!"%P%9%A%C%W$K$O!"#2<oN`#68D$N%G%P%$%9$,@\B3$9$k$?$a!"#6%]!<%H$N%P%9%]!<%H$
5l$F$$$k!#6qBNE*KO0J2<$K<($9%]!<%HHV9f$,3F%G%P%$%9$KBP1~$9$k!#

- Fs<!%-%c%C%7%e%a%b%j!JE-Cache !K$*$h$S%-%c%C%7%e!&%3%s%H%m!<%i!JCC!K
  0. %-%c%C%7%e!&%3%s%H%m!<%i !t#0
  1. %-%c%C%7%e!&%3%s%H%m!<%i !t#1
  2. %-%c%C%7%e!&%3%s%H%m!<%i !t#2
  3. %-%c%C%7%e!&%3%s%H%m!<%i !t#3
- Memory-Based Processor !JMBP!K
  4. #M#B#P !t#0 !J6v?t%Z!<%8B&!K!J#M#M#C$r@\B3$9$k>l9g$,$"$k!K
  5. #M#B#P !t#1 !J4q?t%Z!<%8B&!K!J#M#M#C$,@\B3$5lk>l9gKO;HMQ7J$$!K
- $=$NB>
  6. 3djEvFJ7!#;HCF$O$$$1$J$$
  7. 3djEvFJ7(all H7$FMQ$$$k)!#

%P%9%A%C%WHN@\B3?.9f@~$N<oN`!?5!G=$O!"@\B3$9$k%]!<%HKh$jHyL/$J:90[$,B8:_$9$k!#8D!9$N:90[$O3
;EMM5-=RK*$$$F>\=R9k$,!"<gMW$J:90[$O<!$NDLjG$"$k!'

- %-%c%C%7%e$N%9%L!<%WA`:n$K4X9k?.9f@S(X_MSH_I, X_CRPLY_I)$O!"%-%c%C%7%e%a%b%j$K@\B3$5$l$F$$$k
  %P%9%]!<%H !t#0 !A !t#3 $@$1$+$iF~NO5l$k!#

2.1 CBus $r9=@.$9$k?.9f@~

CBus $O0J2<$K<($9?.9f@~$G9=@.5l$k!#3F?.9f@~$NEE05$O!"%P%9%A%C%W$,B>$N5!G=$N%A%C%W$r7s$M$F$$$k >e6&DL%P%9;EMM=q V2.x GOLDjG$"$j!"#3!%#3#V$H#5#V$,:.:_9k!#3F?.9f@~$O86B'E*$KC1J}8~G"k,!" %S%C%H$N%G!<%?!?%"%I%l%9 %U%#!<%k%I$*$h$S!"$=lK4XO"9k[10] WWE $OAPJ}8~$G$"$k!#=>CF!"%G!<%?!?%"%I %l%9 %U%#!<%k%I$NE>AwJ}8~$,JQ2=9k>l9gKO!">/J/Hb#1%/%m%C%/$N6uGr$rF~lkI,MW$,$"$k!# J*!" $N>l9g$O>o$KMW5a$r=P7?%G%P%$%9$,=PNO!"B>$N%G%P%$%9$,F~NOJ}8~$HJj!"8e=R X_ES ?.9fKh$jE>Aw$,CfC $J$$8B$j%P%9!&%Q%1%C%HE>Aw$,=*N;9k%P%9%/%m%C%/$^$GJ}8~@-$,0];}$5lk!#

J*!"%P%&%s%@%j!&%9%-%c%sJI%G%P%0!?%a%s%F%J%s%9$KMQ$$$k?.9f@~$N>\:Y$OEl<GKh$k JTAG %^%K%e% ;2>H$9k3$H

%P%9%A%C%W6&DL@)8f?.9f@~

?.9fL>	K\?t	J}8~	%l%Y%k	5-=R
CLK	1	F~NO	@5O@M}	%P%9KBP9$k%/%m%C%/!##6#0#M#H z %/%m%C%/$rF~NO$9$k!#%/%m%C %/$O#L"*#H$N%(%C%8$rMQ$$!"#H"*#L$N%(%C%8$OMxMQ7J$$!#
X_RESET	1	F~NO	IiO@M}	%P%9%A%C%WKBP9$k%j%;%C%H?.9f!# X_RESET $O%P%9%A%C%W3F ItJ,$N=i4|2=$K;HMQ$5$l!" X_RESET $,#L$G$"$k4|4V$K>/$J $/$H$b#2#5#68D CLK Kh$k%/%m%C%/$,2C$($ilkI,MW$,$" $k!#
FS	3	F~NO	@5O@M}	%P%9%A%C%W$N5!G=@_Dj$r9TJ&!#%P%9%A%C%W$O!" FS Kh$j<!$N 3F5!G=$r<B8=9k!# FS $O!"%A%C%W$,O@M}F0:n$r9T$J$&4\|4V!"%l %Y%k$,8GDj7F$$$kI,MW$,$"$j!" FS $,JQ2=$7$?>l9g$K$O X_RESET Kh$j%j%;%C%Hr+$1kI,MW,$"$k!# 0. %P%9%A%C%W!t#0!JMSB B&!K 1. %P%9%A%C%W!t#1 2. %P%9%A%C%W!t#2 3. %P%9%A%C%W!t#3!JLSB B&!K 4. %-%c%C%7%e%3%s%H%m!<%iMQ%G!<%?%P%C%U%! 5. #M#B#P%a%b%j%$%s%?!<%U%'%$%9 6. %P%9$KD>@\@\B3$5lk#M#M#C
SCLK	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%sMQ%/%m%C%/F~NO
SRST	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s2sO)$N%j%;%C%H?.9f
SMOD	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s2sO)$NF0:n%b!<%I;X Dj
SI	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s%G!<%?F~NO
SO	1	=PNO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s=PNO

3F%]!<%H%G!<%?E>Aw?.9f@~

<table>
<tr><th>?.9fL></th><th>K\?t</th><th>J}8~</th><th>%l%Y%k</th><th>5-=R</th></tr>
<tr><td>DATA[63:0]</td><td>64</td><td>F~=PNO</td><td>@5O@M}</td><td>%G!<%?$*$h$S%"%I%l%9E>Aw$KMQ$$$ilk!#%P%9!&%Q%1%C%HE>Aw<j=g$N:G=i$G$O!"%"%I%l%9!?%3%^%s%I$,Awil!";DjNItJ,GO%G!<%?$^$?$O5!G=$r<B8=9k$?$aKI,MWJ>pJs$,Aw$ilk!# DATA $NE>AwJ}8~$r@ZBX$($k>l9gKO!"#1%/%m%C%/$NM>M5!JAPJ}$,F~NO%b!<%IHJ$k!K$rHk3H$,I,MW$G$"$k!#</td></tr>
<tr><td>WWE[1:0]</td><td>2</td><td>F~=PNO</td><td>@5O@M}</td><td>WWE[1:0]$O!"%Q%1%C%H$N%"%I%l%9%U%j%C%H$N>l9g!" request %Q%1%C%H$N%G!<%?%U%j%C%H$N>l9g$*hS reply %Q%1%C%H$N%G!<%?%U%j%C%H$N>l9g$N#3<oN`$N0UL#$K2r<a$5lk!#
%Q%1%C%H$NBh0l%U%j%C%H$G$"$k%"%I%l%9!&%U%j%C%HK*$$$F$O!" WWE[1:0]$O%Q%1%C%HD9$rI=$9!#%Q%1%C%HD9$N2r<a$O2<I=NDLjG"$k!#
<table>
<tr><th>WWE[1]</th><th>WWE[0]</th><th>Packet Length</th></tr>
<tr><td>L</td><td>L</td><td>1</td></tr>
<tr><td>L</td><td>H</td><td>2</td></tr>
<tr><td>H</td><td>L</td><td>5</td></tr>
<tr><td>H</td><td>H</td><td>Reserved</td></tr>
</table>
%G!<%?!&%U%j%C%HK*$$$F$O!"%-%c%C%7%e$+iN request %Q%1%C%HK*$$$F$O%P%9%A%C%W$H$N%G!<%?!J#6#4%S%C%H!K$N8l!J#3#2%S%C%H!KC10L$N=q$-9~$_%$%M!<%V%k?.9fH7$F WWE[0]$, DATA[63:32]$K BP1~$7!" WWE[1]$, DATA[31:0]$KBP1~9k!#

%-%c%C%7%e$^$?$O MBP $+$i$N reply %Q%1%C%H$G$O!"WWE[0]$, Ev3: double word $N R-WAIT %U%i%0!JFI$_=P7rBTCF$$$k=q$-9~$^l?%G!<%?$,B8:_$9$k!K$r1?$S!"WWE[1]$, WWE-WAIT %U%i%0!J=q$-9~$_rBTC$F$$$kFI$_=P$7%j%/%(%9%H$,B8:_$9$k!K$r1?$V!#
J*!" WWE $NE>AwJ}8~$O DATA $NE>AwJ}8~$H0lCW9k</td></tr>
<tr><td>X_ASTB_I</td><td>1</td><td>F~NO</td><td>IiO@M}</td><td>%P%9%A%C%WXN DATA ?.9f$,%"%I%l%9$G$"$k3H$r<($9!#%Q%1%C%HE>Aw$N:G=i$K;HMQ5l$k!#</td></tr>
<tr><td>X_ASTB_O</td><td>1</td><td>=PNO</td><td>IiO@M}</td><td>%P%9%A%C%W$,Aw$j=P$9 DATA ?.9f$,%"%I%l%9G"k3Hr<($9!#%Q%1%C%HE>Aw$N:G=i$K;HMQ$5lk!# X_ASTB_I $+$i>o$K#1%/%m%C%/CY$l$k</td></tr>
</table>

<table>
<tr><th>?.9fL></th><th>K\?t</th><th>J}8~</th><th>%l%Y%k</th><th>5-=R</th></tr>
<tr><td>X_BREQ[1:0]</td><td>2</td><td>F~NO</td><td>IiO@M}</td><td>3F%G%P%$%9$+iN%P%9MW5a!#MW5aKO#2<o$NM%@hEY$,D1il!" X_BREQ[0]$,M%@hEY$NDc$$%j%/%(%9%H7OMW5a$r!" X_BREQ[1]$,M%@hEY$N9b$$%j%W%i%$7OMW5a$rI=$9!#
3F%G%P%$%9$G$O3FM%@hEY$KBP1~9k X_BREQ $NC<$G$0U$K assert 7?jda?j7$FNI$$!#%"!<%S%?$,G'<1$9$kMW5a$O>o$K!" 3F%G%P%$%9$, X_BGRT $,JV$CF-$?;~E@$N#1%/%m%C%/A0$K3F%G%P%$%9$,AwCW$7$? X_BREQ[0]$N$&$A!"MW5aEY$N9b$$J}G"$k!#$b$7!">CLG$7$?MW5a$KBP7F X_BGRT $,Aw$ilF$-$?>l9g$O!" nop %Q%1%C%H$J$IL532$JbNrAwkI,MW$,$"$k!#
$^$?!" X_BGRT $r<u$1HC$?#1%/%m%C%/8e$N%P%9%5%$%/%k$K$O!"BP1~$9$k X_BREQ[1:0]$NCM$O2r=|$5lF$$$kI,MW$,$"$k!#$5bJ1l$P!"?7$?$KMW5a$r9TJC$F$$$kbN$H2r<a$5lk!#</td></tr>
<tr><td>X_BBUSY[1:0]</td><td>2</td><td>F~NO</td><td>IiO@M}</td><td>%G%P%$%9$,?7$?$JMW5a$r<u$1Hk3H$,2DG=$+!"M%@hEYJL$K<($9J*!" X_BBUSY[1:0]NCMOKh%/%m%C%/FHN)$KM?$(ilk,!"%"!<%S%H%l!<%7%g%s$r9T$JC?;~E@$H>u67$,$+$o$j!"<u$1HlJ/JC$?request 7O%Q%1%C%H$O8e=R X_BRETRY_O ?.9f$r=PNO$9k3HKhj<u1Hjr5qH]9kI,MW$,$"$k!#$?$@$7!" reply 7O$N%Q%1%C%H$OI,$:<uM}$9kI,MW,$"$k!#
=>CF!"2<5->r7o$K=>$C$F X_BBUSY[1:0]$r:n@.9kI,MW$,$"$k!#

1. X_BBUSY[1]$O **assert** 5l$?;~E@$G **arbitration** $rDL2a$7$? **reply** 7O%Q%1%C%HA4$F$r<h$j9~ak3H$rA0Ds$K **assert** 9kI,MW$,$"$k!#
2. X_BBUSY[0]$O **assert** 5l$?;~E@$G **arbitration** $rDL2a$7$?%Q%1%C%H$O!"%j%H%i%$$9$kA0Ds$G **assert** 7F$bNI$$
3. X_BBUSY[1:0]$O!"%Q%1%C%H$r<u$1<h$k%G%P%$%9$N0l;~E*860x$G assert G-$k!#G"$k!#$?$@$7!$ BBUSY $N860x$O2?$b6&DL%P%9$+$i%Q%1%C%H$r<u1Hi:!$$^$?!Vrequest 7O%Q%1%C%H$rAw$j=P$5J/Fb!W;~4V$N7P2a$HHb$K2r7h$9kI,MW,$"$k!#

%G%C%I%m%C%/$K4X$9$kCm0U!'%M%C%H%o!<%/$r4^a?7OGN%G%C%I%m%C%/rHr1k?$a!"%j%W%i%$%-%e!<$H%j%/%(%9%H%-%e!<$O40A4$KJ,N%$7$F$$$kI,MW$,$"$k!#
<table><tr><th>X_BBUSY[1]</th><th>X_BBUSY[0]</th><th>Device Status</th></tr><tr><td>H</td><td>H</td><td>A4FN%Q%1%C%H$r<u$1<h$j2D</td></tr><tr><td>H</td><td>L</td><td>%j%/%(%9%H7O%Q%1%C%H<u$1<h$jIT2D</td></tr><tr><td>L</td><td>H</td><td>%j%W%i%$7O%Q%1%C%H<u$1<h$jIT2D</td></tr><tr><td>L</td><td>L</td><td>A4FN%Q%1%C%H<u$1<h$jIT2D</td></tr></table></td></tr>
</table>

3F%]!<%HE>Aw@)8f?.9f@~!JB3$-!K

?.9fL>	K\?t	J}8~	%l%Y%k	5-=R
X_BGRT	1	=PNO	IiO@M}	X_BGRT $,#L$HJk$H!"<!$N%P%9%5%$%/%k$+$i%G!<%?$NE>Aw J}8~$,3NDj$7!"Ev3:%G%P%$%9$,%P%9$r@jM-$9$k!#$J$*!"<B:]$N %P%9E>Aw$O X_ASTB_I ?.9f$,#LHJ$k%P%9%5%$%/%k$+$i3+;O 5l$k!# X_BGRT $O>o$K assert 5l$?#1%/%m%C%/A0$NMW5a KBP7$F%"!<%S%H%l!<%7%g%s$r9TJC$?7k2L$r<(7F$$$k!#!J$J $*!"%"!<%S%?$N2sO)@_7W>e$NLdBjE@$+$i!"#2%/%m%C%/A0$NMW5a $K=>$&2DG=@-$b;D$C$F$$$k3H$KN10U$5l?$$!K X_BGRT ?.9f$,#L$HJC$?$,!" X_ASTB_I ?.9f$,#L$HJi$: <B:]$N%P%9E>Aw$,D94\|4V!JM=$a@_Dj5l$?%P%9%/%m%C%/?t!K3+ ;O$5lJ$$>l9gKO!"CWL?E*%(%i!<HJ$j%7%9%F%`$NF0:n$OJ] >Z$5lJ$$!#%P%9$N2rJ\|;~4\|$O!"%Q%1%C%HD9$G7hDj$5lk!# X_BGF $O!"%P%9E>Aw$,3+;O5lk^$G!"$9Jo$AEv3:%G%P%$%9$+$i X_AST ?.9f$, #L$HJk%P%9%5%$%/%k$^$GJ];}$9kI,MW,$"$j!" X_ASTB_I ?.9f$, #L$HJC$?<!$N%P%9%5%$%/%k$G$OO"B3$7$FF10l%G%P%$ %9$+$i$NMW5a$,G'ailJ$$8B$j#H$KLakI,MW,$"$k!#
X_ES	1	F~NO	IiO@M}	X_ES $O!"%Q%1%C%H$N%^%9%?$,@Z$jBXok;~KI,MWJ%P%9?.9f >eGN%P%V%k$r8:>/$5$;$k3H$rL\E*$H7?!" Early Send ?. 9f@~G"$k!#>\$7$/$O!"8e$K%"!<%S%H%l!<%7%g%s$N9`L\$G=R$Y k,!"35MW$r@bL@$9kH!" • X_ES ?.9f$O!"%P%9E>Aw$N%9%l!<%VB&!J<u?.B&!K$@1, assert 9k!#%P%9E>Aw$N%^%9%?B&!JAw?.B&!K$G$O%Q%1%C %HE>Aw$N4V!">o$K#H$KJ]DI,MW,$"$k!#%P%9E>Aw$N%^%9 %?B&$G!"%Q%1%C%HE>AwESCf$G#L$HJk>l9g$NF0:n$OJ]>Z 5l$J$$!# • X_ES ?.9f$O!"D9$5#5$N%Q%1%C%H$r<u?.7F$$$k>l9g$@ 1K assert 5l$k!#D9$5#1$J$$$7$O#2$N%Q%1%C%H<u?.$K :]$7FO>o$K#H$KJ]DI,MW,$"$k!#5bJ/$P!"@5>o$J F0:n$OJ]>Z$5lJ$$!# • X_ES ?.9f$O!"%Q%1%C%H<u?.B&$,%9%L!<%WF0:nJIr* 3J$$!"E>AwCf$N%U%j%C%H0J2<$,I,MW$J$$>l9g$K assert 5l$k!#J*!" assert 5l$k%?%$%_%s%0$O!"%P%9!&%Q%1%C %H$rBh i %P%9%/%m%C%/H9kH!" i + 4 %P%9%/%m%C%/0J A0G"$k!#$^$?!" i + 1 %P%9%/%m%C%/$J$IHs>o$KAa4| $K CM$,3NDj$7!" assert 9k>l9gGb!"<!$KEv3:%G%P%$ %9$,%^%9%?$HJk>l9g#2%P%9%/%m%C%/0J>eAa4|$K<!%Q%1%C %H$rE>Aw3+;O9k3H$OIT2DG=$G$"$k!# • X_ES ?.9f$, assert 5lkH!"%P%9%A%C%W$O DATA $* hS WWE ?.9f@~NCMr Input J}8~ $KJQ99$9$k!#
X_BRETRY_O	1	=PNO	IiO@M}	%P%9$,%G%P%$%9$+$i<u1HC?%Q%1%C%HKBP9$k%j%H%i%$MW5a!# %Q%1%C%H$rAw=P$9$k%G%P%$%9GOBh i %P%9%/%m%C%/$+$i3+;O$7 $?%Q%1%C%H$K4X9k X_BRETRY_O ?.9f$OBh i+4 %P%9%/%m%C %/$G<uM}9k!# BRETRY Kh$j%P%9$r%j%H%i%$$9$k>l9g$O$9 YF%G%C%I%m%C%/$r9MN8$7!"@dBP$KH/@8$7$J$$$3Hr3NG'9k I,MW$,$"$k!#$J$*!" X_BRETRY_O $O!"3F%G%P%$%9$+$iF~NO 7? X_BRETRY_I NOBrHj!"0lC6%i%C%A7??.9fG"$k
X_BRETRY_I	1	F~NO	IiO@M}	9JoA!"%Q%1%C%H$r<u$1Hk%G%P%$%9$KHj!"Bh j %P%9%/%m%C %/$+$i%Q%1%C%H$r<uM}$9kH!"%j%H%i%$$,I,MW$J>l9g$K$OBh j+ 2 %/%m%C%/$K$F **X_BRETRY_I** ?.9f$rAw=P9kI,MW$,$"$k!#

3F%]!<%H%9%L!<%W@)8f?.9f@~

?.9fL>	K\?t	J}8~	%l%Y%k	5-=R
X_MSH_I	1	F~NO	IiO@M}	8=:_E>AwCf$^$?$OD>A0$KE>Aw7?%Q%1%C%HKBP7$F!"%V%m%C%/$r6&M-9k>l9g$KAw=P$9$k?.9f!#%Q%1%C%H$rBh i %P%9%/%m%C%/$+$iAw$j=P$9$H!"Bh $i+2$ %/%m%C%/$K X_MSH_I $r<uM}$9$k!# X_BRETRY_I ?.9f$HF1$8%?%$%_%s%0$GF~NO$9$k!#
X_MSH_O	1	=PNO	IiO@M}	8=:_E>AwCf$^$?$OD>A0$KE>Aw7?%Q%1%C%HKBP7$F!"%V%m%C%/$r6&M-9k%-%c%C%7%e$,B8:_$9k3Hr<($9?.9f!#<B$O X_MSH_I $rC1$K OR $7!"%i%C%A$7$??.9f@~!#%G%P%$%9$,%Q%1%C%H$rBh j %P%9%/%m%C%/$K%P%9A%C%W$XAw=P9k$H!"Bh $j+4$ %/%m%C%/$G X_MSH_O $rAw=P$9$k!#
X_CRPLY_I	1	F~NO	IiO@M}	8=:_E>AwCf$^$?$OD>A0$KE>Aw7?%Q%1%C%HKBP7$F!"Ev3:%-%c%C%7%e$,%j%W%i%$$9k3Hr<($9?.9f!#%G%P%$%9$X%Q%1%C%H$rBh i %P%9%/%m%C%/$GAw=P$9kH!"Bh $i+2$ %/%m%C%/$K X_CRPLY_I ?.9f$r<uM}9k!# X_BRETRY_I ?.9f$HF1$8%?%$%_%s%0$GF~NO9k!#
X_CRPLY_O	1	=PNO	IiO@M}	8=:_E>AwCf$^$?$OD>A0$KE>Aw7?%Q%1%C%HKBP7$F!"%-%c%C%7%e%a%b%j$,%j%W%i%$$9k3Hr<($9?.9f!#<B$O X_CRPLY_I $rC1$K OR $7!"%i%C%A$7$??.9f@~!#%G%P%$%9$,%Q%1%C%H$rBh j %P%9%/%m%C%/$K%P%9A%C%W$XAw=P9k$H!"Bh $j+4$ %/%m%C%/$G X_CRPLY $rAw=P$9$k!#

J*!"%P%9?.9f@~GO$J$$$,!"%-%c%C%7%e%3%s%H%m!<%i$H#M#B#P$^$?$O#R#D#T%k!<%?4V$G!"<!$N?.9f$,7k(k3HKCm0U5l$?$$!#!J%-%c%C%7%e%3%s%H%m!<%i$r<gBN$H7F?.9f$r8+$k!K

CC–MBP D>@\?.9f@~

?.9fL>	K\?t	J}8~	%l%Y%k	5-=R
X_PEND	1	F~NO	IiO@M}	%-%c%C%7%e%3%s%H%m!<%i$r2p$7$F SuperSPARC $N PEND ?.9f@~$KBP1~!#

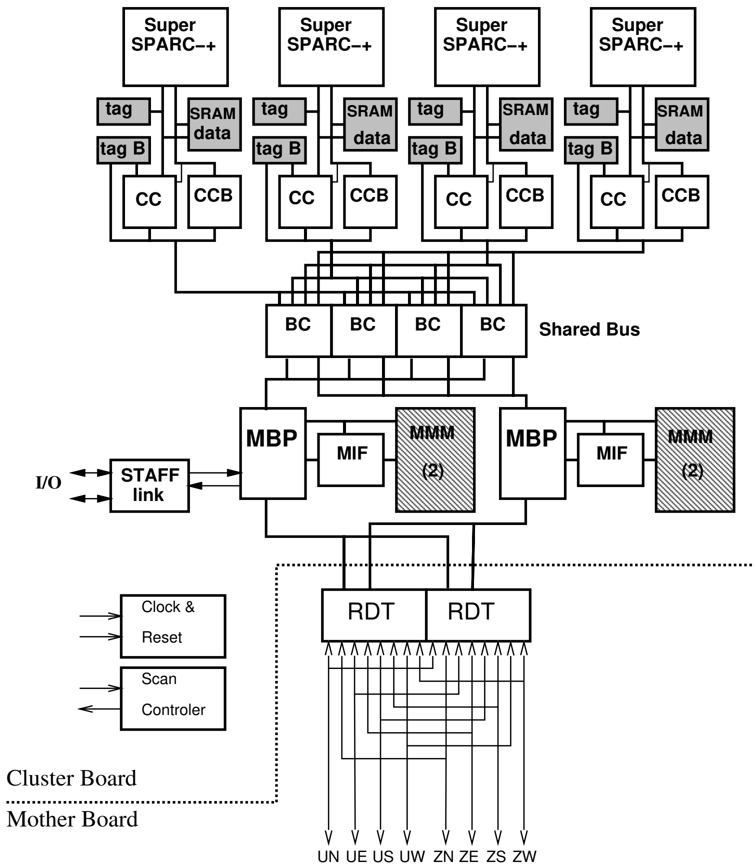
X_PEND ?.9f$O!"#M#B#P!J$^$?$O#M#M#C!K$,%P%9$+$i%Q%1%C%H$r<uM}9k$H!" X_RETRY_O ?.9f$N<!$N%/%m %/$G#M#B#P$,@8@.$9$k!# write 7O$N request GO!" request %Q%1%C%H$N%"%I%l%9!&%U%j%C%H$K$"$k ACK %U%#!<%k$ Kh$j!" X_PEND ?.9f@8@.$,@)8f5l$k!# ACK %U%#!<%k%I$,#0$N>l9g!" X_PEND ?.9f@8@.$OM^;_5l$k!# X_P ?.9f$N>\:Y$O!"8e=R$9$k

3 %P%9%A%C%W

A0@a$G<($7$? CBus $O!"<B:]$K$O 4 8D$N ASIC $G<B8=$5lk!#$3$3GO!"%P%9%A%C%W$N%P%9%A%C%W$H7F$N5
$r2L$?9?aKI,MW$J9`L\$r=RYk!#

%P%9%A%C%W$O!"<g$K%G!<%?%Q%9$KCmL\$7$F#4J,3d$9$k!#$7$+$7J,$i!"A4$F$N?.9f@~$,J,3d2DG=Jo1G$O
6&DL@)8f?.9f@~$d%O%s%I%7%'%$%/$K4XO"$9kbNNBgItJ,$O=EJ#$7$FG[CV$9kI,MW,$"$k!#

?^ 2$O!"#J#U#M#P!]#1%/%i%9%?$N%A%C%WJ,3d$r<($9bNG"$k!#K\@a$G=RYk%P%9%A%C%W$O?^Cf CCB!" BC!
%A%C%W$r@.$9$,!"$3$3$G$O BC $KBP1~$9$k;EMM$r=RYk!#3l$i%A%C%W$N@ZBX$($O!"%P%9%A%C%W$N FS F~NO$K$
Jolk!#



CPU SuperSPARCII (PGA293)
CC Cache Controler (TCP296)
CCB Cache Controler Buffer (= BC) (TCP296)
BC Bus Chip (TCP296)
STA STAFF Link (Daughter board)
MBP Memory-Based Processor (TCP344)
MIF Memory Interface (= BC) (TCP296)
MMM Main Memory Module (SDRAM + SRAM)
SDRAM (TSOP44-400 X 20)
SRAM (512K X 8 X 4)
RDT RDT router (PGA299)

tag SRAM (SOJ28P300 X 4)
tagB SRAM(SOJ28P300 X 2)
data SRAM(SOJ36P400 X 8)

?^ 2: 1 %/%i%9%?$N%A%C%WJ,3d

0J2<$K<($9%P%9%A%C%W?.9f@~Cf%P%&%s%@%j!&%9%-%c%sJI%G%P%0!?%a%s%F%J%s%9$KMQ$$$kbN$OEl<G$N ASI
%W;EMM$K4p$E$/$bNG$"$k!#3liN?.9f@~$O%P%9%A%C%W30It;EMM=q$K$*$$$F5,Dj9kM=DjG"$k!#

%P%9%A%C%W6&DL@)8f?.9f@~

?.9fL>	K\?t	J}8~	%l%Y%k	5-=R
CLK	1	F~NO	@5O@M}	%P%9KBP9$k%/%m%C%/
X_RESET	1	F~NO	IiO@M}	%P%9%A%C%WKBP9$k%j%;%C%H?.9f
FS	3	F~NO	@5O@M}	%P%9%A%C%W$N5!G=@_Dj
SCLK	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%sMQ%/%m%C%/F~NO
SRST	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s2sO)$N%j%;%C%H?.9f
SMOD	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s2sO)$NF0:n%b!<%I;XDj
SI	1	F~NO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s%G!<%?F~NO
SO	1	=PNO	@5O@M}	%P%9%A%C%W JTAB %P%&%s%@%j!&%9%-%c%s=PNO

3F%]!<%H%G!<%?E>Aw?.9f@~

?.9fL>	K\?t	J}8~	%l%Y%k	5-=R
DATA[15:0]	16	F~=PNO	@5O@M}	%G!<%? !? %"%I%l%9?.9f
WWE[1:0]	2	F~=PNO	@5O@M}	WWE[1:0]$O!"%Q%1%C%H$N%"%I%l%9%U%j%C%H$N>19g!" request %Q%1%C%H$N%G!<%?%U%j%C%H$N>19g$*hS reply %Q%1%C%H$N%G!<%?%U%j%C%H$N>19g$N#3<oN`$N0UL#$K2r<a$5lk!# WWE $N0UL#$K$D$$$F$OA0@a$r;2>HN3$H!#$J$*!" WWE[1:0]$O!"#48D%P%9%A%C%WA4FGF10lF~NO$r<uM}$9kI,MW,$"$k$,!"=PNOB&$O#18D$N%G%P%$%9$+$i$@$1=PNO9l$PNI$$!#
X_ASTB_I	1	F~NO	IiO@M}	%P%9%A%C%W$KF~NO$9$k%Q%1%C%H$N:G=i$r<($9!#%"!<%S%H%l!<%7%g%sGI,MWJ$?$a!"A4%P%9%A%C%W$KF~NO$9$k
X_ASTB_O	1	=PNO	IiO@M}	%P%9%A%C%W$+$i=PNO9k%Q%1%C%H$N:G=i$r<($9!#%G%P%$%9GNMW5a@)8fGI,MWG$"$k!#A4FN%P%9%A%C%W$,F10l>pJs$r=PNO2DG=G"k,!"#18D$N%P%9%A%C%W$+$i=PNO$9lP$h$$!#

3F%]!<%HE>Aw@)8f?.9f@~

?.9fL>	K\?t	J}8~	%l%Y%k	5-=R
X_BREQ[1:0]	2	F~NO	IiO@M}	3F%G%P%$%9$+iN%P%9MW5a!#%"!<%S%H%l!<%7%g%s$K;HMQ$9k?$a!"A4%P%9%A%C%W$KF~NO9k
X_BBUSY[1:0]	2	F~NO	IiO@M}	%G%P%$%9$,?7$?$JMW5a$r<u$1Hk3H$,2DG=$+!"M%@hEYJL$K<($9!#%"!<%S%H%l!<%7%g%s$K;HMQ$9k?$a!"A4%P%9%A%C%W$KF~NO9k
X_BGRT	1	=PNO	IiO@M}	%P%9%A%C%W$+$i$N%0%i%s%H?.9f!##48D$N%P%9%A%C%WNJ$+$G!"#18D$@$1=P$;$P$h$$
X_ES	1	F~NO	IiO@M}	%P%9%A%C%WXN early send ?.9f!##48D$N%P%9%A%C%WA4$F$,F~NO$9kI,MW,$"$k
X_CNTL_O	1	=PNO	IiO@M}	X_BRETRY, X_MSG, X_CRPLY N&AN$$$:l+$r!"%P%9%A%C%W#48D$N$&$A#38D$rMQ$$$F<B8=
X_CNTL_I	1	F~NO	IiO@M}	F1>e$N?.9fF~NO!##48D$N%P%9%A%C%WN&$A!"#38D$KJ,1F<B8=!#

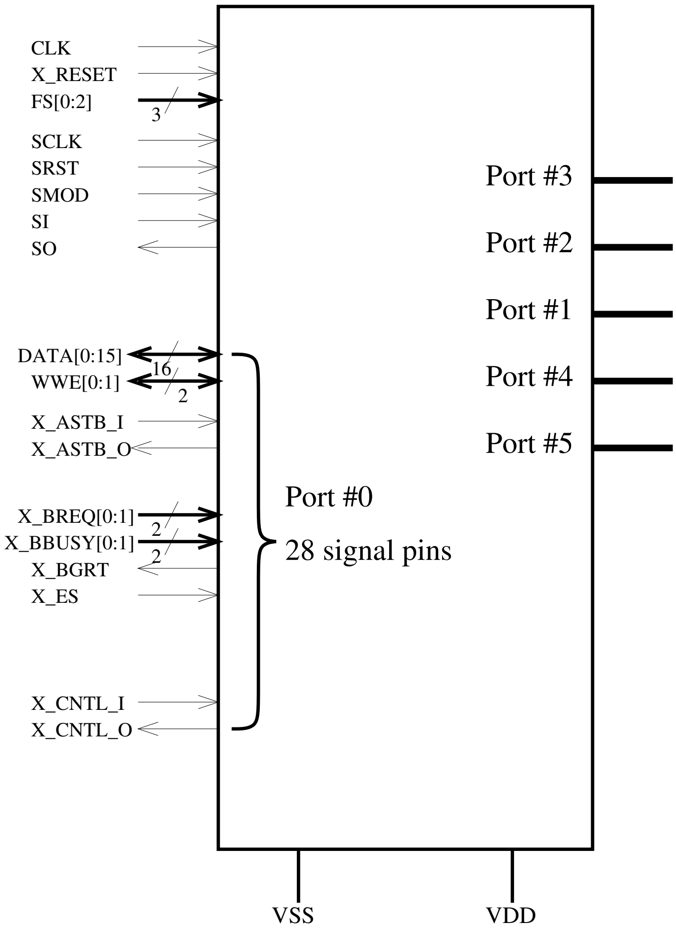
0J>e$^$Hak$H!"3F%P%9%A%C%W$KI,MW$J?.9f@~?t$O2<I=NDLjG"$k!#

%P%9%A%C%W$N%T%s?t3d$jEv$F

J,N`	?.9fL>	J}8~	K\?t	=EJ#9kMQES
6&DL@)8f	CLK	I	1	
	X_RESET	I	1	
	FS	I	3	
	SCLK	I	1	
	SRST	I	1	
	SMOD	I	1	
	SI	I	1	
	SO	O	1	
%]!<%H 0 … 5	DATA	IO	16	
	WWE	IO	2	1 chip $@$1 IO!#B>$O I
	X_ASTB_I	I	1	
	X_ASTB_O	O	1	B>$N?.9f$H7sMQ2D
	X_BREQ	I	2	
	X_BBUSY	I	2	
	X_ES	I	1	Early send
	X_BGRT	O	1	
	X_CNTL_I	I	1	X_MSH, X_BRETRY, X_CRPLY
	X_CNTL_O	O	1	X_MSH, X_BRETRY, X_CRPLY
	%]!<%HF~NO>.7W	I	7	
	%]!<%H=PNO>.7W	O	3	
	%]!<%HF~=PNO>.7W	IO	18	
	#6%]!<%HAm7W		168	
9g7W	F~NO9g7W	I	51	
	=PNO9g7W	O	19	
	F~=PNO9g7W	IO	108	
	Am7W		178	

vspace8mm

%P%9%A%C%W$N@5>o5!G=<B8=$KI,MW$J#1#7#8K\$N$&$A!"4pK\5!G=<B8=$K#1#6#8?.9f%T%s!"%/%m%C%/Ey6&DL?.9f$K#1#0K\$,I,MWG"$k!#



X_CNTL_I Used for X_MSH_I, X_CRPLY_I, X_BRETRY_I

X_CNTL_O Used for X_MSH_OI, X_CRPLY_O, X_BRETRY_O

?^ 3: %P%9%A%C%W$NF~=PNO

3.0.1 %"!<%S%H%l!<%7%g%s$N35MW

CBus $O!"%A%C%W$r;HC?FCD'$r@8$+$7!"$^$?%j%/%(%9%H$H%j%W%i%$$,J,N%7F$$$k3H$rM-8z$K;H$&$?$
CJ3,M%@hEY=8Cf%"!<%S%H%l!<%7%g%s $rMQ$$$k!##1#6%S%C%HKh$K%9%i%$%9$5$l$?3F%P%9%A%C%W$O3F!9%"!<%S%?$r
F10l%"!<%S%H%l!<%7%g%sF0:n$r9T$J$&!#$^$?!"3F%G%P%$%9$H%P%9%A%C%W$N%G!<%??.9f$OAPJ}8~?.9f@~$G7k9g$5
k?$a!"J}8~@ZBX$N$?$a$KH/@8$9$k%P%9>e$N%P%V%k$r:G>.2=$9k?$a!"%Q%1%C%H$ND9$5$K1~8?@ZBX$(@)8f
$&!#

%"!<%S%H%l!<%7%g%s2sO)$,K~$?$9I,MW$,$"$k<g$J>r7o$O!'

1. $$$+Jk>u67Gb%G%C%I%m%C%/$rH/@8$7$J$$!J$?$@$7!"%G%C%I%m%C%/$rH/@8$7$J$$>r7o$O!"3F%G%P%$%9F
   M}J}<0$K0MB8$9$k!K
2. 3F%G%P%$%9$,%U%'%"$J%P%93d$jEvFr<u1k
3. =PMhk@$1%P%9$rM-8z3hMQ$7!"%P%9>e$G$N%P%V%k$rM^$($k
4. %"!<%S%H%l!<%7%g%s2sO)$,9bB.F0:n!J#6#0#M#H z Kh%/%m%C%/%"!<%S%H%l!<%7%g%s$r9T$J$&!K2DG=$G$"$k

3liN>r7o$rK~$?9?$a0J2<$N35MW$N%"!<%S%H%l!<%7%g%sJ}<0$r;HMQ9k!#

1. =hM}2DG=$J reply 7OMW5a$,$"$k>l9gKO!"I,$: request 7OMW5a$K@hN)CF=hM}$,9T$Jol$k!#

2. 3F%G%P%$%9$,%U%'%"$J%P%93d$jEvFr<u1k$?$a$K0J2<$NJ}<0$rMQ$$$k!'

   (a) 3F%G%P%$%9$+iNMW5a$O!"!J=`!K%i%&%s%I%m%S%sM%@hEY$G<uM}$5lk!#

   (b) %i%&%s%I%m%S%sM%@hEY$N>l9g!"MW5a$rC5::9k5/E@$O!":G8e$KMW5a$,<uM}$5l?%]!<%HNNYK@_Dj
   $+!"5!3#E*!"Nc$($PMW5a$,G'ailkKhKK=d2s9k%]!<%H$K@_Dj$9$k!#!JF0:n$N:F8=@->e!"A0<T$
   $7$$!K

3. =PMhk@$1%P%9$rM-8z3hMQ$7!"%P%9>e$G$N%P%V%k$rM^$($k$?$a!"2<5-$NJ}<0$rMQ$$$k!'

   (a) %Q%1%C%HD9$r#1!"#2!"#5$KJ,1k!#$?$@$7!"%Q%1%C%HD9#1$N>l9g!"%Q%1%C%H$,O"B3$9k3HOJ/!
   4V$K#1%P%9%/%m%C%/$N6u7d$,I,MW$G$"$k!#

   (b) Aw?.85$,F10l$G$"$k%Q%1%C%H$,O"B3$9$k>l9g!"%Q%1%C%HD9$,#2!"#5$N>l9g$K$O%Q%1%C%H4V$N6u7d$,A
   $/!"%Q%1%C%HD9$,#1$N>l9g$K$O6u7d$,#1%P%9%/%m%C%/HJ$k!#

   (c) Aw?.85$,JQ$o$k>l9g!"@h9T$9$k%Q%1%C%HD9$,#5G"$j!"<!$NAw?.85$,@h9T$9$k%Q%1%C%H$N8eH>$r<uM
   I,MW$,$J$$>l9g!J%9%L!<%WK*$$$F!"%"%I%l%9%U%j%C%H$r8!::$7$?7k2L%G!<%?$r<u1Hk3H,ITI
   $"$k3H$,H=L@$7$?>l9g!"$*hS%9%L!<%W$,ITMW$G!"%"%I%l%9%U%j%C%H$G<($5lkAw$j@h$,0[JC$
   >l9g!K!" X_ES $r=PNO$7!"<!$NAw?.85$,@h9T9k%Q%1%C%H$NBh#4%U%j%C%H$N0LCV$+$iAw?.$r3+;O$9k
   Kh$j!"@h9T$9$k%Q%1%C%H!"<!$N%Q%1%C%HHb<u?.9k%G%P%$%9$+$i8+$FO"B3$9$k%Q%1%C%HH7$F<
   G=Jh$&$K9k!#

   (d) @h9T9k%Q%1%C%H$ND9$5$,#1$G$"$jAw?.85$,JQ$o$k>l9g!"%"%I%l%9%U%j%C%H$K0z$-B3$/%P%96u7d$rA
   ?.9f@~$NJ}8~@ZBX$($N6u7d$H7F;HMQ9k!#

3.0.2 %"!<%S%H%l!<%7%g%sJ}<0

K\@aGO!"%"!<%S%H%l!<%7%g%s2sO)$N9=@.$r<($9!#$9GK<(7F$$$kFbMFG"k,!"%"!<%S%H%l!<%7%g%s
E>Aw@)8f$K4XO"$9$k3F?.9f@~$N0UL#FbMF$*$h$S!"%"!<%S%H%l!<%7%g%s$*hSE>Aw@)8fKI,MWG$"$k<g$JFbIt?.
$$$F@bL@9k!#

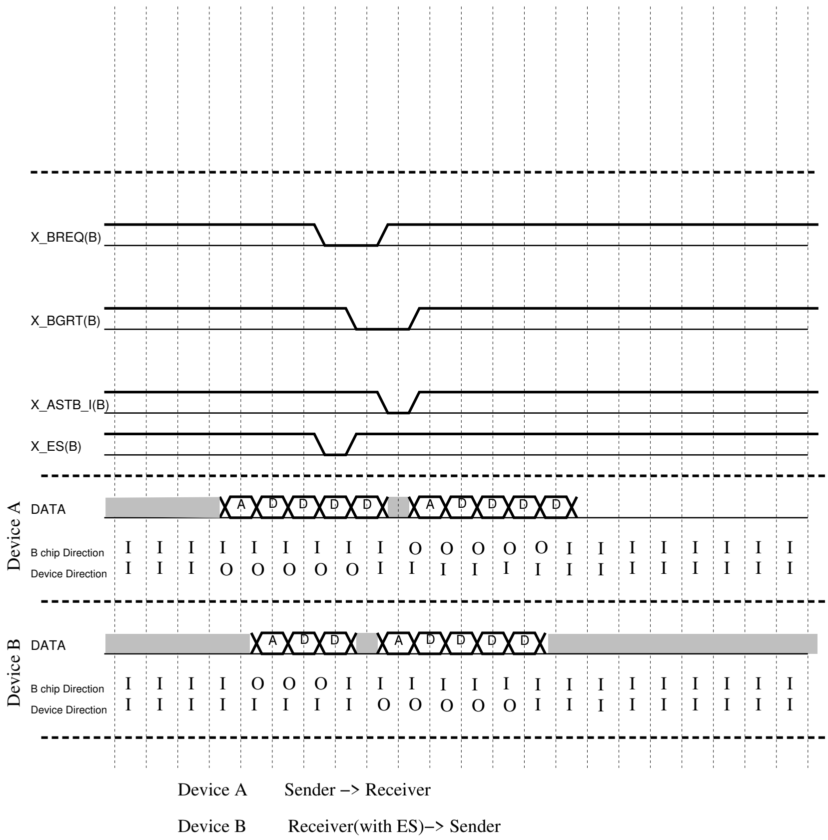
X_BREQ X_BREQ[1:0]$O!"3F%G%P%$%9$+$i$N%P%9MW5a$G$"$k!#MW5a$O request 7O$H reply 7O$KJ,$1il!" request
7O$O X_BREQ[0]!" reply 7O$O X_BREQ[1]GEA(il$k!# reply 7O$O request 7Ohj9b$$M%@hEY$r;}$D!#

X_BBUSY X_BBUSY[1:0]$O!"3F%G%P%$%9$, request 7O $*$h$S reply 7O$NMW5a$r!JF~NO%P%C%U%!$, full G"kEyN
M}M3Kh$j!K<uM}IT2DG=$G$"$k3HrEA($k?.9f@~$G$"$k!# request 7O$[0]X_BBUSY reply 7O$O X_BBUSY[1]$r
;HMQ9k!# X_BBUSY $O<+M3$KJQ2=7FNI$$$,!"3F%G%P%$%9$K$*$$$F BUSY GJ$$>uBV$+$i BUSY >uBV$KJ
2=9k>l9g!"MW5a$N%"!<%S%H%l!<%7%g%s$H<B:]$NE>Aw$K;~4V:9$,$"$k4X78$G!" BUSY >uBV$N%G%P%$%9$K%Q
%H$,E>Aw$5lk>l9g$,H/@8$9$k!#$=$N>l9g$O 3F%G%P%$%9$K$*$$$F BUSY >uBV$G:GDc#18D$N%Q%1%C%H$,<u
G=G"k+!" X_BRETRY ?.9fKh$j!":FE>Aw$,I,MWG"$k!#

X_ES X_ES $O!"D9$5#5$N%Q%1%C%H$r<u?.7F$$$k%G%P%$%9$,!"#3!"#4HVL\$N%G!<%?%U%j%C%H$,ITI,MW$G$"$k
$rDLCN$9$k?.9f$G$"$j!" X_ES $r<uM}$7$?<!$N%/%m%C%/$+$i!"%P%9%A%C%W%G!<%??.9f@~$r=PNO%b!<%I$+$i
%b!<%IXH@ZBX$($k!# X_ES rAwC$?%G%P%$%9$O!"$=$N<!$N%/%m%C%/0J9_!":GBg#2%P%9%/%m%C%/J,Aa$/<!
%1%C%HAw?.$r3+;O$9k3H,2DG=G"$k!#!J%?%$%_%s%0?^;2>HN3$H!K %P%9%A%C%W$G$O!" X_ES $r<uM}
$H!"<!$N%/%m%C%/$+$i%G%P%$%9$X$N=PNO$rCf;_$7!"APJ}8~?.9f@~$rF~NO%b!<%IH7$F<!$N%Q%1%C%HE>Aw$r

WWE WWE[1:0]$O!"%G!<%?%U%j%C%H$K$*$$$F$O8lC10L$N%i%$%H%$%M!<%V%k?.9fG"k,!"%"%I%l%9%U%j%C%H$
$$$F$O!"%Q%1%C%HD9$r<($9!#Aw?.B&%G%P%$%9GO!" X_BGRT $, assert 5l$kD>A0$N X_ASTB_O $H!"IU?o$
$k WWE $+$i!"D>A0$N%Q%1%C%H$ND9$5$r5a$a!" X_BGRT KhjG'ail$?%Q%1%C%HE>Aw$N3+;O;~4|$r7hD
$k!#$J$*!"D>A0$N%Q%1%C%HE>AwCf X_ES $, assert 5l$?>l9gKO!":GBg#2%P%9%/%m%C%/%Q%1%C%HE>Aw$N3+;
Aaailk!#

X_ASTB_I $r assert 7?%P%9%/%m%C%/$+$i WWE $G<($5lk%Q%1%C%HD9$N4|4V=PNO%b!<%I$HJk!# %P%9%A%
%WGO!" X_ASBT_O $r assert 7?%P%9%/%m%C%/$+$i WWE $G<($5lk%Q%1%C%HD9$N4|4V$G X_ES Kh$jCf
CG5lk^$G =PNO%b!<%I$HJk!#!JD9$5#1$^$?$O#2$N%Q%1%C%H$O7h7FCfCG5l$J$$!K



?^ 4: X_ES $N@bL@?^

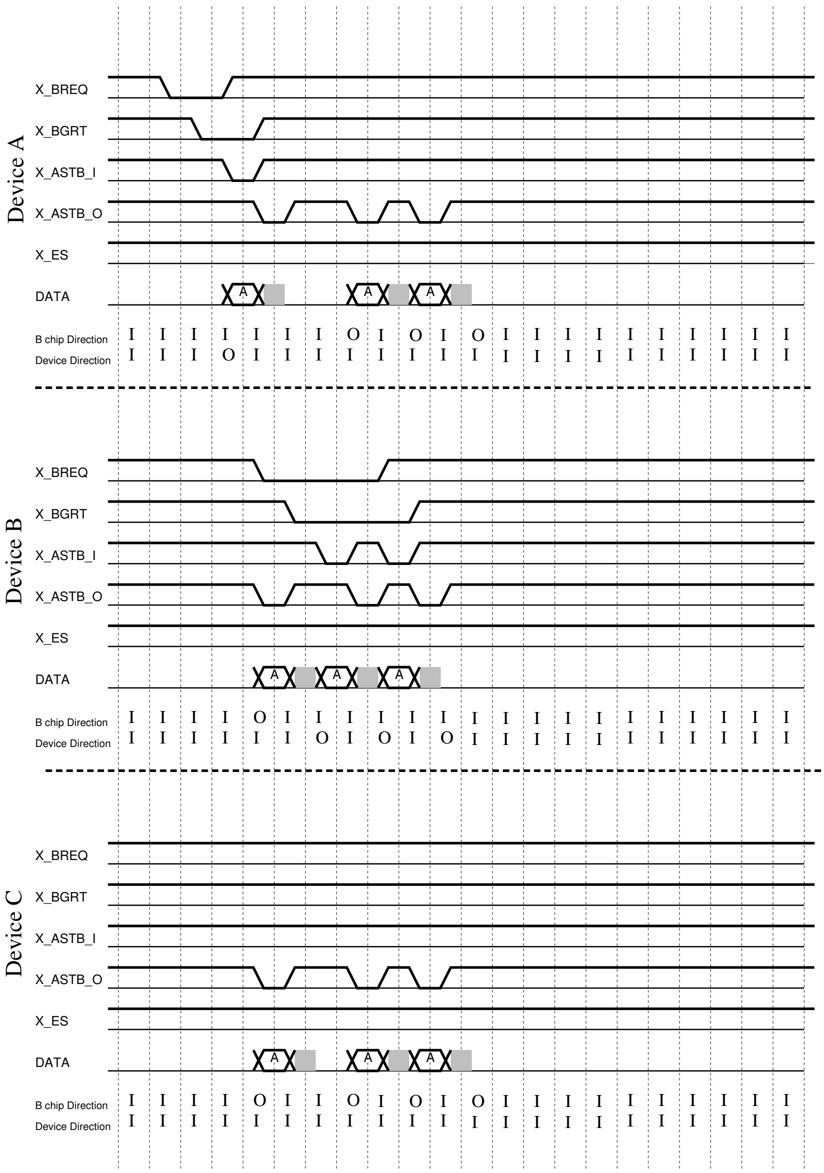
X_ASTB_I X_ASTB_I $O!"3F%G%P%$%9$+$i$N%Q%1%C%H$N@hF,$r<($9?.9fG"$j!" X_ASTB_I $, assert 5l$F$$ $k4|4V$KF~NO9k%U%j%C%H$O%"%I%l%9!&%U%j%C%H$G$"$k!# X_ASTB_I $OI,$:8e=R$N X_BGRT $H=E>v$9$k%? %_%s%0$G=PNO5lk?$a!"#1%P%9%/%m%C%/$G$O#08D$^$?$O#18D$N X_ASTB_I $r%P%9%A%C%W$OF~NO9k3H$ 0U!#

X_BGRT X_BGRT $O!"%P%9%A%C%W$,3F%G%P%$%9$K6&DL%P%9$N;HMQ$,3djEvFil$?$3HrDLCN9k=PNO?.9f$ $k!#Ev3:%G%P%$%9$, X_BREQ $r assert $7!"%"!<%S%H%l!<%7%g%s$N7k2L!"A*Br5l!"Ev3:MW5a%l%Y%k$NA4$ %G%P%$%9$, X_BBUSY $r assert $;$:!"$+$D8=:_B>$N%G%P%$%9KBP7$F X_BGRT $r assert 7F$$$J$$>uBV$G assert 5l$k!#3F%G%P%$%9$+iNMW5a$O!" X_BGRT ?.9f$, assert 5l$k %P%9%/%m%C%/$N #1%/%m%C%/<jA0$ G'<1$5$l$k!#$^$?!" X_BGRT $O!"Ev3:%G%P%$%9$+$i$N X_ASTB_I $, assert 5lkH 2r=|5l$k!# F10l%G% %$%9KBP7$F X_BGRT $H X_ASTB_O $,F10l%/%m%C%/$G=P5l$k>l9g$K$O!" X_ASTB_O $,M%@h$5$l!"$=$N %/%m%C%/$K$O X_BGRT $,$J$+$C$?$bNH2r<a5l$k!#$J$*!"F10l%G%P%$%9$+$iO"B3$7$?MW5a$,G'$ail$ 9gKO!"2r=|5lD>AK assert 5lk?$a!"O"B3$7$F#L%l%Y%k$HJk!#

X_ASTB_O X_ASTB_O $OC1$K%i%C%A5l$? X_ASTB_I G"$k!#

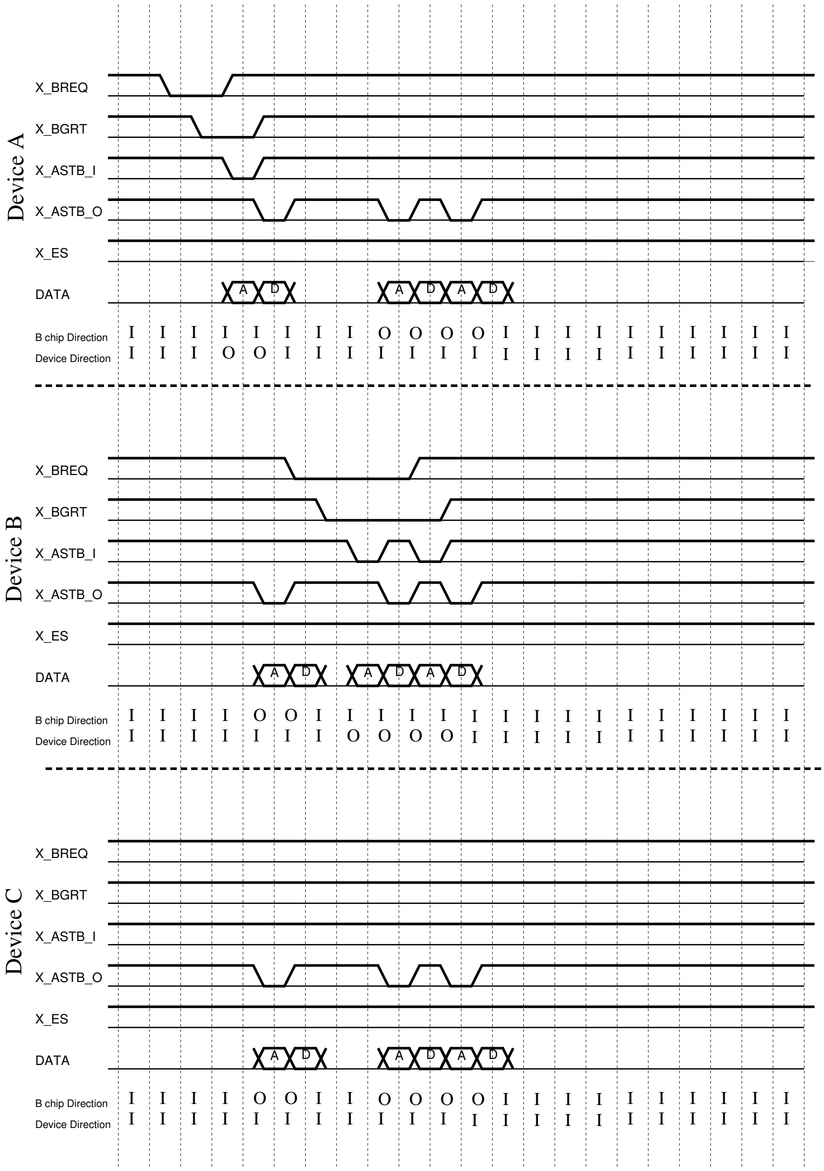
DATA =PNO$N **enable** DATA =PNO$O!"%P%9%^%9%?$+$i X_ASTB_I $rF~NO$7$?<!$N%P%9%/%m%C%/$N@hF,$+$i%P%9% %9%?0J30$N%]!<%H$, enable 5l!"%"%I%l%9%U%j%C%H$KIU?o$9$k WWE !J%Q%1%C%HD9!K$N<($9%P%9%/%m%C%/ $^$?$O X_ES $, assert 5lk^$G enable 5lDE1k!#

%&%'!<%V%U%)!<%`$N?^$O!"MM!9$J>l9g$K$D$$$F$NBeI=E*%P%9%?%$%_%s%0$r<($9bNG"$k!#



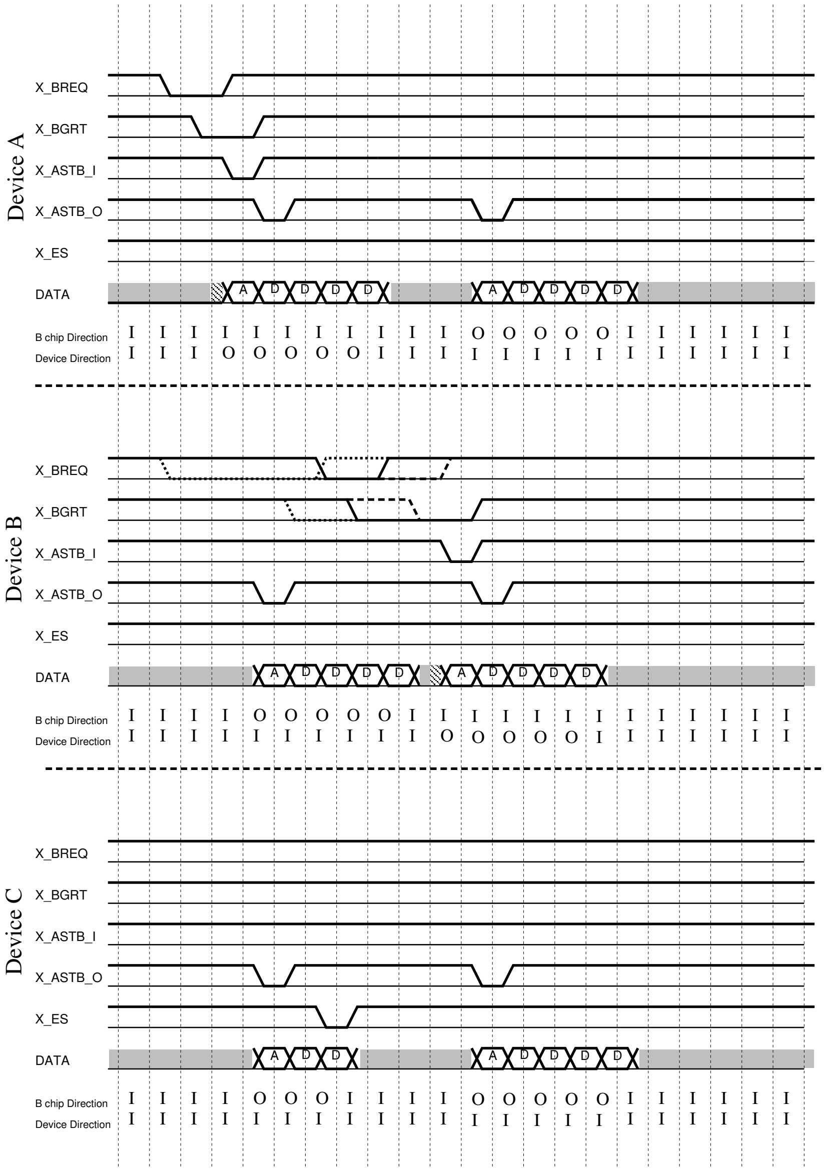
A: Send –> Rec –> Rec,   B: Rec–>Send –> Send, C: Rec –> Rec –> Rec

?^ 5: D9$5#1$N%Q%1%C%H



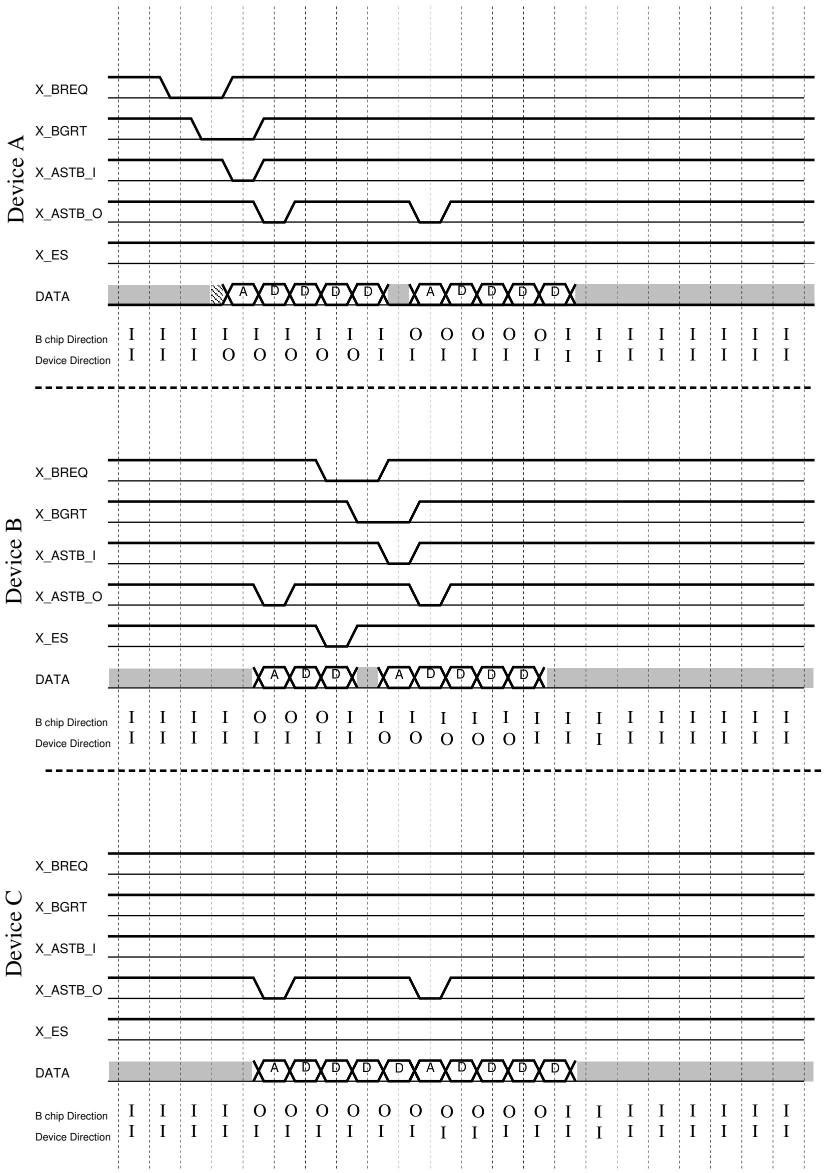
A: Send –> Rec –> Rec,   B: Rec–>Send –> Send, C: Rec –> Rec –> Rec

?^ 6: D9$5#2$N%Q%1%C%H



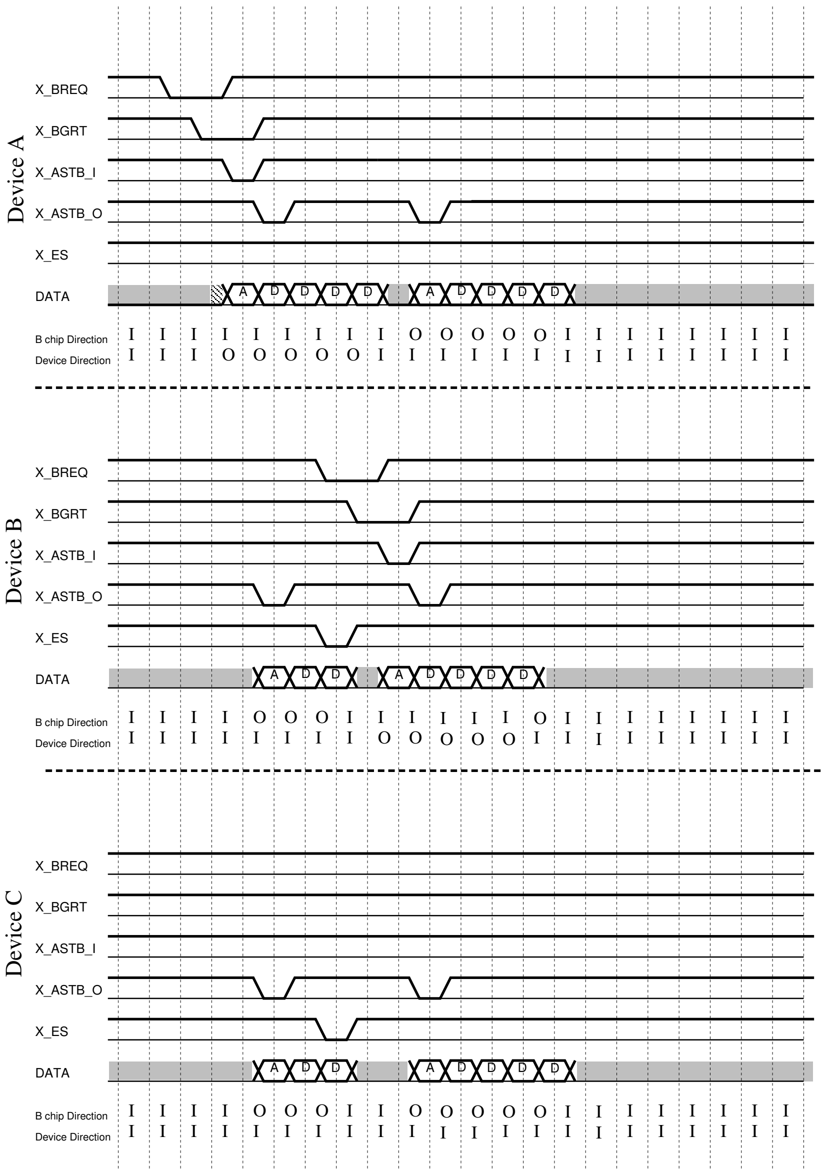
A: Send –> Rec, B: Rec–>Send, C: Rec(ES) –> Rec

?^ 7: D9$5#5$N%Q%1%C%H



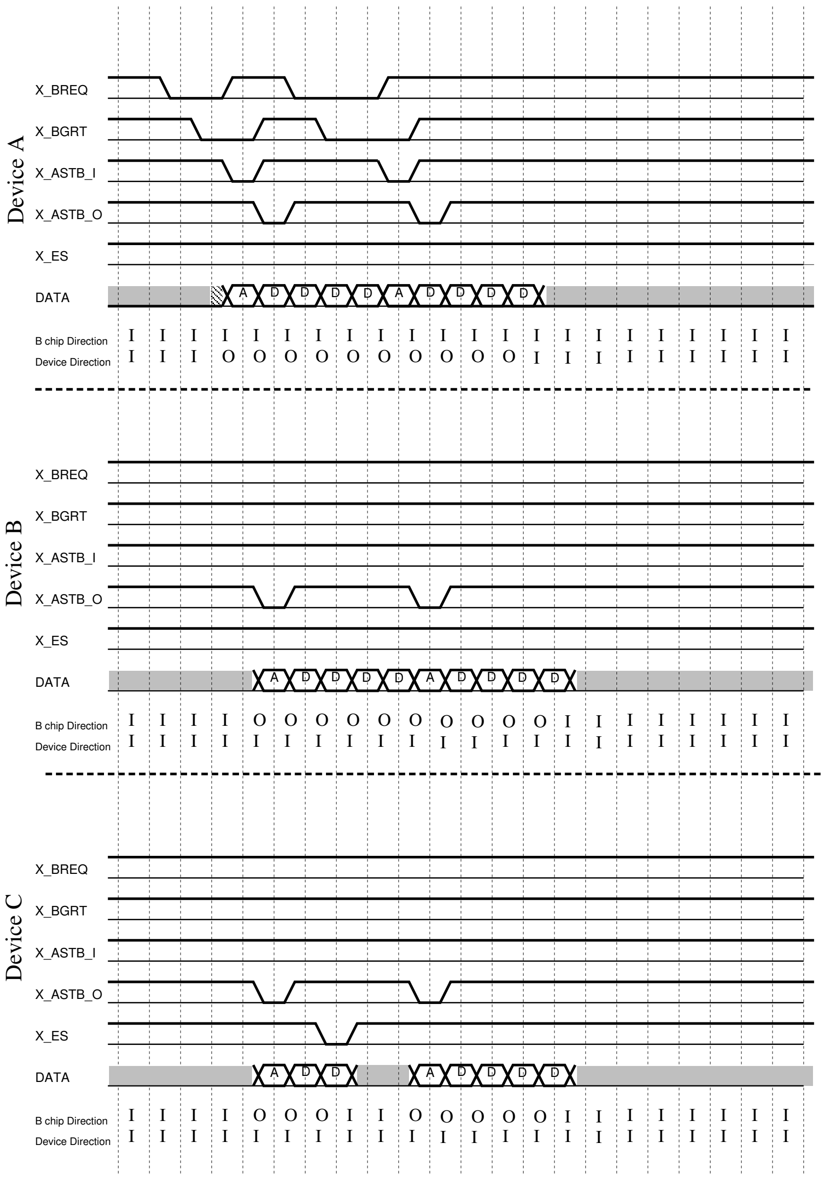
A: Send –> Receive, B : Receive –> Send, C: Receive –> Receive

?^ 8: D9$5#5$N%Q%1%C%H!JX_ES $, assert $5$1$k>l9g!K



A: Send –> Receive, B: Receive (ES) –> Send, C: Receive(ES) –> Rec

?^ 9: D9$5#5$N%Q%1%C%H!JX_ES $, assert 5lk,!"<!$K%^%9%?KJiJ$$>l9g!K



A: Send –> Send, B: Receive –> Receive, C: Receive(ES) –> Receive

?^ 10: D9$5#5$N%Q%1%C%H!JF101%^%9%?$,O"B3$7$FE>Aw$9$k>l9g!K

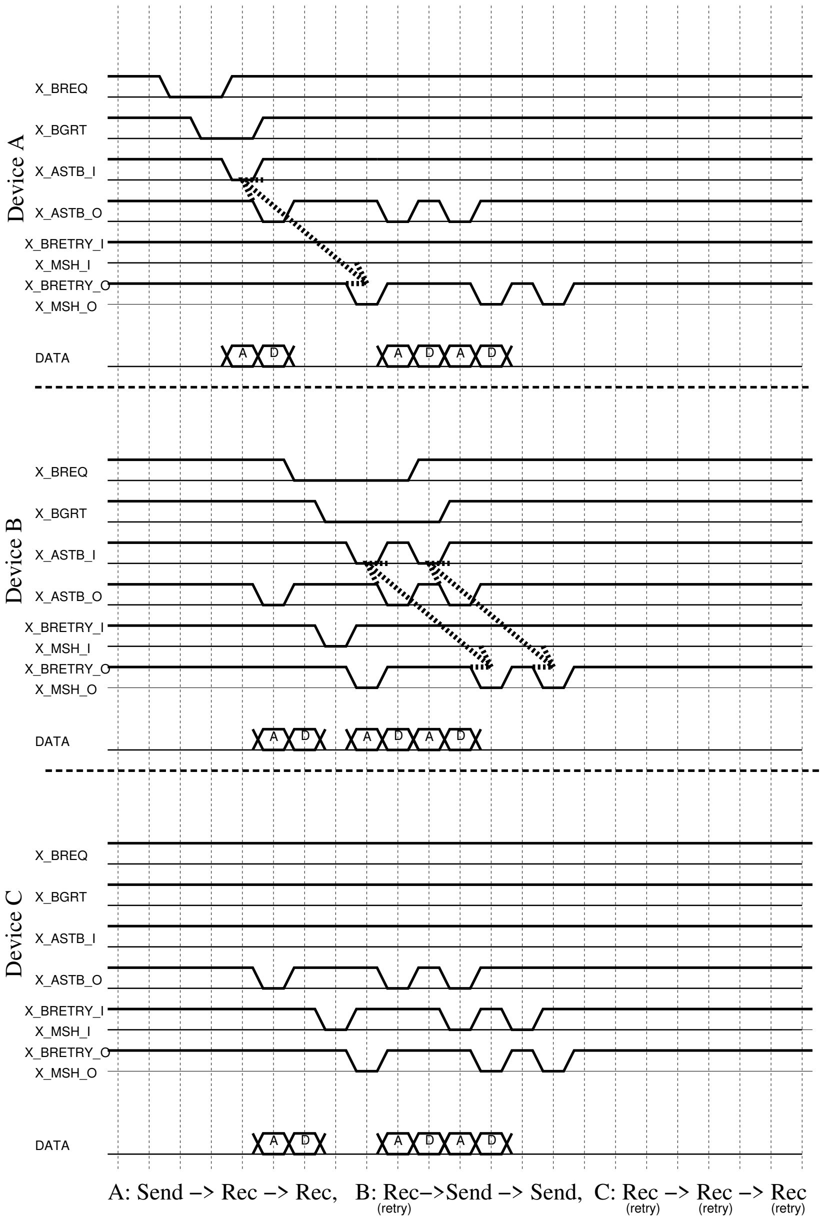
3.1 CYlF$/$k%P%9?.9f@~$N%?%$%_%s%0

3.1.1 X_BRETRY, X_MSH, X_CRPLY $N%?%$%_%s%0

JUMP-1 6&DL%P%9GO!"%P%9E>Aw$K4X$o$k X_BRETRY, X_MSH, X_CRPLY ?.9f@~$O!"%P%9%A%C%W$,H/9k X_ASTB_O $r4p=`$H7?%/%m%C%/$G!" 2 %/%m%C%/8e$K=PNO5l$k!#=>$C$F!"%P%9%A%C%W$r2p7F@\B3$5$l$F$$ $N%G%P%$%(9j%/%(%9%?$r4)$O #4%/%m%C%/8eK3li$N?.9f$r<uM}9k!#?^ 11$O!"%j%H%i%$$K4X9k%?%$%_%s% $r<($7$?$bNG$"$k!#

3.1.2 X_PEND $N%?%$%_%s%0

X_PEND $O!"%W%m%;%C%5$,H/7?%a%b%jA`:n!"FC$K store A`:n$N40A4$J=*N;F14|$r?^$k$?$a$K STBAR L?Na$K $jMQ$$$ilk?.9f@~G"$k!# CPU $+$i8+kH!" X_PEND ?.9f$O Fs<!%-%c%C%7%e%3%s%H%m!<%i$+$i6!5k5l!" %-%c%C%7%e%3%s%H%m!<%iK*1k%a%b%j store F0:n$N=*N;$rDLCN9k!#Fs<!%-%c%C%7%e%3%s%H%m!<%i$O!"Ev3:% A`:n$,Fs<!%-%c%C%7%e%3%s%H%m!<%iFbGJD8$k>l9g!"8=:_=hM}Cf$N store $r7W?t$7!";D?t$,#0$G$J$$>l9g$K X_P



?^ 11: X_BRETRY, X_MSH, X_CRPLY $N%?%$%_%s%0

$r assert 9k!#

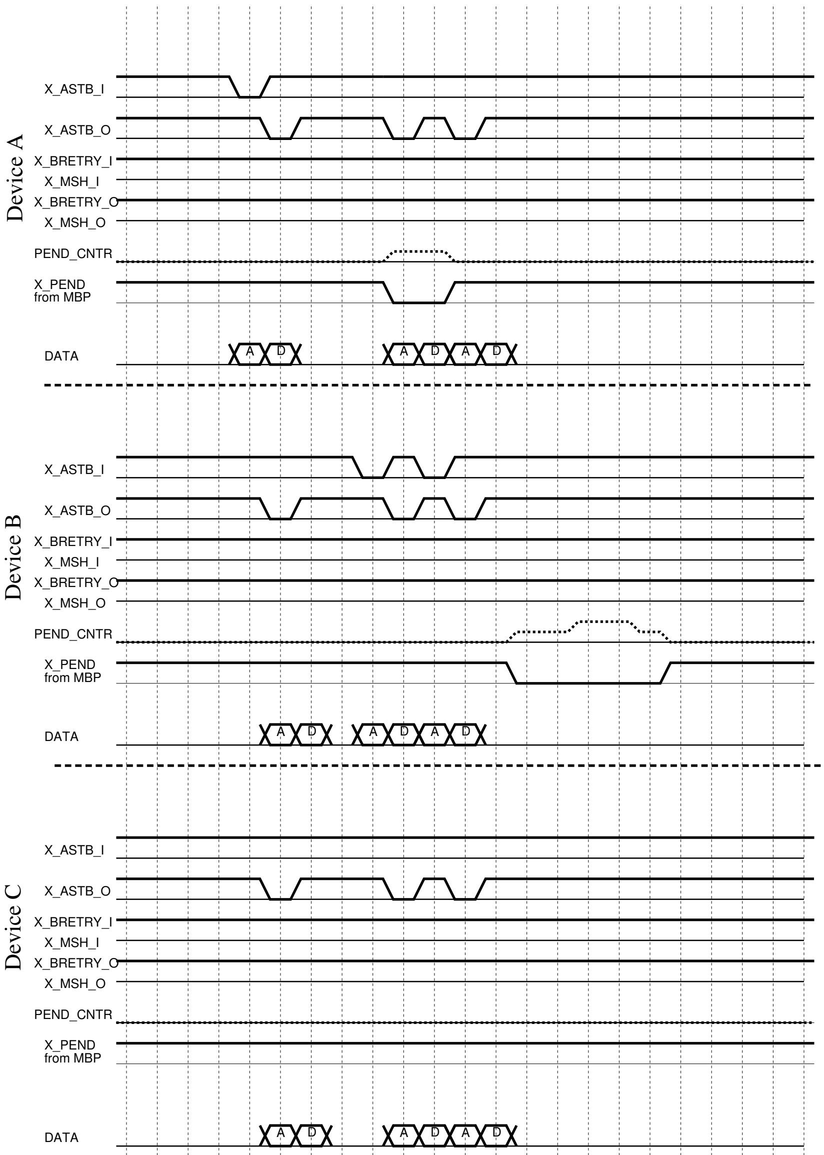
%a%b%j=hM}$,Fs<!%-%c%C%7%e%3%s%H%m!<%iGJD8$J$$>l9g$O!"6&DL%P%9>e$K%Q%1%C%H$rAw=P$7!"=hM}$r30 $($P#M#B#P$K0MMj$9$k!#MW5a%Q%1%C%H$r<uM}7?#M#B#PGO!"FbIt$G=hM}Cm$N store Ey$rMW5a85%-%c%C%7%e% %m!<%iKh$K7W?t$7!";D?t$,#0$G$J$$>l9g$K!"@\B3$5lF$$$k#48D$NFs<!%-%c%C%7%e%3%s%H%m!<%i3F!9$K BP1~$9 $r assert 9k!#

;EMM>e!"LdBjKJ$kE@$O!"A4$/=hM}Cf$N store $,$J$$>u67$G!"$I$N%?%$%_%s%0$^$G$,Fs<!%-%c%C%7%e$, X_PE $r assert 9kHO0O$G!"$I3+i, #M#B#P!J$^$?$O2>#M#B#P!K$,@UG$$r;}CF assert 9kHO0O$+$G$"$k!# JUMI GO!" MBP $, X_PEND $r assert 9k%?%$%_%s%0$H7F0J2<$N;EMM$r<ikbNH9k!’

1. CPU XN PEND ?.9f$OFs<!%-%c%C%7%e$,=P$9!#Fs<!%-%c%C%7%e$GJD8kA‘:n$K4X$9$k PEND ?.9f$N=hM} Fs<!%-%c%C%7%e$,9T$J$&

2. MBP $K PEND ?.9f$KhkF14|$,I,MW$J%Q%1%C%H$r=P$9>l9g!" %Q%1%C%H$N%"%I%l%9!&%U%j%C%HCf$N ACK %U %k%I$r #1$K9k!#

3. MBP $O!"%Q%1%C%H$N<oN‘$K4X$oi:!" ACK %U%#!<%k%I$,#1$G$"$k%Q%1%C%H$r<u$1Hj!" X_BRETRY ?.9



A: Send –> Rec –> Rec,   B: Rec–>Send –> Send, C: Rec –> Rec –> Rec

?^ 12: X_PEND $N%?%$%_%s%0

$,3NDj$7$F<uM}$9kH!" SID $G<($5lkMW5a85$K4X$9$k PEND %+%&%s%?$r %+%&%s%H%"%C%W$7!"Fs<!%-%
%7%e$K X_PEND $r assert 9k!#

4. PEND %+%&%s%?$,#0$G$"$k MBP $,,ACK $,#1$N%Q%1%C%H$r<uM}$9kH!" retry $r<uM}$7$?<!$N%/%m%C%/$G X
$rFs<!%-%c%C%7%e$KAw$k

5. PEND %+%&%s%?$O!"=hM}$7$F$$$kA`:n$,!J#1!K=hM}>e$N%7%j%"%i%$%:$r<u1?$+!"!J#2!K$"$H #8 %/%m%C
Fb$K=*N;$9k3H,3NDj7?;~E@$G!"%+%&%s%H%@%&%s$5lk!#

6. MBP $O PEND %+%&%s%?$,#0KJkHF1;~$K Fs<!%-%c%C%7%e$KBP9k X_PEND $r <h$j2<2k!#

?^ 12$O!" X_PEND ?.9f$K4Xok%?%$%_%s%0$r<(9bNG$"$k!’

4 %Q%1%C%H

CBus GO!"A4FN>pJs$O%Q%1%C%H$*hS$=$l$KIU?o$9$k?.9f$H7F%G%P%$%94V$rEAC#5l$k!#

3F%Q%1%C%H$O **1** 8D$^$?$OO"B3$9$k **2** 8D$^$?$O **5** 8D$N%U%j%C%HNAH_9go;$+$iJk!%$?$@$7!"%Q%1%C%HD9$, >l9g!"%"%I%l%9%U%j%C%H$ND>8e$N%P%9%5%$%/%k$OE>Aw$K;HMQ$9k3HO=PMh$J$$!#!JD^$j!"O"B3$7$FD9$5 %1%C%HrAwk3H$OIT2DG=$G$"$k!K!#7+7J$,$i!"D9$5$,#1$N>l9g!"#28DL\$N%U%j%C%H$OE>Aw$,9TJo$l $a!"APJ}8~$N?.9f@~$NJ}8~@-$r@ZBX$($kL\E*$G;HMQ$9k3H,2DG=G"$k!#

%U%j%C%H$O!$ CBus $N4p='%/%m%C%/$N 1 %5%$%/%k$K$*$1[63:0] DATA$N%G!<%?$*hS!"F1;~KAwilk[10:0] MOVE $"$k!#D9$5$,#10J>e$N%Q%1%C%H$r9=@.9kA4%U%j%C%H$OO"B3$7$FE>Aw$5lk!#J*!"%Q%1%C%HF0:n$KF14|$7$F X_CRPLY, X_BRETRY (3F!9 _O $^$?$O) I?.9f@~$b;HMQ5lk,!"?.9f@~$,M-8z$J;~4|$,%U%j%C%H$NE>Aw$HF14| $;$:!"CYlk!#

3F%Q%1%C%H$N@hF,$O!"BP1~9k%P%9%]!<%HK?$$$7$F X_BGRT $, ??$HJC$?8e$N X_ASTB !J%Q%1%C%H$,%G% %9$+$i%P%9%A%C%W$XE>Aw5l$k>l9g$K$O X_ASTB_I, %P%9%A%C%W$+$i%G%P%$%9$XE>Aw$5lk>l9gKO X_ASTB_O $,?? G"$k;~G"$j!" 3F%Q%1%C%H$N:G8e$O!" X_ASTB $, ??$H5l$?%P%9%/%m%C%/$K$*$1$k %"%I%l%9!&%U%j%C IU?o$9$k WW[1:0]$NCM!"9JoA%Q%1%C%HD9%U%#!<%k%I$G7hDj$5lk!#

request 7O%Q%1%C%H$O!"Ev3:%Q%1%C%H$,E>AwCf!JD9$5#5!K$^$?$OE>Aw5l$?8e!JD9$5#2$*$h$S#1!K$K X_BRET ?.9fKh$j%j%H%i%$$5lk!#%j%H%i%$$5l?%Q%1%C%H$O!"A4$/L5$+$C$?$bNH7F07ol$k!#=>$C$F!" request %1%C%H$O%j%H%i%$?.9f$,3NDj9k$^$G915WE*>uBV$NJQ99$r9TJCFOJi$J$$!#

$^$?!"O@M}E*M}M3Kh$k%j%H%i%$$O!" request 7OG"CF$b%G%C%I%m%C%/$N860xHJk?$a!"==J,$KCm0U$9 MW$,$"$k!#!J%M%C%H%o!<%/$+$i$b!" request 7OMW5a$,CmF~5lk3HKCm0U9k3H!K

4.1 %Q%1%C%H$N%j%H%i%$$K4X9kCm0U

6&DL%P%9K*1k%j%H%i%$$O!"%G%C%I%m%C%/$KF~$k4m81@-$rKI;_$9k?$a2<5->r7o$r<ikI,MW,$"$k!#2< $r<i$kHO0OFbGN@_7WNG0U@-$O!"@-G=$K1F6A9k$@$1G"$k!#

1. **reply** 7O%Q%1%C%H$O!"%j%H%i%$$7FOJi$J$$

2. **request** 7O%Q%1%C%H$O!"%Q%1%C%H$rH/?.7?%G%P%$%9<+?H$G>o$K%j%H%i%$2DG=G"$k!#$?$@$7!" request MW $,B8:_$7B3$1$k>l9g$K<+J,<+?H$G%j%H%i%$$r$+$1k3HO!"%G%C%I%m%C%/E*>u67$KF~$k2DG=@-$,$"k?$ 0U$,I,MW$G$"$k!#

3. request 7O%Q%1%C%H$O<u$1<h$k%G%P%$%9$N0l;~E*860x$G%j%H%i%$2DG=$G$"$k!#$?$@$7!$%j%H%i%$$N860x$O2? DL%P%9$+$i%Q%1%C%H$r<u1Hi:!$$^$?!Vrequest 7O%Q%1%C%H$rAw$j=P$5J/Fb!W;~4V$N7P2a$HHb$K2r kI,MW,$"$k(reply 7O%Q%1%C%HrAwj$@$9$3H,>r7o$G)$bNI$$

4. **request** 7O%Q%1%C%H$r<u$1<h$kFs<!%-%c%C%7%e$*hS#M#B#P$O!"BP>]%V%m%C%/$K4X7F **reply** 7O%Q%1%C%H= M=Dj$,$"lP!"<u$1<h$k **request** 7O%Q%1%C%H$r%j%H%i%$$9kI,MW,$"$k!#!JD^$j!" reply 7h$&$H7F$ %V%m%C%/KBP9$k B>$+iN request 7O%Q%1%C%H$O%j%H%i%$$9$k!K

5. **request** 7O%Q%1%C%H$r<u$1<h$kFs<!%-%c%C%7%e$O!"BP>]%V%m%C%/$K4X$7$F **request** 7O%Q%1%C%H$r=P$9M=Dj hC$F!"<u$1<h$k **request** 7O%Q%1%C%H$r%j%H%i%$$7FOJi$J$$!#!JD^$j!" request 7h$&$H7F$$$k%V %/KBP9$kB>$+iN request $r%j%H%i%$$9k3HOBLL\!#!K

6. **request** 7O%Q%1%C%H$r<u$1<h$k#M#B#P$O!"BP>]%V%m%C%/$K4X$7$F **request** 7O%Q%1%C%H$r=P$9M=Dj$,$"$k>l9 <u$1<h$k **request** 7O%Q%1%C%H$r%j%H%i%$2DG=G"$k!#!J$D$^$j!" request 7h$&$H7F$$$k%V%m%C%/KBP B>$+$i$N request $r#M#B#P$O%j%H%i%$$7$FNI$$!#!K

7. Fs<!%-%c%C%7%eGO **request** 7O%Q%1%C%H$N=PNO!J$H$=$N7k2L$N%j%H%i%$!KKh$j **reply** 7O%Q%1%C%H$NAw= AK32$7$FOJiJ$$!#!JD^$j!"30It$+iN reply rBTC$F$$$k%V%m%C%/KBP9$k request $r %j%H%i%$$9$ 9g!"Ev3:%V%m%C%/KBP9$k%j%W%i%$=PNO$rAK32$7F)OJi$J$$

8. >e5-Bg86B'$N<B8=J}K!$H7F!"#M#M#CKh$k%$%s%W%j%a%s%H$r9MN8$7$F2<5->.86B'$r@_Dj9k!'

   (a) %-%c%C%7%e$+$i$NJVEz$rBT$D%V%m%C%/$KBP9k #M#B#P$+$i$N **request** $OFs<!%-%c%C%7%e$,%j%H%i%$$ 3H$,I,MW$G$"$k!#!JD^$j!" CRPLY $,JV$k#M#B#P$+$i$N read !" rdinv req NFI_=P$7BP>]%V%m%C%

KBP9$k request $N%j%H%i%$$ONI$$!##M#M#C$N%$%s%W%j%a%s%H>eFs<!%-%c%C%7%e$,%j%H%i%$$9k3H
MWG"$k!#!K

(b) #M#B#P$+$i$NJVEz$rBT$D%V%m%C%/$KBP9k Fs<!%-%c%C%7%e$+$i$N **request** $N%j%H%i%$$OFs<!%-%c%C%
$,$9kI,MW,$"$k!# !JD^$j!" CRPLY $, assert 5l$J$$ request 7O%Q%1%C%H$G!"#M#B#P$+$iJVEz$,
JV$k%V%m%C%/$KBP7F!"Fs<!%-%c%C%7%e$+$i$N?7$?$J request 7O%Q%1%C%H$O%j%H%i%$$9k3H,2DG=$
$k!##M#M#C$N%$%s%W%j%a%s%H>e$3$N%j%H%i%$$OFs<!%-%c%C%7%e$G9T$J$&$3H,I,MWG"$k!#!KFs<!%-
%7%eK*1kK\%j%H%i%$$O2<5-J}?K$G<BAu$5lk!#

%"%I%l%9#A$K4X$9$k MBP $+$i$NJVEz$rBTCF$$$kFs<!%-%c%C%7%e$O!$B>$NFs<!%-%c%C%7%e$,Aw=P9
%1%C%H$NFb!$ ADDR[27:5] $, A[27:5] KEy7$$$bNrA4$F%j%H%i%$$5$;$k!#

J*!$JVEzBT$A$N%H%i%s%6%/%7%g%s$,FC<lJbNG$"$k>l9g(control_read)!$%j%H%i%$$5lk%H%i%s
%6%/%7%g%s$,FC<l$JbNG"$k>l9g!$$"$k$$$OJVEzBTAN%H%i%s%6%/%7%g%s$H%j%H%i%$$5lk%H%i%s
%7%g%s$N%-%c%C%7%e2DH]$,0lCW7J$$>l9g$O!VITI,MW$J%j%H%i%$!W$,H/@8$9$k!#

(5,B'#3KhCF MBP $O reply $rAw=P$9k3HKhj2r7h9k0l;~E*860xKhCFG$0U$N%Q%1%C%H$r
%H%i%$$5$;$k3H$,$G$-!$$3lrJVEzBT$AFs<!%-%c%C%7%e$,Be9T9k3H$b2DG=$G$"$k!#)

4.2 %U%j%C%H

%U%j%C%H$O!$ CBus $N4p=`%/%m%C%/$N 1 %5%$%/%k$K$*$1$k[63:0]$rI=$*$h$S%G!<%?E>Aw$K4XO"9k?.9f@~
$N%G!<%?$G$"$k!#%U%j%C%HKO0J2<$N#2<o$N%U%)!<%^%C%H$,$"$k!'

1. %"%I%l%9!&%U%j%C%H(Address Flit)

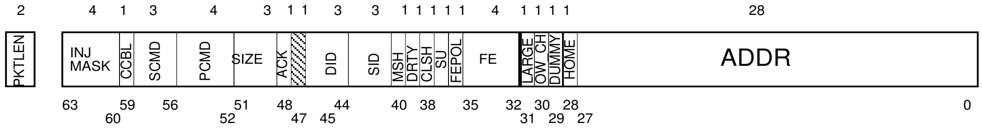
2. %G!<%?!&%U%j%C%H(Data Flit)

3F%Q%1%C%H$N@hF,$N%U%j%C%H$OI,$: %"%I%l%9!&%U%j%C%HG"$j!"%"%I%l%9$*hS0z$-B3$/%U%j%C%H$NFbMF
$r;XDj$9$k!#0z$-B3$/#08D!"#18D$^$?$O#48D$N%U%j%C%H$O!"%G!<%?!&%U%j%C%HG"$k!#=>$C$F!"9g7W#3<oN`$N
%H7A<0rJ$9!#

0J2<GO!$3F%U%j%C%H$N%U%)!<%^%C%HKD$$$F@bL@9k!%

4.2.1 %"%I%l%9!&%U%j%C%H

%"%I%l%9!&%U%j%C%H $O!$$9YF$N%Q%1%C%H$NBh 1 %5%$%/%k$K8=lk!%9JoA!" X_BGRT $, #L HJC
X_ASTB $, #L G"$k%P%9%5%$%/%k$K=P8=9k!#%Q%1%C%H$N<oN`KhCF$O%"%I%l%9%U%j%C%H$@1G9=@.$5$1
$N%b$"$k!#$^$?!"%Q%1%C%H$N<oJL$H WWE Kh$k%Q%1%C%HD9$,?)$$0c$&;XDj$,5l$?>l9g$O!"%Q%1%C%HD9$K4
WWE Kh$k;XDj$,M%@h5l!"%Q%1%C%H$NM>J,$JItJ,$O<N$Fil!"ITB-$NItJ,$OM=A[G-$J$$%G!<%?$,Jd=<$5$
?^ 13$K!$%"%I%l%9!&%U%j%C%H $N%U%)!<%^%C%H$r<($9!%



?^ 13: %"%I%l%9%U%j%C%H$N9=@.

<table>
<tr><th>%U%#!<%k%IL></th><th>I}</th><th>5-=R</th></tr>
<tr><td>WWE[1:0]</td><td>2</td><td>%"%I%l%9!&%U%j%C%HK*$$$F WWE %U%#!<%k%I$O%Q%1%C%HD9$r<(
$9!#
<table><tr><th>WWE[1]</th><th>WWE[0]</th><th>Packet Length</th></tr><tr><td>L</td><td>L</td><td>1</td></tr><tr><td>L</td><td>H</td><td>2</td></tr><tr><td>H</td><td>L</td><td>5</td></tr><tr><td>H</td><td>H</td><td>Reserved</td></tr></table></td></tr>
<tr><td>ADDR[27:0]</td><td>28</td><td>%Q%1%C%H$NA`:nBP>]$r<($9%/%i%9%?!&%"%I%l%9!#A`:nBP>]$N%5%$
%:$, byte, half word, word K+$+$oi:!"3F!9Djail?%P%&%s
%@%j$r<i$kI,MW$,$"$k!#$9Jo$A!"%V%m%C%/%G!<%?$G$O%V%m%C%/
6-3&!"#28l%G!<%?GO#28l6-3&!"#18l%G!<%?GO#18l6-3&!"H>8l
%G!<%?GO6v?t%P%$%H6-3&$N%"%I%l%9G"kI,MW,$"$k!# ADDR
$,%/%i%9%?%a%b%j$NHO0OG"$j!J2>#M#B#PHG$N>l9g!"2<0L#3#2#M
Bytes!"K\#M#B#P$N>l9g!"2<0L#1#2#8#M Bytes!K!"$+$D2<5- OW_CH
%S%C%H$,#1$GJ/!" DUMMY $,#1$G$J$$>l9g!"D>@\%/%i%9%?%a
%b%j$,%"%/%;%9$5$l!"$=$l0J30$N>l9g$O#M#B#PF0:n$,5/F0$5$l$k</td></tr>
<tr><td>HOME</td><td>1</td><td>HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home
page G"k3Hr<($9!##0$G$"$k>l9g$OBP>]$, home page GJ$/!"
%3%T!<5l$?%Z!<%8$G$"$k3H$r<($9!#2<5- DUMMY == 1 G"$k
%@%_!<%Z!<%8$O7h$7$F home page HJ$jF@$J$$$?$a!" HOME %Z!<
%8%U%#!<%k%I$O ADDR $N0lIt$H7F07ol$k!# J*!" HOME $O
PE $,=PNO$9$k%"%I%l%9$NBh#2#8%S%C%H$KBP1~$9$k!#</td></tr>
<tr><td>DUMMY</td><td>1</td><td>DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@
%_!<%Z!<%8G"k3Hr;XDj9k!##0G"$k>l9g$O!"BP>]$,%@%_!<%Z!<
%8GJ$$!"9JoA%/%i%9%?Fb%a%b%j$KB8:_$9k3Hr<($9!#$J$*!"
DUMMY $O PE $,=PNO$9$k%"%I%l%9$NBh#2#9%S%C%H$KBP1~$9$k!#$J
$*!" DUMMY == 1 $N>l9g$O!" >e5- HOME %S%C%H$O;HMQ$5l:!"
%/%i%9%?%"%I%l%9!J%@%_!<%"%I%l%9!K$N0lIt$H7F;HMQ5l$k!#</td></tr>
<tr><td>OW_CH</td><td>1</td><td>OW_CH (Owner Change JLL> CTLB-lookup) $,#1$G$"$k>l9g!"
ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J
6&M-%"%/%;%9G"$kEy!" C-TLB $N%k%C%/%"%C%W$rMW9k3H$r<($9!#
#0G"$k>l9g$O!"BP>]$K C-TLB $N%k%C%/%"%C%W$J7G%"%/%;%9$9$k
3H$r<($9!#J*!" OW_CH $O PE $,=PNO$9$k%"%I%l%9$NBh#3#0
%S%C%H$KBP1~$9$k!#</td></tr>
<tr><td>LARGE</td><td>1</td><td>LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<
%8%Z!<%8 !J#2#5#6#K%P%$%HC10L!K$K$"$k3H$r<($9!# #0G"$k>l9g
$OBP>]$,%9%b!<%k%Z!<%8 !J#4#K%P%$%HC10L!K$K$"$k3H$r<($9!# LARGE
%S%C%H$O<g$K%"%/%;%9BP>]$N%/%i%9%?%a%b%j$,B8$9$k#M#B#PK*$$$F!"
%Q%1%C%H$N<h$j9~$_$r7hDj9k!#J*!" LARGE $O PE $,=PNO$9$k
%"%I%l%9$NBh#3#1%S%C%H$KBP1~9k!#J*!"2>#M#B#PKh$k<BAu$G$O!"
2>#M#B#P$,#18D$7$+$J$$$?$a!" LARGE %U%#!<%k%I$O;HMQ$;$:!"L5
;k5l$k!#</td></tr>
<tr><td>PCMD[3:0]</td><td>4</td><td>PCMD %U%#!<%k%I$O SCMD %U%#!<%k%I$H6&$K!"%Q%1%C%H<o$r;XDj
9k!#J*!"%-%c%C%7%e%a%b%j$+$i=PNO5l$k%Q%1%C%H$N PCMD %U%#!<
%k%I$O PE $N=PNO$9$k%"%I%l%9$NBh#3#2$+$iBh#3#5%S%C%H$r%G%3!<%I
7?bNG"$k!#</td></tr>
</table>

%"%I%l%9!&%U%j%C%H!J#2!K

%U%#!<%k%IL>	I}	5-=R
SCMD[2:0]	3	%Q%1%C%H$NF0:n$r;XDj9kI{%3%^%s%I!# PCMD $H SCMD $,J,N%$7 $?%U%#!<%k%I$G$"$k3H$ONr;KE*7P0^$G$"$j!"APJ}$rO"7k$7$?#7%S%C %H%U%#!<%k%I$,%3%^%s%IH7$F;HMQ$5$l!"3F%S%C%H$K0UL#$,$"kb$N GO$J$$!#
FEPOL	1	CPU $+$i$N%"%/%;%9$G F !? E bits $N2r<a$KMQ$$$ilk8=:_$N6K@- $r<($9!# CPU $+$i$N%"%I%l%9>e0L#4%S%C%H$K%(%s%3!<%I5l$?%3%^ %s%I$+$iF@$ilk!##M#B#P$,F14 \| %W%j%_%F%#%V$r<uM}7?>l9g$KMQ$$ $k
CCBL	1	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C %7%c%V%kG"k3Hr<($9!##0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G $"$k3H$r<($9!#$3$3$G!"%-%c%C%7%c%V%k$H$O>/$J$/$H$bFs<!%-%c%C %7%e$,%-%c%C%7%c%V%kG"k3Hr0UL#9k!#
SU	1	SU %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%HA`:n$,FC8"!J%+!<%M%k!K%b!<%I $G9T$J$o$l$k$3$H$r<($9!##0$G$"$k>l9g$O!"%Q%1%C%HA`:n$,HsFC8"!J%f %6!K%b!<%I$G9TJolk3H$r<($9!#
SNOOP_CNTL[2:0]	3	SNOOP_CNTL %U%#!<%k%I$O!"%Q%1%C%H$,%9%L!<%WA`:n$rH<$&>l 9g$K;HMQ$5lk!#2<0L%S%C%H$+$i!' **CLSH** CLSH %S%C%H!"9JoA SNOOP_CNTL[0]$,#1$G$"$k>l 9g!"%Q%1%C%H$NBP>]$,%/%i%9%?4V$G6&M-$5lF$$$k2DG=@-$, $"$k3H$r<($9!##0G"$k>l9g!"%Q%1%C%H$NBP>]$,%/%i%9%? 4V$G6&M-5l$F$$$k2DG=@-$,$J$$$3Hr<($9!# request %Q %1%C%H$N>l9g$O!" requester $,<+J,$NEv3:%V%m%C%/$N>pJs$K 4p$E$$$F CLSH ?.9f$rAw=P$9$k!#$?$@$7!" write_req %Q%1%C %HGO requester K*$$$F writeback 9k%V%m%C%/$N global/local >pJs$GOJ$/!" %/%i%9%?Fb$N%/%i%9%?%a%b%j$^$G$(CLSH$a$9 == 0) $+!"%[!<%`$^$G=q$-La$9(CLSH == 1)$r6hJL 9k$?$a$KMQ$$$i$l!" CPU $+$iAwilF/$k%3%^%s%I$r %G%3!<%I7?FbMF$r CLSH %S%C%H$K:\$;$k!# reply %Q%1%C%H$N>l9g$O!" reply $r<uM}$9$k%G%P%$%9K*$$ $F!" CLSH $^$?$O CLPR $r6hJL$9k?aK!"%j%W%i%$$$9$k #M#B#P$^$?$O#C#C$,Ev3:%V%m%C%/$N>pJs$K4p$E$$$FAw=P$9 $k!# **DRTY** DRTY %S%C%H 9JoA SNOOP_CNTL[1]$,#1$G$"$k>l 9g!"Ev3:%Q%1%C%HKh$j%-%c%C%7%e$K%m!<%I9k%V%m%C%/$N B0@-$, dirty G"k3Hr<($9!##0$G$"$k>l9gKO clean $G $"$k3H$r<($9!# DRTY %S%C%H$O!" request %Q%1%C%H$G$O >o$KL5;k5l$k!# reply %Q%1%C%H$G$O%j%W%i%$$$9$k#M#B#P $^$?$O#C#C$,Ev3:%V%m%C%/$N>uBV$r8+$F7hDj$9$k!# **MSH_RPLY** MSH_RPLY %S%C%H!"9JoA SNOOP_CNTL[2]$O!" reply %Q%1%C%H$K$*$$$F!"%j%/%(%9%H;~K*1k MSH ?.9f @~$N7k2L$r<($9!#$J$*!" rdinv, invalidate ;~$K$O!" request ;~$K$*$1kCMK78oi$:!"#0$rAw=P9k J*!"3l$i#3%S%C%HCf!" DRTY $*$h$S MSH_RPLY %S%C%H$O%j %W%i$70%Q%1%C%H$@1GMQ$$$ilk!#

%U%#!<%k%IL>	I}	5-=R
FE[3:0]	4	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C %H!# FEPOL !JF14|6K@-!K$,#0$N>l9g!"#1$, FULL, #0$, empty >uBVG"k3Hr<($9!# J*!"#1%V%m%C%/%G!<%?rFI_=P$9>l9g!"%"%I%l%9$G;XDj7? double word $, read_reply %Q%1%C%H$N@hF,%G!<%?$KF~$j!";DjO>: =g mod 4 GJBYilk,!" F !? E %S%C%H$N#4%S%C%H>pJs$O!";X Dj5l$k%V%m%C%/Fb%"%I%l%9$K78oi$:!">o$K%V%m%C%/$N %"%i%$ %s%a%s%H$r<u$1$k!#=>$C$F!"FE[3]$O!"%V%m%C%/Cf:GBg%"%I%l%9 $r;}$D$N double word!"FE[0]$O%V%m%C%/Cf:G>.%"%I%l%9$r;}$D double word $K78$o$k full / empty >pJs$r;}$D!J%S%C%H$NBP1~ $, **Little Endian** KJCF$$$k3H$KCm0U$9k3$H!K
SIZE[2:0]	3	SIZE %U%#!<%k%I$O%Q%1%C%H$KIU?o9k%G!<%?$N%5%$%:$r<($9!#$? $@$7!" SIZE %U%#!<%k%I$N2r<a<+?H$O SCMD $*$h$S PCMD %U%#!< %k%I$K0MB8$9$k!#0lHL$K!"FI$_=P$7MW5a (read_req Ey) GO SIZE %U%#!<%k%I$O %j%W%i%$%Q%1%C%H$N%G!<%?%5%$%:$r7hDj$7!"$=$l0J 30$N>l9g$O!"Ev3:%Q%1%C%H<+?H$,1?$V%G!<%?$N%5%$%:$r7hDj$9$k!# **V2.0** K*$$$FJQ99$5$l$?$3HKCm0U9k3H SIZE %U%#!<%k%I$, masked block G"$k>l9gKO!"3F%G!<%?%U %j%C%H$KIU?o9k WWE %U%#!<%k%I$, word C10L$N=q$-9~$_%^%9 %/H7$F;HMQ$5lk!#

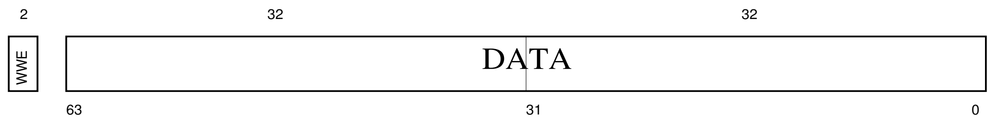
SIZE	%G!<%?$N%5%$%:	BP1~9k%G!<%?E>Aw$N%/%m%C%/?t
000	byte	1
001	half word	1
010	word	1
011	double word	1
100	block	4
101	reserved	4
110	masked block	4
111	none	0

<table>
<tr><th>%U%#!<%k%IL></th><th>I}</th><th>5-=R</th></tr>
<tr><td>DID[2:0]</td><td>3</td><td>%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#2<I=$K=>$&!#I=Cf all $O!"%j%/%(
%9%H7O%Q%1%C%H$GA4%G%P%$%9$,<+H/E*$K%3%^%s%I$KBP1~$9$kF0:n$r9T
J&3H$r;XDj$9$k!#!J<B:]$K$O!"6&DL%P%9$O%P%9G"$kFC<A$+$i>o
$K%V%m!<%I%-%c%9%H$r9T$J$$!"A4%G%P%$%9$KhkBP1~$O PCMD, SCMD
Kh$k%3%^%s%I<o$G7hDj5lk,!"%9%L!<%W;22C>r7oH7$F all $r;X
Dj9k!K
3F%G%P%$%9$O!" DID $K all $^$?$O Ev3:%G%P%$%9HV9f$,;XDj$5l?>l
9g$K%Q%1%C%H$r<h$j9~$_!";XDj5l$?F0:n$r9TJ&!#
#M#B#P$O#28DB8:_$9k,!"$$$:lN#M#B#P$,<uM}$9k+$O!"%"%I%l%9
%U%j%C%H$K4^$^lk ADDR %U%#!<%k%I$*$h$S LARGE %U%#!<%k%I
Kh$j#M#B#P$,7hDj9k!#=>CF!"$$$:lN#M#B#P$, Destination $G
$"$k>l9gGb!"#M#B#P#0!"$^$?$O#M#B#P#1$rE,59;HMQ9k3H$,2DG=
G"$k!#
2>#M#B#PHGGN<BAuGbF1MM!"#18D7+<BAu5l$J$$$,!"#M#B#P#0$*
hS#M#B#P#1$NN>J}$N DID $r;}$D%Q%1%C%H$O2>#M#B#P$G<uM}5l$k!#
<table>
<tr><th>DID</th><th>E>Aw@h%G%P%$%9</th></tr>
<tr><td>000</td><td>CC 0</td></tr>
<tr><td>001</td><td>CC 1</td></tr>
<tr><td>010</td><td>CC 2</td></tr>
<tr><td>011</td><td>CC 3</td></tr>
<tr><td>100</td><td>MBP 0</td></tr>
<tr><td>101</td><td>MBP 1</td></tr>
<tr><td>110</td><td>Reserved</td></tr>
<tr><td>111</td><td>all</td></tr>
</table>
</td></tr>
<tr><td>SID[2:0]</td><td>3</td><td>%Q%1%C%H$NAw?.85$N;XDj!#2<I=$K=>$&!#I=Cf all $O;HMQ$7$J$$!#
<table>
<tr><th>SID</th><th>E>Aw@h%G%P%$%9</th></tr>
<tr><td>000</td><td>CC 0</td></tr>
<tr><td>001</td><td>CC 1</td></tr>
<tr><td>010</td><td>CC 2</td></tr>
<tr><td>011</td><td>CC 3</td></tr>
<tr><td>100</td><td>MBP 0</td></tr>
<tr><td>101</td><td>MBP 1</td></tr>
<tr><td>110</td><td>Reserved</td></tr>
<tr><td>111</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td>ACK</td><td>1</td><td>ACK %U%#!<%k%I$O!"Ev3:%Q%1%C%H$, MBP K*$$$F X_PEND ?.9f
$rMW5a$9k+I&$+$r7hDj9k!# ACK $,#0$N>l9g!"MW5a=*N;rBTA
9go;kI,MWOJ/!" X_PEND ?.9f$O>o$K assert 5l$J$$!# ACK
$,#1$N>l9g!"%Q%1%C%H$,<uM}$5$l!" Retry 5l$J$$$3H,3NDj7?
;~E@$G SID $KBP1~$9$k X_PEND ?.9f$, assert 5l!"#M#B#PK*$1
$k=hM}$,=*N;8e :F$S deassert 5l$k!# write 7O request %Q%1%C%H$G
M-8z!# ACK $r;HMQ$7$J$$%Q%1%C%HGO 0 $r;XDj$9kI,MW,$"$k!#</td></tr>
<tr><td>INJ_MASK[3:0]</td><td>4</td><td>INJ_MASK %U%#!<%k%I$O Fs<!%-%c%C%7%e$KBP7F%-%c%C%7%e%$%s
%8%'%/%7%g%s$r9T$J$&:]!"BP>]$HJkFs<!%-%c%C%7%e%a%b%j$r<($9!J#1
$,N)$C$F$$$k%S%C%H$KBP1~$9$kFs<!%-%c%C%7%e$K%-%c%C%7%e%$%s%8%'
%/%7%g%s$r9T$J$&!#!K read_reply 7O%Q%1%C%H>e0J30GO#0G"$kI,
MW$,$"$k!#</td></tr>
</table>

4.2.2 %G!<%?%U%j%C%H

%G!<%?%U%j%C%H $O%@%V%k%o!<%I$r3JG<$7!$%G!<%?$O Double-word !% 8B 6-3&$K%"%i%$%s$$? 8B %G!<%?!$$^$?$O!$$=$N0U(*SuperSPARC User's Guide* 2.2.1 Load/Store $r;2>H)$G$"$k!#

?^ 14$K %G!<%?%U%j%C%H $N%U%)!<%^%C%H$r<($9!%



?^ 14: %G!<%?%U%j%C%H$N9=@.

%G!<%?!&%U%j%C%H

%U%#!<%k%IL>	I}	5-=R
DATA[63:0]	64	DATA %U%#!<%k%I$O%Q%1%C%H$N%G!<%?ItJ,$r1?$V!#%G!<%?$O>o$K double word $G%"%i%$%s%a%s%H$,<h$ilF$$$k!# double word 0J 2<NBg-5N%G!<%?$O!">o$K double word CfH7$F%"%I%l%9$N2< 0L%S%C%H$G;XDj$5lk@5$7$$0LCVK*$+$l$k!#%G!<%?%U%j%C%HFb $N%"%I%l%9$O!">o$K#M#S#BB&$,>.Jk%"%I%l%9G"$k!# %G!<%?%5%$%:$,%V%m%C%/$N>l9g!"%"%I%l%9$G;XDj$5l? double word $,:G=i$KE>Aw5l!"0J8e>:=g mod 4 $G;D$j$N double words $, E> Aw$5lk!#3lKBP7$F!"%"%I%l%9%U%j%C%H$K4^$^$l$k FE %U%#!< %k%I$O!"%V%m%C%/FbGN8GDjE*0LCV4X78$rJ]$D3H$KCm0U$,I,MW G"$k!#
WWE[1:0]	2	WWE %U%#!<%k%I$O!"%G!<%?%U%#!<%k%I$NFbMF$r=$>~9kJd=u%U%#!< %k%IG"$j!"%G!<%?%U%#!<%k%I$N8l$^$?$OG\8l$KBP9k=q$-9~$_ %^%9%/$*$h$SF14\|BT$A>pJs$rEAC#$9k?aK;HMQ5l$k!# =q$-9~$_%^%9%/$H7F;HMQ9k>l9g$O!"WWE[0]$,#1G"$k>l9g WORD #0 9JoA DATA[63:32]$N=q$-9~$_$r9T$J$$!"#0G"$k >l9g!"=q$-9~$_$r9TJo$J$$!#F1MM!"WWE[1]$,#1$G$"$k>l9g!" WORD #1$9$JoA DATA[31:0]$N=q$-9~$_$r9T$J$$!"#0 G"$k >l9g!"=q$-9~$_$r9TJo$J$$!# F14|BT$A>pJs$rEAC#9k>l9g!"WWE[1]$,#1$G$"$k$H W-WAIT 9JoA!"=q$-9~$_rBTC$F$$$kFI$_=P$7%j%/%(%9%H$,B8:_$9$k 3H$r<($7!"#0G"kH!" W-WAIT GJ$$$3Hr<($9!#F1MM!" WWE[0]$,#1G"$k>l9g!" R-WAIT !"$9JoAFI_=P7rBTCF $$$k=q$-9~$^l?%G!<%?$,B8:_$9k3Hr<($7!"#0$G$"$k>l9g R-WAIT GJ$$$3Hr<($9!#=>$C$F!" WWE %U%#!<%k%I>e$N0UL#>p Js$O%Q%1%C%H<o$K0MB8$7!"8e=R$N;EMM$r;2>H$9k3$H!# %G!<%?%5%$%:$,%V%m%C%/$N>l9g!"%"%I%l%9$G;XDj$5l? double word $H WWE %U%#!<%k%I$,:G=i$KE>Aw$5$l!"0J8e>:=g mod 4 $G;D$j $N double words $H WWE %U%#!<%k%I $,E>Aw$5lk!#3l$KBP 7F!"%"%I%l%9%U%j%C%H$K4^$^lk FE %U%#!<%k%I$O!"%V%m%C%/ FbGN8GDjE*0LCV4X78$rJ]D3HKCm0U$,I,MWG"$k!#

6&DL%P%9%3%^%s%I0lMwI=

PCMD: SCMD	%Q%1%C%H<o	BP1~9k%j%W%i%$	>>K\%Q%1%C%HL>	>>K\%j%W%i%$L>	Hw9M
0000-000	read_req	read_reply	c/m_read_req	c/m_reply_read	%3%R!<%l%s%HFI$_=P$7 MW5a
0000-001	n_c_rd_req	n_c_rd_reply	c_read_noc_req	m_reply_noc	Hs%3%R!<%l%s%HFI$_=P $7MW5a
0000-100	read_XA_req	read_XA_reply			BQ @hF,%V%m%C%/FI$_ =P$7MW5a
0000-101	read_XB_req	read_XB_reply			BQ BhFs@hF,%V%m%C%/ FI$_=P$7!?%G%-%e!<MW 5a
0000-110	read_XC_req	read_XC_reply			BQ @hF,%V%m%C%/FI$_ =P$7MW5a
0000-111	read_XD_req	read_XD_reply			BQ BhFs@hF,%V%m%C%/ FI$_=P$7!?%G%-%e!<MW 5a
0010-000	allread_req	allread_reply	c/m_allrd_req	c/m_reply_allrd	%3%R!<%l%s%H allread MW5a
0010-010	injection_req	none			%$%s%8%'%/%7%g%sMW5a
0000-011	swap_req	swap_reply	c_swap_req	c/m_swap_reply	%9%o%C%WMW5a
0010-011	swap_M_req	swap_M_reply	c_swap_M_req	m_swap_M_reply	MBP 8F$S=P$7MW5a
0100-000	rdinv_req	rdinv_reply	c/m_rdinv_req	c/m_reply_inv	read invalidate MW5a
0100-100	rdinv_P_req	rdinv_P_reply	c_rdinv_P_req	c/m_reply_inv_P	p F14|IU$- rdinv MW 5a
0100-110	rdinv_Q_req	rdinv_Q_reply	c_rdinv_Q_req	c/m_reply_inv_Q	q F14|IU$- rdinv MW 5a
0100-111	rdinv_F_req	rdinv_F_reply			q-check MQ MW5a
1000-000	update_via _home _req	update_reply	c_up_req	m_update	%[!<%`7PM3$N update MW5a
1000-100	update_via _home _S_req	update_S_reply	c_up_S_req	m_update_S	s F14|D- update MW 5a
1000-110	update_via _home _Q_req	update_Q_reply	c_up_Q_req	m_update_Q	q F14|D- update MW 5a
1001-000	update_req	none	m_update	none	%[!<%`7PM3$N update A`:n
1001-100	update_S_req	none	m_update_S	none	s F14|D- update A` :n
1001-110	update_Q_req	none	m_update_Q	none	q F14|D- update $N A`:n
1010-000	update_direct_req	none	c/m_up_drct	none	D>@\%"%C%W%G!<%HMW5a
1010-100	update_direct _S _req	none	c_up_drct_S	none	s F14|D- update MW 5a
1000-010	write_req	none	c_writeback _to _home _wo _inv	none	%i%$%HMW5a
1000-011	cflush_req	none	c_writeback _to _home _with _inv	none	%$%s%P%j%G!<%H$9$k%i %$%H%P%C%/

PCMD: SCMD	%Q%1%C%H<o	BP1~9k%j%W%i%$	>>K\%Q%1%C%HL>	>>K\%j%W%i%$L>	Hw9M
1010-001	n_c_write_req	none	c_write	none	Hs%3%R!<%l%s%H=q$-9~ $_MW5a
1010-011	n_c_write_M_req	none	c_write_M	none	Hs%3%R!<%l%s%H M F1 4 | =q$-9~$_
1100-000	invalidate _via _home _req	invalidate_ req or none	c_inv_req	m_invalidate or none	%[!<%`7PM3%$%s%P%j%G!< %HMW5a
1100-100	write_XA_req	write_XA_reply			9b5!G==q$-9~$_MW5a A
1100-101	write_XB_req	write_XB_reply			9b5!G==q$-9~$_MW5a B
1100-110	write_XC_req	write_XC_reply			9b5!G==q$-9~$_MW5a C
1100-111	write_XD_req	write_XD_reply			9b5!G==q$-9~$_MW5a D
1101-000	invalidate_req	none	m_invalidate	none	%[!<%`7PM3%$%s%P%j%G!< %HA`:n
1110-000	control_read_req	control_read_reply	c/m_cntrl_read_req	c/m_cntrl_reply	%3%s%H%m!<%kFI$_=P$7 MW5a
1110-010	control_write_req	none	c/m_cntrl_write	none	%3%s%H%m!<%k=q$-9~$_ MW5a
1110-001	demap_req	demap_ack	c/m_demap_req	c/m_demap_ack	%G%^%C%WMW5a
1110-011	interrupt_req	none	m_interrupt	none	3d$j9~$_MW5a

%j%W%i%$%Q%1%C%H0lMwI=

PCMD: SCMD	%Q%1%C%H<o	Ey2A$J%j%W%i%$	>>K\%Q%1%C%HL>	Hw9M
0001-000	read_reply	read_reply	c/m_reply_read	FI$_=P$7%j%W%i%$
0001-001	n_c_rd_reply	read_reply	m_reply_noc	Hs%3%R!<%l%s%HFI$_=P $7%j%W%i%$
0001-100	read_XA_reply			read_XA_req XN%j%W %i%$
0001-101	read_XB_reply			read_XB_req XN%j%W %i%$
0001-110	read_XC_reply			read_XC_req XN%j%W %i%$
0001-111	read_XD_reply			read_XD_req XN%j%W %i%$
0011-000	allread_reply	allread_reply	c/m_reply_allrd	allread %j%W%i%$
0001-011	swap_reply	read_reply	c/m_swap_reply	%9%o%C%W$N%j%W%i%$
0011-011	swap_M_reply	read_reply	m_swap_M_reply	M F14|D-%9%o%C%W$N %j%W%i%$
0111-000	rdinv_reply	rdinv_reply	c/m_reply_inv	read invalidate %j%W %i%$
0101-000	rdinv_reply	rdinv_reply	c/m_reply_inv	>e5-$N alias
0101-100	rdinv_P_reply	rdinv_reply	c/m_reply_inv_P	p F14|IU$- rdinv %j %W%i%$
0101-110	rdinv_Q_reply	rdinv_reply	c/m_reply_inv_Q	q F14|IU$- rdinv %j %W%i%$
0101-111	rdinv_F_reply	rdinv_reply		q-check <B8=MQ %j%W%i %$
1001-010	writeback_reply	none		%i%$%H%P%C%/MW5a!J%j %W%i%$%l%Y%k!K
1101-100	write_XA_reply			9b5!G==q$-9~$_MW5a A $N%j%W%i%$
1101-101	write_XB_reply			9b5!G==q$-9~$_MW5a B $N%j%W%i%$
1101-110	write_XC_reply			9b5!G==q$-9~$_MW5a C $N%j%W%i%$
1101-111	write_XD_reply			9b5!G==q$-9~$_MW5a D $N%j%W%i%$
1111-000	control_read_reply	read_reply	c/m_cntrl_reply	%3%s%H%m!<%kFI$_=P$7 %j%W%i%$
1111-001	demap_ack	read_reply	c/m_demap_ack	%G%^%C%W%j%W%i%$
1111-111	nop			no operation

%3!<%II=

PCMD: SCMD	%Q%1%C%H<o	Hw9M
0000-000	read_req	%3%R!<%l%s%HFI$_=P$7MW5a
0000-001	n_c_rd_req	Hs%3%R!<%l%s%HFI$_=P$7MW5a
0000-010		Reserved
0000-011	swap_req	%9%o%C%WMW5a
0000-100	read_XA_req	BQ @hF,%V%m%C%/FI$_=P$7
0000-101	read_XB_req	BQ BhFs@hF,%V%m%C%/FI$_=P$7
0000-110	read_XC_req	BQ $N@hF,%V%m%C%/FI$_=P$7!?%G%-%e!<
0000-111	read_XD_req	BQ $NBhFs@hF,%V%m%C%/FI$_=P$7!?%G%-%e!<
0001-000	read reply	FI$_=P$7%j%W%i%$
0001-001	n_c_rd_reply	Hs%3%R!<%l%s%HFI$_=P$7%j%W%i%$
0001-010		Reserved
0001-011	swap_reply	%9%o%C%W$N%j%W%i%$
0001-100	read_XA_reply	read_XA_req XN%j%W%i%$
0001-101	read_XB_reply	read_XB_req XN%j%W%i%$
0001-110	read_XC_reply	read_XC_req XN%j%W%i%$
0001-111	read_XD_reply	read_XD_req XN%j%W%i%$
0010-000	allread_req	%3%R!<%l%s%H allread MW5a
0010-001		Reserved
0010-010	injection_req	%$%s%8%'%/%7%g%sMW5a
0010-011	swap_M_req	MBP 8F$S=P$7MW5a
0010-100		Reserved
0010-101		Reserved
0010-110		Reserved
0010-111		Reserved
0011-000	allread_reply	allread %j%W%i%$
0011-001		Reserved
0011-010		Reserved
0011-011	swap_M_reply	M F14|D-%9%o%C%W$N%j%W%i%$
0011-100		Reserved
0011-101		Reserved
0011-110		Reserved
0011-111		Reserved

PCMD: SCMD	%Q%1%C%H<o	Hw9M
0100-000	rdinv_req	rdinv MW5a
0100-001		Reserved
0100-010		Reserved
0100-011		Reserved
0100-100	rdinv_P_req	p F14|IU$- rdinv MW5a
0100-101		Reserved
0100-110	rdinv_Q_req	q F14|IU$- rdinv MW5a
0100-111	rdinv_F_req	q-check MQMW5a
0101-000	rdinv_reply	rdinv XN reply
0101-001		Reserved
0101-010		Reserved
0101-011		Reserved
0101-100	rdinv_P_reply	p F14|IU$- rdinv %j%W%i%$
0101-101		Reserved
0101-110	rdinv_Q_reply	q F14|IU$- rdinv %j%W%i%$
0101-111	rdinv_F_reply	q-check MQ%j%W%i%$
0110-000		Reserved
0110-001		Reserved
0110-010		Reserved
0110-011		Reserved
0110-100		Reserved
0110-101		Reserved
0110-110		Reserved
0110-111		Reserved
0111-000	rdinv_reply	read invalidate %j%W%i%$
0111-001		Reserved
0111-010		Reserved
0111-011		Reserved
0111-100		Reserved
0111-101		Reserved
0111-110		Reserved
0111-111		Reserved

PCMD: SCMD	%Q%1%C%H<o	Hw9M
1000-000	update_via _home _req	%[!<%‘7PM3$N update MW5a
1000-001		Reserved
1000-010	write_req	%i%$%HMW5a
1000-011	cflush_req	%$%s%P%j%G!<%H$9$k%i%$%H%P%C%/
1000-100	update_via _home _S_req	s F14 | D- update MW5a
1000-101		Reserved
1000-110	update_via _home _Q_req	q F14 | D- update MW5a
1000-111		Reserved
1001-000	update_req	%[!<%‘7PM3$N update $N%j%W%i%$
1001-001		Reserved
1001-010	writeback_reply	%i%$%H%P%C%/MW5a!J%j%W%i%$%l%Y%k!K
1001-011		Reserved
1001-100	update_S_req	s F14 | D- update $N%j%W%i%$
1001-101		Reserved
1001-110	update_Q_req	q F14 | D- update $N%j%W%i%$
1001-111		Reserved
1010-000	update_direct_req	D>@\%"%C%W%G!<%HMW5a
1010-001	n_c_write_req	Hs%3%R!<%l%s%H=q$-9~$_MW5a
1010-010		Reserved
1010-011	n_c_write_M_req	Hs%3%R!<%l%s%H M F14 | =q$-9~$_
1010-100	update_direct _S _req	s F14 | D- update MW5a
1010-101		Reserved
1010-110		Reserved
1010-111		Reserved
1011-000		Reserved
1011-001		Reserved
1011-010		Reserved
1011-011		Reserved
1011-100		Reserved
1011-101		Reserved
1011-110		Reserved
1011-111		Reserved

PCMD: SCMD	%Q%1%C%H<o	Hw9M
1100-000	invalidate_via_home_req	%[!<%`7PM3%$%s%P%j%G!<%HMW5a
1100-001		Reserved
1100-010		Reserved
1100-011		Reserved
1100-100	write_XA_req	9b5!G==q$-9~$_L?Na A
1100-101	write_XB_req	9b5!G==q$-9~$_L?Na B
1100-110	write_XC_req	9b5!G==q$-9~$_L?Na C
1100-111	write_XD_req	9b5!G==q$-9~$_L?Na D
1101-000	invalidate_req	%[!<%`7PM3%$%s%P%j%G!<%H$N%j%W%i%$
1101-001		Reserved
1101-010		Reserved
1101-011		Reserved
1101-100	write_XA_reply	9b5!G==q$-9~$_L?Na A $N%j%W%i%$
1101-101	write_XB_reply	9b5!G==q$-9~$_L?Na B $N%j%W%i%$
1101-110	write_XC_reply	9b5!G==q$-9~$_L?Na C $N%j%W%i%$
1101-111	write_XD_reply	9b5!G==q$-9~$_L?Na D $N%j%W%i%$
1110-000	control_read_req	%3%s%H%m!<%kFI$_=P$7MW5a
1110-001	demap_req	%G%^%C%WMW5a
1110-010	control_write_req	%3%s%H%m!<%k=q$-9~$_MW5a
1110-011	interrupt_req	3d$j9~$_MW5a
1110-100		Reserved
1110-101		Reserved
1110-110		Reserved
1110-111		Reserved
1111-000	control_read_reply	%3%s%H%m!<%kFI$_=P$7%j%W%i%$
1111-001	demap_ack	%G%^%C%W%j%W%i%$
1111-010		Reserved
1111-011		Reserved
1111-100		Reserved
1111-101		Reserved
1111-110		Reserved
1111-111	nop	No operation

4.3 %Q%1%C%H$N>\:Y

%Q%1%C%H$N<oN`$O!"%"%I%l%9!&%U%j%C%H$N PCMD $*$h$S SCMD %U%#!<%k%I$NCM$K$h$jDj$^$k!#<oN`$OBgJL$
%j%/%(%9%H7O$H%j%W%i%$7OKo1i$l!"3F!90[$JC?MW5aM%@h=g0L$,M?$(il$k!#$J$*!"%j%/%(%9%H7O$+%j%W
$+$r!" PCMD $^$?$O SCMD $NFCDj%S%C%H$GH=CG9k3H$OIT2DG=$G$"$j!" full bit $N%G%3!<%I7k2L$rMQ$$$k!#
$?!"%Q%1%C%H$,%j%/%(%9%H7O$+%j%W%i%$7O$+$O!"%P%9K*1k%"!<%S%H%l!<%7%g%s$*$h$S%j%H%i%$@)8f$K4X78
HG$"$j!"%Q%1%C%H$NL\E*$,2?$+$rMW5a9k$+!"MW5a$KBP9k%j%W%i%$$G$"$k$+$H$OL54X78$G$"$k3H$KCm0U
$H!#

3F%Q%1%C%H$N@bL@Cf!"%Q%1%C%H<oJL$O PCMD $*$h$S SCMD G"$?$(ilkbNH$7!"@bL@$+$i>JN,$5l
$k!#$^$?!"@bL@$K8=lJ$$%U%#!<%k%I$O>o$K don't care G"$j G$0U$N%S%C%H%Q%?%s$,5v5l$k!#

4.3.1 read_req

read_req $O!"%P%9$K@\B3$5$l$?%a%b%j$+iN%3%R!<%l%s%HFI$_=P$7MW5aG"$j!"%Q%1C%HD9$O#1G"$k!#%P
@\B3$5$l$F$$$kA4#M#B#P!?%-%c%C%7eO read_req $r%9%L!<%W$7!">u67$K1~$8$F RETRY ?.9f$r!"99$K%-%c%C%7
CRPLY ?.9f$*$h$S MSH ?.9f$rJV$9!#

read_req $r<uM}$7$?%-%c%C%7$e$KL\E*%V%m%C%/$,B8:_9k>l9gKO!" MSH ?.9f$r assert 9k!#$^$?!"%-%c%C
>e$KL\E*%V%m%C%/$, dirty >uBV$GB8:_$9$k>l9gEy%-%c%C%7%e$, %j%W%i%$$Q%1C%H$rJVAw$9$k>l9g!" CRPLY ?.
assert 9k!#

%P%9$K@\B3$5l?A4%G%P%$%9$,%Q%1C%H$r<uM}$7!JD^$j retry $,H/@8$;$:!K!" CRPLY ?.9f$r $$$:l+$N%-
%7%e%a%b%j$, assert 7?>l9gKO CRPLY ?.9f$rH/$7$?%-%c%C%7%e%a%b%j$, read_reply %Q%1C%HrJV7!"#M#B#P
%a%b%jNFI_=P$7Ey$NF0:n$rCf;_$9$k!#%-%c%C%7%e$,%j%W%i%$$9$k>l9g!" read_req $,<uM}$5l?8e!"BP1~9k
$,%j%/%(%9%H$rH/7?%G%P%$%9$KJVk^GN4V!"Ev3:%V%m%C%/KBP9$kA4$F$N%j%/%(%9%H$O read_req $rH/$7$
%$%9$^$?$O CRPLY rJV7$?%-%c%C%7%e$Khj %j%H%i%$$5lk!#

CRPLY $, assert 5lJ+C?>l9gKO#M#B#P$,%/%i%9%?%a%b%jEy$r%"%/%;%9$7!" read_reply %Q%1C%H$rJV$9
3N>l9g!" read_req $rH/$7$?%G%P%$%9$,L\E*%V%m%C%/$KBP9k #M#B#P$+$i$N%j%/%(%9%H$r!" read_req $r2r7h$
read_reply $,Aw$ilk$^$G%j%H%i%$$7B3$1$FOJiJ$$!#

J*!"%-%c%C%7%e$, read_req $rH/$9$k>l9g$K$O!"Ev3:%-%c%C%7%e$KL\E*%V%m%C%/$,B8:_$7FOJi$J$$!##M
$, read_req $rH/$9$k>l9g$O!"$=$N8BjGOJ$/!"<+J,<+?H$,JVEz9k2DG=@-$,$"$k!J$^$?$O!" CRPLY $, assert
lJ$$>l9g!"Ev3: read_req F0:n$rJ|4~$9$k!##M#B#P$N%$%s%W%j%a%s%F!<%7%g%s$K0MB8$9$k!K!#

read_req K*1k CCBL %U%#!<%k%I$,#1$N>l9g!"%-%c%C%7%e%V%m%C%/FI$_9~$_G"$j!"#0$N>l9g$O%-%c%C%
>u67$rJQ99$7$J$$C1JkFI$_=P$7G"$k!#3F%G%P%$%9$O reply $,=*N;$9k^GK!"E,59%V%m%C%/>uBV$rJQ99$9$
$*!" CCBL= #0$G$"$k>l9gK*$$$F%j%/%(%9%?$^$?O=$l0J30$N%-%c%C%7%e>e$KEv3:%V%m%C%/$,B8:_9k>l9g$
$O5,Dj$5lJ$$!#

Cm#1!' read_req $O!">>K\;EMM=q$N c_read_req, m_read_req!"5~Bg;EMM=q$N Shared Read Request, Non-Cacheable Read Request $KBP1~$9$k!# c_read_req, m_read_req $O!" SID %U%#!<%k%I$NCM$G6hJL$5$l!" Shared Read Request $H Non-Cacheable Read Request $N:9$O!" CCBL %S%C%HKh$j6hJL$5lk!#

Cm#2!' non_cacheable J%"%/%;%9GOF14|6K@-$N;XDj$,I,MWG"$k!#;XDj$OF101%/%i%9%?%"%I%l%9KBP7$FD%$il?#28D$N%
%9Kh$j6hJL$5lk!# FEPOL O3$N6hJL$rMW5a@hKEA(k?aK;HMQ9k!#

Cm#3!' V3.0 $^$GB8:_7? read_F_req $O!"%U%i%0$N2r<a$rFs<!%-%c%C%7%e$,9TJ&3H$G!"GQ;_$HJC$?!#

%U%#!<%k%IL>	5-=R
ADDR[27:0]	FI$_=P$7BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	read_req GO HOME $O don't care G"$k!#
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"$j!" %/%i%9%?%a%b%j$rD>@\%"%/%;%9$9$k3H$,IT2DG=$G$"$k3H$r<($9!##0G"$k>l9g$O!"BP>]$,%@%_!<%Z!<%8$G$J$$!"9JoA%/%i%9%?Fb%a%b%j$KB8:_$9k3Hr<($9
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]%"%/%;%9$K CTLB $r8+$k3H$,I,MW$J3H$r<($9
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K%P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"k3Hr<($9!##0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G$"$k3H$r<($9!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"FI$_=P$7MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r<($9!#%/%i%9%?FbGJD8$k read_req GOFC8"%l%Y%k$N8!::$,9TJolJ$$$?$a!"0UL#$,$J$$
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!# CCBL = 1 G"$k%-%c%C%7%c%V%k%"%/%;%9$N>l9g$OEvA3 block $,A*Br$5lkY-G"$k!#
DID[2:0]	read_req GO%9%L!<%W$rI,$:9k$?$a!" non cacheable $J>l9g$r4^$_ all $r;XDj$9$k!#
SID[2:0]	%Q%1C%H$NAw?.85$N;XDj!# reply %Q%1C%H$O SID 08$K$*$/il$k!#
ACK	PEND ?.9fKh$k40N;DLCN;XDj!#I,$:#0$r;XDj$9$k

4.3.2 non_coherent_read_req

non_coherent_read_req $O!"%P%9$K@\B3$5$l$?%a%b%j$+iNHs%3%R!<%l%s%HFI$_=P$7MW5aG"$j!"%Q%1%C%HD9
#1G"$k!# MBP $OL\E*%"%I%l%9$rFI$_=P$7 non_coherent_read_reply %Q%1%C%HGJV9!#

non_coherent_read_req $O DID $G;XDj$5l?%G%P%$%9$@1G<uM}$7!"$=$NB>$N%G%P%$%9$O!"%9%L!<%WEy$K4X$
$k?.9f!"$9Jo$A!" MSH ?.9f!" CRPLY ?.9f!"%O!<%I%&%'%"$NET9g$Khk01;~E*%j%H%i%$0J30$N BRETRY ?.9f
assert 7J$$!#$^$?!"$=$NB>$N%G%P%$%9$O2?$i>uBV$rJQ99$9$kF0:n$r9TJo$J$$!#=>CF!" DID $,%-%c%C%7%e
$k%j%/%(%9%H$NF0:n$OJ]>Z$5lJ$$!#

non_coherent_read_req $rH/$7$?Fs<!%-%c%C%7%e$O!" non_coherent_read_reply $,JV$k$^$G!"Ev3:%V%m%C%/KBP9
$kB>$N%-%c%C%7%e$+$i$N%j%/%(%9%H$r%j%H%i%$$9$k!#

non_coherent_read_req %Q%1%C%HF0:n$N>\:Y$O!"%"%I%l%9!&%U%j%C%H$K4^$^lk3F%U%#!<%k%INCMKhjDj$a
lk!# CCBL %U%#!<%k%I$,#1$G$"$k>l9g$O!"Hs%3%R!<%l%s%H$J%V%m%C%/MW5aG"$j!"#0$G$"$k>l9g$OHs%3%R!
%HJFI_=P$7MW5a$G$"$k!#

Cm#1!' non_coherent_read_req $O!"$[$\ read_request $KBP1~$9k,!"%9%L!<%WF0:n$r9T$JoJ$$$E@$,0[$JCF$$$k!#>>K\0F$
c_read_noc_req $KBP1~$9$k!#$^$?!" non_coherent_read_req $KBP1~$9$kF14|4X78$N%j%/%(%9%HOJ$$!#

Cm#2!' DID %U%#!<%k%I$O!"%9%L!<%W$r9TJo$J$$$?$a BP1~$9$k#M#B#P$r;XDj9k!#$=$l0J30NCM,;XDj5l$k>l9g$NF0:n
5l$F$$$J$$!#

Cm#3!'F14|4XO"%"%/%;%9GOF14|6K@-$N;XDj$,I,MWG"$k!#;XDj$OF10l%/%i%9%?%"%I%l%9KBP7$FD%$il?#28D$N%"%I%l%
6hJL5l$k!# FEPOL O3$N6hJL$rMW5a@hKEA(k?aK;HMQ9k!#

Cm#4!' non_coherent_read_req $rH/9T$9$k%V%m%C%/$,B>$N%-%c%C%7%e$K$"$k>l9g$NF0:n$O%$%s%W%j%a%s%H0MB8$G$"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	FI$_=P$7BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	don't care G"$k!#
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!##0G"$k>l9g$O!"BP>]$r Owner rBX($:$K%"%/%;%9$9$k3H$r<($9
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"$k 3H$r<($9!##0G"$k>l9g$O!"%N%s%-%c%C%7%c%V%kG"k3Hr<($9!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"FI$_=P$7MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!# CCBL = 1 G"$k%-%c%C%7%c%V%k%"%/%;%9$N>l9g$OEvA3 block $,A*Br$5 lkY-G"$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!##M#B#P$r;XDj$9$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# reply %Q%1%C%H$O SID 08$K$*$/il$k!# all $O;HMQ$7$J$$!#
ACK	PEND ?.9fKh$k40N;DLCN;XDj!#I,$:#0$r;XDj$9$k

4.3.3 allread_req

allread_req $O!"%P%9$K@\B3$5$l$?%a%b%j$+iNFI$_=P$7MW5aG"$j!"%Q%1%C%HD9$O#1G"$k!# MBP $*$h$S %-%c%C%7%e$O!"3F!9BP1~9kF0:n$r9T$J$$ allread_reply %Q%1%C%HrJV9!#

%P%9$K@\B3$5lF$$$k3F%G%P%$%9$O!" allread_req $r%9%L!<%W$7!" BRETRY ?.9f$r!"99$K%-%c%C%7%e$O CRPLY ?.9f$*hS MSH ?.9frJV9!# BRETRY,MSH,CRPLY ?.9f$N>\:Y$O!" read_req $HA4$/F1$8$G$"$k!#

%P%9$K@\B3$5l?A4%G%P%$%9$,%Q%1%C%H$r<uM}$7!JD^$j retry $,H/@8$;$:!K!" CRPLY ?.9f$r $$$:l+$N% %7%e%a%b%j$, assert 7?>l9gKO!"%-%c%C%7%e%a%b%j$, allread_reply %Q%1%C%H$rJV$9!# CRPLY $, assert 5l$J $+$C$?>l9g$K$O#M#B#P$, allread_reply %Q%1%C%HrJV9!#

%P%9$K@\B3$5l?A4%G%P%$%9$,%Q%1%C%H$r<uM}$7!JD^$j retry $,H/@8$;$:!K!" CRPLY ?.9f$r $$$:l+$N% %7%e%a%b%j$, assert 7?>l9gKO!"%-%c%C%7%e%a%b%j$, allread_reply %Q%1%C%H$rJV$9!#%-%c%C%7%e%a%b%j$, allrea %Q%1%C%HrJV9>l9g!" %j%W%i%CfN INJ_MASK $K 1111 $rN)$F!"%/%i%9%?FbA4FN%-%c%C%7%eKBP7$F%$%s%8% %7%g%s$r9T$J$&!#

CRPLY $, assert 5lJ+C?>l9gKO#M#B#P$, allread_reply %Q%1%C%H$rJV$9!#$3$N>l9g$O#M#B#P$,%$%s%8% %/%7%g%s$r9T$J$&%-%c%C%7%e$rA*Br$7!"E,59 INJ_MASK $r@_Dj$9$k!#

allread_req $O%-%c%C%7%c%V%k$G$J$$$$H0UL#$,$J$/ CCBL %U%#!<%k%I$,#1G"kI,MW,$"$k!##0$N>l9g$NF0:n J]>Z5l$J$$!#

all_read_req %Q%1%C%HF0:n$N>\:Y$O!"%"%I%l%9!&%U%j%C%H$K4^$^lk3F%U%#!<%k%INCMKhjDjailk!# C $O#1$G$J$$$$H0UL#$,$J$$$$3HKCm0U9k3H!#

Cm#1!' allread_req $O!">>K\;EMM=q$N c_allread_req $KBP1~$9$k!#

Cm#2!' DID %U%#!<%k%I$O!"%9%L!<%W%"%/%;%9$r9TJ&$?$a!" all $r;XDj$9$k!#

Cm#3!'F14|%"%/%;%9GOF14|6K@-$N;XDj$,I,MWG"$k!#;XDj$OF10l%/%i%9%?%"%I%l%9KBP7$FD%$il?#28D$N %9$Khj6hJL5l$k!# FEPOL O3$N6hJL$rMW5a@hKEA(k?aK;HMQ9k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	FI$_=P$7BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	Don't care G"$k!#
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k!##0G"$k>l9g$O!"BP>]$,%@%_!<%Z!<%8$G$J$$!"9JoA%/%i%9%?Fb%a%b%j $KB8:_$9k3Hr<($9
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!##0G"$k>l9g$O!"BP>]$r Owner rBX($:$K%"%/%;%9$9$k3H$r<($9
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	%-%c%C%7%e%a%b%j$r;H$o$J$$ allread $O0UL#$,$J$$$?$a!" CCBL %S%C%H$O#1G"kI, MW,$"$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"FI$_=P$7MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!# CCBL = 1 G"$k%-%c%C%7%c%V%k%"%/%;%9$N>l9g$OEvA3 block $,A*Br$5 lkY-G"$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$&$?$a!" all $r;XDj$9$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# reply %Q%1%C%H$O SID 08$K$*$/il$k!#
ACK	PEND ?.9fKh$k40N;DLCN;XDj!#I,$:#0$r;XDj$9$k

4.3.4 injection_req

injection_req $O!"%P%9$K@\B3$5$l$?%a%b%j$+iNFI$_=P$7MW5aG"$j!"%Q%1%C%HD9$O#1G"$k!#3F%-%c%C%7%
3F!9BP1~9kF0:n$r9T$J$&!# reply %Q%1%C%H$rOJV5$J$$!#

%P%9$K@\B3$5lF$$$k3F%G%P%$%9$O!" injection_req $r%9%L!<%W$7!"I,MWJi$P BRETRY ?.9f$rJV$9!# injectio
$O%j%W%i%$$,$J$$$?$a!"%j%H%i%$MW0x$O<g$K%j%H%i%$>r7o$N0l;~E*JbNG$"$k!#

MSH,CRPLY ?.9f$O%j%W%i%$$,$J$$$?$a!"FC$KJV$9I,MW$O$J$$!#

%P%9$K@\B3$5l?A4%G%P%$%9$,%Q%1%C%H$r<uM}$7!JD^$j retry $,H/@8$;$:!K!"$?>l9gKO!"%-%c%C%7%e%
$,%-%c%C%7%e%$%s%8%'%/%7%g%sF0:n$r9T$J$&!#$3$N>l9g!"$$$:l+$N%-%c%C%7%e$,M=$a allread_req Ey$r=P7F
I,MWOJ$/!"40A4$KEj5!E*%$%s%8%'%/%7%g%s$HJk!#

DID $, **all** $N>l9g$O!"A4FN%-%c%C%7%e$,%$%s%8%'%/%7%g%sBP>]G"$j!" **DID** $,$$$:l+$N%-%c%C%7%e$G$
>l9g$OEv3:%-%c%C%7%e$,%$%s%8%'%/%7%g%sBP>]$G$"$k

#M#B#P$O!" injection_req $r<uM}$7Fb2?iNF0:n$r9T$JoJ$$!#

injection_req $O%-%c%C%7%c%V%k$G$J$$$$H0UL#$,$J$/ CCBL %U%#!<%k%I$,#1G"kI,MW,$"$k!##0$N>l9g$NF0
$OJ]>Z$5lJ$$!#

Cm#1!' injection_req $O V3.4 ;EMM=q$K$*$$$F?7@_5l$?!#

Cm#2!' DID %U%#!<%k%I$O!" all $N>l9g!"A4$F$N%-%c%C%7%e$K injection $7!"%-%c%C%7%e$N>l9g!"$=$N%-%c%C%7%e$@$1$K inject
9k!# injection_req GO INJ_MASK %U%#!<%k%I$r;HMQ$7$J$$!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	FI$_=P$7BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	Don't care G"$k!#
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k!##0G"$k>l9g$O!"BP>]$,%@%_!<%Z!<%8$G$J$$!"9JoA%/%i%9%?Fb%a%b%j $KB8:_$9k3Hr<($9
OW_CH	don't care G"$k
LARGE	don't care G"$k
FEPOL	don't care G"$k
CCBL	%-%c%C%7%e%a%b%j$r;H$o$J$$ injection $O0UL#$,$J$$$?$a!" CCBL %S%C%H$O#1G"$k I,MW$,$"$k!#
SU	don't care G"$k!#
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!# CCBL = 1 G"$k%-%c%C%7%c%V%k%"%/%;%9$N>l9g$OEvA3 block $,A*Br$5 lkY-G"$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#A4FN%-%c%C%7%e$K injection $r9T$J$&>l9g$O all $r;X Dj$7!"FCDj$N%-%c%C%7%e$K9TJ&>l9g$O!"$=$N%-%c%C%7%eHV9f$r;XDj9k
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!#
ACK	PEND ?.9fKh$k40N;DLCN;XDj!#I,$:#0$r;XDj$9$k

4.3.5 rdinv_req

rdinv_req $O!"%P%9$K@\B3$5$l$?%a%b%j$+iNFI$_$@$7MW5a7s%$%s%P%j%G!<%HMW5aG"$j!"%Q%1%C%HD9$O#1 $k!# rdinv_req $O4pK\E*$K$OA4$F home K*1k%7%j%"%i%$%:$r<u$1!"$=$N7k2L rdinv_reply rJV9!"%j%/%(%9%? 30$+$iL\E*%V%m%C%/$r>C5n$9kEyNF0:n$r3+;O$9$k!#

$?$@$7!"%/%i%9%?Fb%m!<%+%k$G$"$k3H$,!"H=L@$7$F$$$k>l9g!J$$$:l+$NFs<!%-%c%C%7%e$+$i CRPLY $ sert 5l$k>l9g!"$*hS#M#B#P$,%/%i%9%?Fb%m!<%+%k$G$"$k3H$rH=Dj$9$k>l9g!K$K$O!"%7%j%"%i%$%:$O<+L@$ $?$a!"%/%i%9%?Fb%-%c%C%7%e$,D>$A$K CRPLY ?.9f$r assert $7!" rdinv_reply rJV9$+!"#M#B#P$,D>AK rdinv_repl rJV7!"%/%i%9%?FbKJD8$?F0:n$r9TJ&!#3N;~!" **MSH** $O3F%-%c%C%7%e$H$b **assert** 7J$$$3H,I,MWG"$

%P%9$K@\B3$5lF$$$k3F%G%P%$%9$O!" read_req $r%9%L!<%W$7!">u67$K1~$8$F RETRY ?.9f$r!"99$K%-%c%C% $O CRPLY ?.9f$*hS MSH ?.9frJV9!#

%-%c%C%7%e>e$KL\E*%V%m%C%/$, dirty >uBV$GB8:_$9$k>l9gEyFs<!%-%c%C%7%e$,%j%W%i%$$9$k>l9g!" CRPLY ? $r assert 9k!# MSH ?.9f$O!"%-%c%C%7%eFb>uBV$K78oi$: assert 7J$$!#

%P%9$K@\B3$5l?A4%G%P%$%9$,%Q%1%C%H$r<uM}$7!JD^$j retry $,H/@8$;$:!K!" CRPLY ?.9f$r $$$:l+$N% %7%e$a%b%j$, assert 7?>l9gKO CRPLY ?.9f$rH/$7$?%-%c%C%7%e$a%b%j$, rdinv_reply %Q%1%C%H$rJV$9!#$3$N> 9g!" rdinv_req $,<uM}$5l?8e!"BP1~9k rdinv_reply $,%j%/%(%9%H$rH/7?%G%P%$%9$KJVk^GN4V!"Ev3:%V% %/KBP9$kA4$F$N%j%/%(%9%H$O rdinv_req $rH/$7$?%G%P%$%9$^$?$O CRPLY rJV7$?%-%c%C%7%e$Khj %j%H%i% lk!#

CRPLY $, assert 5lJ+C?>l9gKO#M#B#P$, rdinv_reply %Q%1%C%H$rJV$9!#$3$N>l9g!" rdinv_req $rH/$7$? %G%P%$%9$,L\E*%V%m%C%/$KBP9k B>$N%j%/%(%9%H$r!" rdinv_req $r2r7h$9$k rdinv_reply $,Aw$ilk$^$G%j%H%i% B3$1$FOJiJ$$!#

J*!"%-%c%C%7%e$, rdinv_req $rH/$9$k>l9g$K$O!"Ev3:%-%c%C%7%e$KL\E*%V%m%C%/$,B8:_$7FOJi$J$$!# #P$, rdinv_req $rH/$9$k>l9g$O!"$=$N8BjGOJ$/!"<+J,<+?H$,JVEz9k2DG=@-$,$"$k!J$^$?$O!" CRPLY $, ass 5l$J$$>l9g!"Ev3: rdinv_req F0:n$rJ|4~$9$k!K!#

rdinv_req K*1k CCBL %U%#!<%k%I$,#1$N>l9g!"=q$-9~$_$rL\E*$H7?%-%c%C%7%e%V%m%C%/FI$_9~$_Kt$OG E*FI$_9~$_$G$"$j!"#0$N>l9g$O%-%c%C%7%e>u67$rJQ99$7$J$$C1JkGSB>E*FI$_=P$7G"$k!#3F%G%P%$%9$O repl N;$9k^GK!"E,59%V%m%C%/>uBV$rJQ99$9$k!#$J$*!" CCBL= #0$G$"$k>l9g$G%/%i%9%?Fb%-%c%C%7%e$KEv3:%V% $,B8:_$9$k>l9g$NF0:n$O5,Dj$5lJ$$!#

%/%i%9%?Fb$G%j%/%(%9%?$N%-%c%C%7%e0J30GN%$%s%P%j%G!<%H$O!" rdinv_req $r<uM}$7$?;~E@!"$^$?$O%j%W %Q%1%C%HG"$k rdinv_reply %Q%1%C%H$r<uM}7?;~E@$G<B9T$5lk!#

rdinv_req %Q%1%C%H$O!" p $*$h$S q F14 | %W%j%_%F%#%V$HF1;~$K;HMQ$9k3H,2DG=G"$k!# rdinv_P_req $*$h$ rdinv_Q_req $N9`L\$r;2>HN3$H!#

ACK %U%#!<%k%I$,#1$G$"$k>l9g!" rdinv_req $,=hM}Cf$G$"$k3H$,!" X_PEND ?.9f$Khj SID %U%#!<%k%I$;XDj5l$k CC $r7PM3$7$F CPU $KDLCN$5lk!# ACK %U%#!<%k%I$,#0$G$"$k>l9g$O!"#M#B#P$K$*$1$kA`:n$O40A CC !? CPU $HFHN)$G$"$j!" X_PEND ?.9fKh$k=*N;DLCN$O9TJolJ$$!#

Cm#1!’ rdinv_req $O!">>K\;EMM=q$N c_rdinv_req, m_rdinv_req!"5~Bg;EMM=q$N Exclusive Read Request $KBP1~$9$k!#

Cm#2!’ DID %U%#!<%k%I$O!"%9%L!<%W%"%/%;%9$r>o$K9T$J$&$?$a!" all $r;XDj$9$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	FI$_=P$7$*$h$S%$%s%P%j%G!<%HBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	rdinv_req $N>l9g#1<!%-%c%C%7%c%V%k$JiP#1!"#3<!%-%c%C%7%c%V%kJi$P#0$r;XDj$9 $k
SU	SU %S%C%H$,#1$G$"$k>l9g!"FI$_=P$7MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!# CCBL = 1 G"$k%-%c%C%7%c%V%k%"%/%;%9$N>l9g$OEvA3 block $,A*Br$5 lkY-G"$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$& rdinv_req GO all $r;XDj$9$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# reply %Q%1%C%H$O SID 08$K$*$/il$k!#
ACK	rdinv A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#

4.3.6 rdinv_P_req

rdinv_P_req $O!"%P%9$K@\B3$5$l$?%a%b%j$+iNFI$_$@$7MW5a7s%$%s%P%j%G!<%HMW5aG"$j!" Memory-Based F $r9=@.$9$k%"%/%;%9K!$N$?$a$N nonblocking FI$_$@$7G"$k!# rdinv_P_req GOEv3:%m%1!<%7%g%s$NF14 | %S%C%H full/empty >pJs$H!" full G"$k>l9g$O%G!<%?$rMW5a85%-%c%C%7%e$X exclusive $J>uBV$H7FFI$_=P$7!" FE %S%C%H %/%j%"9k!# empty G"k3HO rdinv_P_reply %Q%1%C%H$N%"%I%l%9!&%U%j%C%H$K4^$^$l$k FE %U%#!<%k%I$G<($l!"<B:]$K CPU JVjCMH7F(null) :n@.$OFs<!%-%c%C%7%e$K$*$$$F=hM}5l$k!#

rdinv_P_req $N%Q%1%C%HD9$O#1G"$k!# MBP $*$h$S3F%-%c%C%7%e$O!"3F!9BP1~9kF0:n$r9T$J$$ MW5a85$,B $k%/%i%9%?0J30$KEv3:%V%m%C%/$,B8:_$7$J$$>u67H7$?8e!" rdinv_P_reply rJV9!#MW5a85%-%c%C%7%e0J30GN %P%j%G!<%H$O!"%j%W%i%$%Q%1%C%HG"$k rdinv_P_reply %Q%1%C%H$r<uM}7?;~E@$G<B9T$5lk!#

rdinv_P_req %Q%1%C%H$O!"8e=R rdinv_Q_req H[$\F1$8F0:nr9k,!" CPU $+$i8+$?F0:n!"#M#B#P$K$*$1$kB $A9g$o$;F0:n$,0[Jk$?$a!"0[Jk%3%^%s%IH9kI,MW,$"$k!#

$=$NB>$NF0:n$K$D$$$F$O!" rdinv_req $K=`$8$k!#

Cm#1!' rdinv_P_req $O!">>K\;EMM=q$N c_rdinv_P_req $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbNOJ$$!#

Cm#2!' DID %U%#!<%k%I$O!"%9%L!<%W%"%/%;%9$r>o$K9T$J$&$?$a!"0UL#$,$J$$!#Cm#3!' rdinv_P_req $O CCBL $,#1$N>l9g$@$1D 5l!" non cacheable $J>l9g$K$O;HMQ$5lJ$$!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	FI$_=P$7$*$h$S%$%s%P%j%G!<%HBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	rdinv_P_req $N>l9g Fs<!%-%c%C%7%c%V%k$JNG#1$r;XDj$9$k
SU	SU %S%C%H$,#1$G$"$k>l9g!"FI$_=P$7MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!# CCBL = 1 G"$k%-%c%C%7%c%V%k%"%/%;%9$N>l9g$OEvA3 block $,A*Br$5 lkY-G"$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$& rdinv_req GO all $r;XDj$9$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# reply %Q%1%C%H$O SID 08$K$*$/il$k!#
ACK	rdinv_P_req A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#

4.3.7 rdinv_Q_req

rdinv_Q_req $O!"%P%9$K@\B3$5$l$?%a%b%j$+iNFI$_$@$7MW5a7s%$%s%P%j%G!<%HMW5aG"$j!" Memory-Based F $r9=@.$9$k%"%/%;%9K!$N$?$a$N nonblocking FI$_$@$7G"$k!# rdinv_Q_req GOEv3:%m%1!<%7%g%s$NF14 | %S%C%H full G"$k>l9g!"MW5a85%-%c%C%7%e$X exclusive $J>uBV$H7FFI$_=P$9!# empty $N>l9g!"F14 | %U%i%0$N$_M-8z$J% %?H7$F%-%c%C%7%e$K rdinv_Q_reply rJV9!#

rdinv_Q_req $N%Q%1%C%HD9$O#1G"$k!# MBP $*$h$S3F%-%c%C%7%e$O!"3F!9BP1~9kF0:n$r9T$J$$ MW5a85$,B $k%/%i%9%?0J30$KEv3:%V%m%C%/$,B8:_$7$J$$>u67H7$?8e!" rdinv_Q_reply rJV9!#MW5a85%-%c%C%7%e0J30GN %P%j%G!<%H$O!"%j%W%i%$%Q%1%C%HG"$k rdinv_Q_reply %Q%1%C%H$r<uM}7?;~E@$G<B9T$5lk!#

$=$NB>$NF0:n$K$D$$$F$O!" rdinv_req $K=`$8$k!#

Cm#1!' rdinv_Q_req $O!">>K\;EMM=q$N c_rdinv_Q_req $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbNOJ$$!#

Cm#2!' DID %U%#!<%k%I$O!"%9%L!<%W%"%/%;%9$r>o$K9T$J$&$?$a!"0UL#$,$J$$!#Cm#3!' rdinv_Q_req $O CCBL $,#1$N>l9g$@$1M il!" non cacheable $J>l9g$K$O;HMQ$7$J$$

%U%#!<%k%IL>	5-=R
ADDR27:0]	FI$_=P$7$*$h$S%$%s%P%j%G!<%HBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	rdinv_Q_req $N>l9gFs<!%-%c%C%7%c%V%k$JNG#1$r;XDj$9$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"FI$_=P$7MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!# CCBL = 1 G"$k%-%c%C%7%c%V%k%"%/%;%9$N>l9g$OEvA3 block $,A*Br$5 lkY-G"$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$& rdinv_req GO all $r;XDj$9$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# reply %Q%1%C%H$O SID 08$K$*$/il$k!#
ACK	rdinv_Q_req A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#

4.3.8 write_req

write_req $O!"%P%9$K@\B3$5$l$?%a%b%j$X$N%3%R!<%l%s%H=q$-9~$_MW5a$G$"$k!# write_req $ODL>o%i%$%H%P%C%/ $J$$%a%b%j=q$-9~$_$*$h$S non cacheable write !JCCBL=0 $N>l9g!K$KMQ$$$ilk!#

write_req $N%Q%1%C%HD9$O!"=q$-9~$`%G!<%?$,%V%m%C%/$N>l9g#5G"$j!"$=$NB>$N>l9g#2G"$k!# SIZE %U%#! %I$, masked block $r;XDj$7$F$$$k>l9g$O!"%G!<%?%U%j%C%H$KIUB0$9$k WWE %U%#!<%k%IKh$j!"=q$-9~$_$r9T$ word $r;XDj$9$k!# MBP $*$h$S3F%-%c%C%7%e$O!"3F!9BP1~9k=q$-9~$_F0:n$r9T$J$&!#

write_req %Q%1%C%HF0:n$N>\:Y$O!"%"%I%l%9!&%U%j%C%H$K4^$^lk3F%U%#!<%k%INCMKhjDjailk!#FC CCBL!" ACK %U%#!<%k%INCMOF0:nrBg-$/5,Dj$9$k!#

ACK %U%#!<%k%I$,#1$N>l9g!" CC !? CPU $K write A`:n$N=*N;$r X_PEND ?.9f$r2p7FDLCN9k!##0$N>l9g!' CC !? CPU $O write =hM}$rBT$A9g$o$;$J$$!#

Cm#1!' write_req $O!"5~Bg;EMM=q$N No-Allocate Write Request, Self-Cleanup Write Request $KBP1~$9$k!# No-Allocate Write Reauest, Self-Cleanup Write Request $O CCBL $,#0$H7FM?$($ilk!# No-Allocate Write Request $H Self-Cleanup Write Request $O ;H$olk>lLL$G6hJL$5lk!#

Cm#2!' V3.0 0J9_GOI,$:%9%L!<%W$,9TJolk$?$a!" DID %U%#!<%k%I$O don't care G"$k!#

Cm#3!' V3.4 0J9_!"%-%c%C%7%e$+$i$N writeback $O %j%W%i%$%l%Y%k$N%Q%1%C%H$G$"$k writeback_reply $G<B8=$5lk

%U%#!<%k%IL>	5-=R
ADDR27:0]	=q$-9~$_BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"$j!" #0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G$"$k!"9JoA no-allocate-write $^$?$O self-cleanup G"k3Hr<($9!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
SNOOP_CNTL[2:0]	SNOOP_CNTL %U%#!<%k%I$O!"%Q%1%C%H$,%9%L!<%WA`:n$rH<$&>l 9g$K;HMQ$5lk!# write_req GO CLSH $@$1$,M-8z$G$"$k!# **CLSH** CLSH %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_%V%m%C%/$(CLSH)global>u BV$G$"$k3H$r<($9!#
F/E bits	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C%H!#$?$@$7!" F !? E %S%C%H$N0LCV$O!"%V%m%C%/$N@hF,%"%I%l%9$NG!2?K+$+$oi:!"%V%m%C%/6-3&$K@0Ns$7$F $$$k!#
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#%5%$%: $, block G"$k>l9g!"#5%U%j%C%H$r;}$D%Q%1%C%H$HJj!"$=$l0J 30$N>l9g #2%U%j%C%H$r;}$D%Q%1%C%H$HJk!# SIZE $G masked block $r;XDj$7$F$$$k>l9g$O!"#3#2%S%C%HC10L$G!" WWE %S%C%HKh$j %G!<%?$NM-8z@-$r<($7!"M-8zG"$k8l$@1,=q$-9~$_BP>]HJ$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$&$?$a!" all $r;XDj$9$k
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# write_req %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU2C9k
ACK	write A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#
DATA[63:0]	=q$-9~$_%G!<%?!#=q$-9~$_D9Kh$j!"#1 %G!<%?%U%j%C%H$^$?$O#4%G!<%?%U%j%C%HHJ$k!# ADDR %U%#!<%k%I$,%V%m%C%/6-3&$r;X$7$F$$$J$$>l9g!"=q$-9~$_%G!<%?$OEv3:%V%m%C%/ Fb$G!"%"%I%l%9$G;XDj$5l? double word $,@hF,$G$"$j!"0J8e%V%m%C%/Fb>:=g!Jmod 4!K $GE>Aw$5lk!#
WWE[1:0]	=q$-9~$_%$%M!<%V%k?.9f!# SIZE $, masked block G"$k>l9g$@$1M-8zG"$k!#Ev3:%G!< %?%U%j%C%HCf=q$-9~$_$r9T$J$& word $r;XDj$9$k!##1$N>l9g=q$-9~$_$r9T$J$&!# ADDR %U%#!<%k%I$,%V%m%C%/6-3&$r;X$7$F$$$J$$>l9g!"=q$-9~$_%G!<%?$OEv3:%V%m%C%/$J$$$G!" %"%I%l%9$G;XDj$5l? double word $,@hF,$G$"$j!"0J8e%V%m%C%/Fb>:=g!Jmod 4!K$GE>Aw 5l$k!#

4.3.9 writeback_reply

writeback_reply $O!"%P%9$K@\B3$5$l$?%a%b%j$X$N%3%R!<%l%s%H=q$-9~$_MW5a$G$"$k!# writeback_reply $O%-%c%
%7%e%a%b%j$+$i$N %i%$%H%P%C%/$KMQ$$$ilk!#

writeback_reply $NF0:n$O!"%"%I%l%9%U%j%C%HCf!"%9%L!<%W%3%s%H%m!<%k%U%#!<%k%I$N **CLSH** %S%C%H$NCM$
hjBg$-$/$+$o$k!# CLSH==1 $N>l9g!"%[!<%`$^$G=q$-La$9 writeback_to_home $N0U$G$"$j!" CLSH == 0 $N
>l9g!"%-%c%C%7%e$,B0$9$k%/%i%9%?Fb$N%/%i%9%?%a%b%j$^$G=q$-La$9!#=>CF!"B>$N%j%/%(%9%H%Q%1%C%H$K$*
CLSH %S%C%H$O%-%c%C%7%e%V%m%C%/$N>uBV!J**global/local**!KKhjCM,Dj$^$k$,!" **writeback_reply** K*$$$F$O
CPU $+$iM?$($ilk%3%^%s%IKh$j!" **CLSH** %S%C%H$NCM$,7hDj$9$k!"Nc30E*F0:n$rMW5a9k!#

writeback_reply $N%Q%1%C%HD9$O!"=q$-9~$`%G!<%?$,%V%m%C%/$G$"$k$?$a!"#5G"$k!#

ACK %U%#!<%k%I$,#1$N>l9g!" CC !? CPU $K writeback A`:n$N=*N;$r X_PEND ?.9f$r2p7FDLCN9k!##0$N>l
9g!" CC !? CPU $O write =hM}$rBT$A9g$o$;$J$$!#

Cm#1!' writeback_reply $O!">>K\;EMM=q$N c_writeback, 5~Bg;EMM=q$N Write-back $KBP1~$9$k!#
Cm#2!' V3.0 0J9_GOI,$:%9%L!<%W$,9TJolk$?$a!" DID %U%#!<%k%I$O all $r;XDj$9$k!#Cm#3!' writeback_reply $O V3.4 $G?
@_5l$?!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	=q$-9~$_BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$O#1$G$"$kI,MW$,$"$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
SNOOP_CNTL[2:0]	SNOOP_CNTL %U%#!<%k%I$O!"%Q%1%C%H$,%9%L!<%WA`:n$rH<$&>l 9g$K;HMQ$5$l$k!# writeback_reply $G$O CLSH $@$1$,M-8z$G$"$k!# **CLSH** CLSH %S%C%H$,#1$G$"$k>l9g!" writeback $,%[!<%`$^$G 5ZV3Hr<($7!"#0$G$"$k>l9g$O!"%3%T!<%Z!<%8$N>l9gEv3: %/%i%9%?Fb$^$G7+ writeback 7J$$$3Hr<($9!#=>$C$F!" Fs<!%-%c%C%7%e$, CPU $+$i$N%"%I%l%9>e0L$K=>CF@_Dj$9 $k!#
F/E bits	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C%H!#$?$@$7!" F !? E %S%C%H$N0LCV$O!"%V%m%C%/$N@hF,%"%I%l%9$NG!2?K+$+$oi:!"%V%m%C%/6-3&$K@0Ns$7$F $$$k!#
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#%5%$%: $, block G"$k>l9g!"#5%U%j%C%H$r;}$D%Q%1%C%H$HJk!# masked block G"$k>l9g$O!"#3#2%S%C%HC10L$G!" WWE %S%C%H$Khj%G!< %?$NM-8z@-$r<($7!"M-8zG"$k8l$@1,=q$-9~$_BP>]$HJk!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$&$?$a!" all $r;XDj$9$k
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# writeback_reply %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU 2C9k
ACK	write A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#
DATA[63:0]	=q$-9~$_%G!<%?!# writeback_reply GO#4%G!<%?%U%j%C%HHJ$k!# ADDR %U%#!<%k%I$,%V %m%C%/6-3&$r;X$7$F$$$J$$>l9g!"=q$-9~$_%G!<%?$OEv3:%V%m%C%/Fb$G!"%"%I%l%9$G;XDj$5 l? double word $,@hF,$G$"$j!"0J8e%V%m%C%/Fb>:=g!Jmod 4!K$GE>Aw$5lk!#
WWE[1:0]	=q$-9~$_%$%M!<%V%k?.9f!# SIZE $, masked block G"$k>l9g$KEv3:%G!<%?%U%j%C%HCf=q $-9~$_$r9T$J$& word $r;XDj$9$k!##1$N>l9g=q$-9~$_$r9T$J$&!# ADDR %U%#!<%k%I$,%V %m%C%/6-3&$r;X$7$F$$$J$$>l9g!"=q$-9~$_%G!<%?$OEv3:%V%m%C%/$J$$$G!"%"%I%l%9$G;XDj 5l$? double word $,@hF,$G$"$j!"0J8e%V%m%C%/Fb>:=g!Jmod 4!K$GE>Aw$5lk!#

4.3.10 non_coherent_write_req

non_coherent_write_req $O!"Fs<!%-%c%C%7%e%a%b%j$+$i!"%P%9$K@\B3$5$l$?%a%b%j$X$NHs%3%R!<%l%s%H=q$-9~MW5aG"$k!# non_coherent_write_req $N%Q%1%C%HD9$O!"=q$-9~$`%G!<%?$,%V%m%C%/$N>l9g#5G"$j!"$=$NB>$N>l#2G"$k!#3F%G!<%?%U%j%C%H$N WWE %U%#!<%k%I$,#1$G$"$k word KD$$$F =q$-9~$_$r9T$J$&!# MBP $O!"3F!1~$9$k=q$-9~$_F0:n$r9TJ&!#

non_coherent_write_req %Q%1%C%HF0:n$N>\:Y$O!"%"%I%l%9!&%U%j%C%H$K4^$^lk3F%U%#!<%k%INCMKhjDjal$k!#FC$K!" CCBL, ACK %U%#!<%k%INCMOF0:nrBg-$/5,Dj$9$k!#

CCBL $,#1$N>l9g!" non_coherent_write_req $OHs%3%R!<%l%s%H$J%-%c%C%7%e$+$i$N writeback G"$j!" CCBL $,#0$N>l9g!"Hs%3%R!<%l%s%H$J non cacheable write G"$k!#

non_coherent_write_req $NF14|;XDj$O!"#M#B#PA`:n5/F0N?aKMQ$$$ilk!#8e=R non_coherent_write_M_req $r;2>H$N3H!#

Cm#1!' non_coherent_write_req $O V3.0 $K >>K\;a$NMW5aKh$j:n@.$5l?!#

Cm#2!' DID %U%#!<%k%I$O!"%9%L!<%W%"%/%;%9$r9TJo$J$$$?$a#M#B#P$K@_Dj9kI,MW$,$"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	=q$-9~$_BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3Hr<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K%P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"k3Hr<($9!##0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G$"$k3H$r<($9!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r<($9
F/E bits	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C%H!#%G!<%?%5%$%:$NG!2?$K78$oi:!">o$K%V%m%C%/6-3&$K@0Ns7?0LCV$G>pJs$,<(5l$k
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#%5%$%:$, block G"$k>l9g!"#5%U%j%C%H$r;}$D%Q%1%C%H$HJj!"$=$l0J30$N>l9g #2%U%j%C%H$r;}$D%Q%1%C%H$HJk!#$$$:lN>l9g$b!"#3#2%S%C%HC10L$G!" WWE %S%C%HKh$j%G!<%?$NM-8z@-$r<($7!"M-8zG"$k8l$@1,=q$-9~$_BP>]HJ$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$JoJ$$$?$a!"#M#B#P$r;XDj9kI,MW$,$"$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# non_coherent_write_req %Q%1%C%H$N>l9g0UL#$,$J$$$,!"%G%P%0JI$NJX59>eIU2C$9$k
ACK	non_coherent_write A`:n$,=*N;$7$?;~E@$G X_PEND ?.9frJV9$3$H$r;XDj$9$k!# ACK $,#1$N>l9g!" X_PEND ?.9frJV9
DATA[63:0]	=q$-9~$_%G!<%?!#=q$-9~$_D9Kh$j!"#1 %G!<%?%U%j%C%H$^$?$O#4%G!<%?%U%j%C%HHJ$k!#=q$-9~$_%5%$%:$,#1%V%m%C%/$N>l9g!" ADDR %U%#!<%k%I$G;XDj$5l? double word $,:G=i$N%G!<%?!&%U%j%C%HHJ$j0J8e>:=g!Jmod 4!K$GE>Aw5l$k!#
WWE[1:0]	=q$-9~$_%$%M!<%V%k?.9f!# SIZE $, masked block G"$k>l9g!"Ev3:%G!<%?%U%j%C%HCf=q$-9~$_$r9T$J$& word $r;XDj$9$k!##1$N>l9g=q$-9~$_$r9T$J$&!#=q$-9~$_%5%$%:$,#1%V%m%C%/$N>l9g!" ADDR %U%#!<%k%I$G;XDj$5l? double word $,:G=i$N%G!<%?!&%U%j%C%HHJ$j0J8e>:=g!Jmod 4!K$GE>Aw5l$k!#

4.3.11 non_coherent_write_M_req

non_coherent_write_M_req $O!"%a%b%j$X$N m F14|$D$-!J#M#B#P%3%"8F$S=P7K;HMQ$5$1$k!KHs%3%R!<%l%s%H=$-9~$_MW5a$G$"$k!# non_coherent_write_M_req $N%Q%1%C%HD9$O!"=q$-9~$`%G!<%?$,%V%m%C%/$N>l9g#5G"$j!"$=B>$N>l9g#2$G$"$k!#3F%G!<%?%U%j%C%H$N WWE %U%#!<%k%I$,#1G"$k word KD$$$F =q$-9~$_$r9T$J$&!# MBI$h$S3F%-%c%C%7%e$O!"3F!9BP1~9k=q$-9~$_F0:n$r9T$J$&!# non_coherent_write_M_req %Q%1%C%HF0:n$N>\:Y$O!"%I%l%9!&%U%j%C%H$K4^$^lk3F%U%#!<%k%INCMKhjDjailk!#FC$K!" CCBL, ACK %U%#!<%k%I$NCM$OF0:n$-$/5,Dj$9$k!#

Cm#1!' non_coherent_write_M_req $O V3.0 $K >>K\;a$NMW5aKh$j:n@.$5l?!#

Cm#2!' DID %U%#!<%k%I$O!"%9%L!<%W%"%/%;%9$r9TJo$J$$$?$a#M#B#P$K@_Dj9kI,MW$,$"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	=q$-9~$_BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3Hr<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K%P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"k3Hr<($9!##0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G$"$k3H$r<($9!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r<($9
F/E bits	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C%H
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#%5%$%:$, block G"$k>l9g!"#5%U%j%C%H$r;}$D%Q%1%C%H$HJj!"$=$l0J30$N>l9g #2%U%j%C%H$r;}$D%Q%1%C%H$HJk!# SIZE $, masked block G"$k>l9g!"#3#2%S%C%HC10L$G WWE %S%C%HKh$j%G!<%?$NM-8z@-$r<($7!"M-8zG"$k8l$@1,=q$-9~$_BP>]HJ$k!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$JoJ$$$?$a!"#M#B#P$r;XDj9kI,MW$,$"$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# non_coherent_write_M_req %Q%1%C%H$N>l9g!"0lHL$K%j%W%i%$$OMW5a7J$$$,#M#B#P$KAw?.85Fs<!%-%c%C%7%e$rDLCN9k$?$a$KMQ$$$ilk
ACK	non_coherent_write A`:n$,=*N;$7$?;~E@$G X_PEND ?.9frJV9$3$H$r;XDj$9$k!# ACK $,#1$N>l9g!" X_PEND ?.9frJV9
DATA[63:0]	=q$-9~$_%G!<%?!#=q$-9~$_D9Kh$j!"#1 %G!<%?%U%j%C%H$^$?$O#4%G!<%?%U%j%C%HHJ$k!#%G!<%?D9$,#1%V%m%C%/$N>l9g!" ADDR %U%#!<%k%I$G<(5l$k double word $r@hF,$N%G!<%?!&%U%j%C%HH7FAwj!"0J8e>:=g!Jmod 4!K$N=g$G%V%m%C%/$rE>Aw$9$k
WWE[1:0]	=q$-9~$_%$%M!<%V%k?.9f!#Ev3:%G!<%?%U%j%C%HCf=q$-9~$_$r9T$J$& word $r;XDj$9$k!##1$N>l9g=q$-9~$_$r9T$J$&!#%G!<%?D9$,#1%V%m%C%/$N>l9g!" ADDR %U%#!<%k%I$G<(5l$k double word $r@hF,$N%G!<%?!&%U%j%C%HH7FAwj!"0J8e>:=g!Jmod 4!K$N=g$G%V%m%C%/$rE>Aw$9$k

4.3.12 swap_req

swap_req $O!"%P%9$K@\B3$5$l$?%a%b%j$X$N%9%o%C%WMW5a$G$"$j!"%Q%1%C%HD9$O#2$G$"$k!#%j%/%(%9%H$, Non- $N>l9g$K$O!" MBP KBP9$k <+L@$N %9%o%C%WMW5aG"$j!"F0:n$N7k2L reply %Q%1%C%HH7FJVk!#%j%/%(%9% %-%c%C%7%c%V%k$N>l9g$K$O3F%-%c%C%7%e$O!" update %W%m%H%3%k$KBP1~$9$k%9%o%C%WF0:n$r9TJ&$?$a!" swap $r;HMQ$7$J$$!#=>CF CCBL==1 $N swap_req %Q%1%C%H$NF0:n$ODj5A$5lJ$$!#

swap_req GO 8BDj5l$?F14|%W%j%_%F%#%V$,;HMQ2DG=G"$k!#$9Jo$A!"#M#B#P$K0MMj9kF14|%W%j%_%F G"$k!#$3lO!" PCMD $*$h$S SCMD $N0lIt$G;XDj5l$k!#E,MQ2DG=$JF14|$O swap-m G"$k!#
Cm#1!' swap_req $O!">>K\;EMM=q$N c_swap_req, 5~Bg;EMM=q$N Swap Request $KBP1~$9$k!# c_swap_req $O CCBL $,#0$N>l9g$K BP1~$9$k!#

Cm#2!' DID %U%#!<%k%I$O all G"$k!# swap_req $O non cacheable $N>l9g$N$_0UL#$r;}D,!"%3%R!<%l%s%H$J%W%m%H%3%k$I B'k?$a all H7$F07$&!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%9%o%C%WBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	;HMQ7J$$
CCBL	swap_req GO CCBL==1, 9JoA%N%s%-%c%C%7%c%V%kG"$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"%9%o%C%WMW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
F/E bits	;HMQ7J$$
SIZE[2:0]	SIZE %U%#!<%k%I$O%9%o%C%WBP>]$N%G!<%?$N%5%$%:$r<($9!#%9%o%C %W$O SPARC $N SWAP $*$h$S LDSTUB L?Na$,860xG"k? $a!"%5%$%:$O%P%$%H!"$^$?$O%o!<%I$G$"$j!"#2%U%j%C%H$r;}$D%Q %1%C%HHJ$k
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$& read_req $OEvA3A4$F$N%-%c%C%7%e $*$h$S MBP $G8+$kI,MW$,$"k?$a all G"$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# swap_req %Q%1%C%H$N>l9g reply %Q%1%C%H$NAw?.@hHJ$k
ACK	PEND ?.9fKh$k40N;DLCN;XDj!#I,$:#0$r;XDj$9$k
DATA[63:0]	=q$-9~$_%G!<%?!# swap_req GO#1 %G!<%?%U%j%C%HG"$k!#
WWE[1:0]	;HMQ7J$$!#

4.3.13 swap_M_req

swap_M_req $O!"%P%9$K@\B3$5$l$?JVCM$rI,MWH9$k#M#B#P8F$S=P$7MW5a$G$"$j!"%Q%1%C%HD9$O#2$G$"$k!#%(%9%H$O Non-cacheable G"$j!" MBP KBP9$k 5/F0MW5a$G$"$j!"F0:n$N7k2L swap_M_reply %Q%1%C%HH7FJVk!#

ACK %U%#!<%k%I$,#1$G$"$k>l9g!" swap_M_req $,=hM}Cf$G$"$k3H$,!" X_PEND ?.9f$Khj SID %U%#!<%k%I$G;XDj$5lk CC $r7PM3$7$F CPU $KDLCN$5lk!# ACK %U%#!<%k%I$,#0$G$"$k>l9g$O!"#M#B#P$K$*$1$kA`:n$O$K CC !? CPU $HFHN)$G$"$j!" X_PEND ?.9fKh$k=*N;DLCN$O9TJolJ$$!#

Cm#1!' swap_M_req $O!">>K\;EMM=q$N c_swap_M_req $KBP1~$9$k!#

Cm#2!' DID %U%#!<%k%I$O%9%L!<%W$r9TJo$J$$$?$a!" MBP $r;XDj$9$k

%U%#!<%k%IL>	5-=R
ADDR27:0]	MBP 5/F0BP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	;HMQ7J$$
CCBL	CCBL %S%C%H$O#0$G$"$j!"%N%s%-%c%C%7%c%V%k$N>l9g$N$_F0:n$,5,Dj5l$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"%9%o%C%WMW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
F/E bits	;HMQ7J$$
SIZE[2:0]	SIZE %U%#!<%k%I$O%9%o%C%WBP>]$N%G!<%?$N%5%$%:$r<($9!#%9%o%C %W$O SPARC $N SWAP $*$h$S LDSTUB L?Na$,860xG"k? $a!"%5%$%:$O%P%$%H!"$^$?$O%o!<%I$G$"$j!"#2%U%j%C%H$r;}$D%Q %1%C%HHJ$k
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$JoJ$$ swap_M_req GO#M#B#P$r;XDj 9k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# swap_M_req %Q%1%C%H$N>l9g reply %Q%1%C%H$NAw?.@hHJ$k
ACK	swap_M_req A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#
DATA[63:0]	=q$-9~$_%G!<%?!#=q$-9~$_D9Kh$j!"#1 %G!<%?%U%j%C%H$^$?$O#4%G!<%?%U%j%C%HHJ$k!#
WWE[1:0]	=q$-9~$_%$%M!<%V%k?.9f!#Ev3:%G!<%?%U%j%C%HCf=q$-9~$_$r9T$J$& word $r;XDj$9$k!##1 $N>l9g=q$-9~$_$r9TJ&!#

4.3.14 update_direct_req

update_direct_req $O!"%P%9$K@\B3$5$l$?%-%c%C%7%e$*hS%a%b%jXND>@\%"%C%W%G!<%HMW5aG"$k!# update_d $N%Q%1%C%HD9$O!"%V%m%C%/$r=q$-9~$`>l9g$K$O#5$G$"$j!"$=$l0J30$N>l9g$O#2G"$k!#%j%/%(%9%H$,%-%c%C%7 $N>l9g$K$O3F%-%c%C%7%e$O!" update %W%m%H%3%k$KBP1~$9$kF0:n$r9TJ&!# update_direct_req %Q%1%C%HF0:n$N>\ $O!"%"%I%l%9!&%U%j%C%H$K4^$^$l$k3F%U%#!<%k%I$NCMKhjDjail$k!#FC$K!" CCBL, ACK %U%#!<%k%I$NCM :n$rBg$-$/5,Dj9k!#

update_direct_req $O!"3F%Z!<%8$N%[!<%`Kh$k%7%j%"%i%$%:$r7P$:!"D>@\E*$K%"%C%W%G!<%H$9$k%W%m%H%3%k$ aN%P%9%3%^%s%IG"$j!"%3%^%s%I$NO@M}E*=*N;$O MBP $+$iMW5a85$N%-%c%C%7%e%3%s%H%m!<%i$+$iD>@\E*$K= $k PEND ?.9f$KhjH=CG5l$k!#=>$C$F!" update_direct_req KBP9$k%j%W%i%$$OB8:_7J$$!#

update_direct_req $,3FFs<!%-%c%C%7%e$Khj<uM}5lkH!"Fs<!%-%c%C%7%e$,Ev3:%V%m%C%/$rJ];}9k>l9gD $K update F0:n$,9TJolk!##M#B#P$O<uM}$7$?7k2L!"I,MW$JB>%/%i%9%?$r update 9kEy$NF0:n$r9TJ&!#

ACK %U%#!<%k%I$,#1$G$"$k>l9g!" update_direct_req $,=hM}Cf$G$"$k3H$,!" X_PEND ?.9f$Khj SID %U%#!< %k%I$G;XDj$5lk CC $r7PM3$7$F CPU $KDLCN$5lk!# ACK %U%#!<%k%I$,#0$G$"$k>l9g$O!"#M#B#P$K$*$1$kA` 40A4$K CC !? CPU $HFHN)$G$"$j!" X_PEND ?.9fKh$k=*N;DLCN$O9TJolJ$$!#

J*!"0lEY 3F%Z!<%8$N%[!<%`$G%7%j%"%i%$%:$9$k%"%C%W%G!<%HMW5a$H7F!" update_via_home_req $,B8:_$9$k $^$?!" s-write $r<B8=$9$kF14|%W%j%_%F%#%V$H7F update_direct_S_req $,B8:_$9$k!#

Cm#1!' update_direct_req $O!">>K\;EMM=q$N c_update!" 5~Bg;EMM=q$N Update Request $KBP1~$9$k!#

Cm#2!' update_direct_req $O%9%L!<%W$r9TJ&$?$a!" DID %U%#!<%k%I$O don't care G"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%"%C%W%G!<%HBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	F !? E bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%k$G$"$k $3$H$r<($9!#$9$J$o$A!"DL>o$N%"%C%W%G!<%HA`:n$G$O CCBL $,#1$G$"$kI,MW$,$"$k!# #0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G$"$k3H$r<($9!# non-cacheable $J>l9g$NF0 :n$O implementation 0MB8$G$"$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"%"%C%W%G!<%HMW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk$3 Hr<($9
FE	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C%H
SIZE[2:0]	SIZE %U%#!<%k%I$O%"%C%W%G!<%HBP>]$N%G!<%?$N%5%$%:$r<($9!# SIZE $, byte, half, word, double G"$k>l9g$O #2%U%j%C%H$r;}$D%Q %1%C%HHJ$j!"BP>]$,%V%m%C%/G"$k>l9g$K$O#5%U%j%C%H$r;}$D %Q%1%C%H$HJk
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$& update_direct_req GO all G"$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# ACK %U%#!<%k%I$N;XDj$Khj acknowledge ?.9frJV9>l9g$K ;HMQ$5lk!#
ACK	rdinv A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#
DATA[63:0]	=q$-9~$_%G!<%?!#=q$-9~$_D9Kh$j!"#1 %G!<%?%U%j%C%H$^$?$O#4%G!<%?%U%j%C%HHJ$k!#
WWE[1:0]	=q$-9~$_%$%M!<%V%k?.9f!#Ev3:%G!<%?%U%j%C%HCf=q$-9~$_$r9T$J$& word $r;XDj$9$k!##1 $N>l9g=q$-9~$_$r9TJ&!#

4.3.15 update_direct_S_req

update_direct_S_req $O!"@8;:<T – >CHq<TF14 | $r<B8=$9$k s-write MW5a$G$"$k!#F14 | 0J30$NE@$G$O!" update_direct_
$K=`5r$9$k!#

J*!"0lEY 3F%Z!<%8$N%[!<%`$G%7%j%"%i%$%:$9$k s-write H7$F!" update_via_home_S_req $,B8:_$9$k!#

Cm#1!' update_direct_S_req $O!">>K\;EMM=q$N c_update_S $KBP1~$7!" 5~Bg;EMM=qKOBP1~9kbNOJ$$

Cm#2!' update_direct_S_req $O%9%L!<%W$r9TJ&$?$a!" DID %U%#!<%k%I$O don't care G"$k!#

4.3.16 update_via_home_req

update_via_home_req $O!"%-%c%C%7%e$KBP9k%[!<%`%Z!<%8$r7PM3$7$?%"%C%W%G!<%HMW5a$G$"$k!# update_via_h $N%Q%1%C%HD9$O!"%V%m%C%/$,BP>]$N>l9g$O#5$G$"$k!"$=$NB>$N>l9g$K$O#2$G$"$k!#%j%/%(%9%H$,%-%c%C%7%c%V 9g$K$O%[!<%`Kh$j%7%j%"%i%$%:$r7P$?NA!" MBP $+$i update_req %Q%1%C%HKh$j3F%-%c%C%7%e$, update $5 $k!# update_via_home_req %Q%1%C%HF0:n$N>\:Y$O!"%"%I%l%9!&%U%j%C%H$K4^$^lk3F%U%#!<%k%INCMKhjDj$a lk!#FC$K!" CLSH!" CCBL, ACK %U%#!<%k%INCMOF0:nrBg-$/5,Dj$9$k!#

update_via_home_req $O!"3F%Z!<%8$N%[!<%`Kh$k%7%j%"%i%$%:$r7P$k$?$a!" update_direct_req hj9-HO0O$N 1~MQ$,2DG=G"$k!#

update_via_home_req %Q%1%C%H$O!"F14|%W%j%_%F%#%V$HF1;~$K;HMQ$9k3H,2DG=G"$k!#F14|%W%j%_%F%#%V PCMD $*$h$S SCMD %U%#!<%k%I$N0lItH7$F;XDj$5lk!#E,1~2DG=$JF14|%W%j%_%F%#%V$O s-write G"$k!#

Cm#1!' update_via_home_req $O!">>K\;EMM=q$N c_up_req $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbN$,$J$$!#

Cm#2!' update_via_home_req %Q%1%C%H$O!"MW5aE>Aw$NCJ3,GO%9%L!<%W$r9T$Jo:!"#M#B#P7PM3$G home $N#M#B#P$KAwil$k =>$C$F!" DID %U%#!<%k%I$O!"$$$:l+$N#M#B#P$r;XDj9kI,MW$,$"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%"%C%W%G!<%HBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	FE bits $N2r<a$KMQ$$$ilk%"%/%;%9$N6K@-
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%k$G$"$k $3$H$r<($9!#$9$J$o$A!"DL>o$N%"%C%W%G!<%HA`:n$G$O CCBL $,#1$G$"$kI,MW$,$"$k!# #0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G$"$k3H$r<($9!#9JoA!"C1Jk=q$-9~$^ $?$O!"#3<!%-%c%C%7%e$@$1$r;H$C$?J}<0$N>l9gG"$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"%"%C%W%G!<%HMW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk$3 Hr<($9
FE	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C%H
SIZE[2:0]	SIZE %U%#!<%k%I$O%"%C%W%G!<%HBP>]$N%G!<%?$N%5%$%:$r<($9!# SIZE $, byte, half, word, double G"$k>l9g$O #2%U%j%C%H$r;}$D%Q %1%C%HHJ$j!"BP>]$,%V%m%C%/G"$k>l9g$K$O#5%U%j%C%H$r;}$D %Q%1%C%H$HJk
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!# update_via_home_req GO all $r;XDj$9$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# ACK %U%#!<%k%I$G;XDj$,$"$k>l9g!" X_PEND rJV9 CC $r ;XDj$9k?aKMQ$$$ilk!#$H6&$K!"JV;vK"$?$k update_req $N9T$-@hHJ$k!#
ACK	update_via_home A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#
DATA[63:0]	=q$-9~$_%G!<%?!#=q$-9~$_D9Kh$j!"#1 %G!<%?%U%j%C%H$^$?$O#4%G!<%?%U%j%C%HHJ$k. %G!<%?=g$K4X7F$O!" write_req $N9`L\$r;2>HN3$H
WWE[1:0]	=q$-9~$_%$%M!<%V%k?.9f!# SIZE = masked block $N>l9g$KEv3:%G!<%?%U%j%C%HCf=q$- 9~$_$r9T$J$& word $r;XDj$9$k!##1$N>l9g=q$-9~$_$r9T$J$&!# WWE $N=g$K$D$$$F$O!" write_req $r;2>H$N3H!#

4.3.17 update_via_home_S_req

update_via_home_S_req $O!"%[!<%`%Z!<%8$r7PM3$7$? s-write F14|%"%/%;%9MW5a$G$"$k!#$=$NB>$NE@$G$O!" update_via_home_req $K=`5r$9$k!#

update_via_home_S_req $O!"3F%Z!<%8$N%[!<%`Kh$k%7%j%"%i%$%:$r7P$k$?$a!" update_direct_S_req hj9-HO 0O$N1~MQ$,2DG=G"$k!#

Cm#1!' update_via_home_S_req $O!">>K\;EMM=q$N c_up_S_req $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbN$,$J$$!#

4.3.18 update_via_home_Q_req

update_via_home_Q_req $O!"%[!<%`%Z!<%8$r7PM3$7$? q-write F14|%"%/%;%9MW5a$G$"$k!#%j%/%(%9%H$,%-%c%C %7%c%V%k$N>l9g$K$O%[!<%`$Khj%7%j%"%i%$%:$r7P$?$N$A!" MBP $+$i update_Q_req %Q%1%C%HKh$j3F%-%c%C% $, update 5l$k!#

$=$NB>$N=tE@$G$O!" update_via_home_Q_req $O update_via_home_req $K=`5r$9$k!#

update_via_home_Q_req $O!"0lHL$K rdinv_Q_req HBPH7FMQ$$$ilk!#

Cm#1!' update_via_home_Q_req $O!">>K\;EMM=q$N c_up_Q_req $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbN$,$J$$!#

4.3.19 invalidate_via_home_req

invalidate_via_home_req $O!"%-%c%C%7%e$*hS%3%T!<%Z!<%8KBP9$k%[!<%`%Z!<%8$r7PM3$7$?%$%s%P%j%G!<%H 5a$G$"$j!"%Q%1%C%HD9$O#1$G$"$k!#%j%/%(%9%H$, Non-cacheable $N>l9g$NF0:n$OL$Dj5A$G$"$j!"%j%/%(%9%H$,%- %7%c%V%k$N>l9g$K$O%[!<%`$Khj%7%j%"%i%$%:$r7P$?$N$A!" MBP $+$i rdinv_reply %Q%1%C%HKh$j3F%-%c%C%7% invalidate 5l$k!#

ACK %U%#!<%k%I$,#1$G$"$k>l9g!" invalidate_via_home_req $,=hM}Cf$G$"$k3H$,!" X_PEND ?.9f$Khj SID %U%#!<%k%I$G;XDj$5lk CC $r7PM3$7$F CPU $KDLCN$5lk!# ACK %U%#!<%k%I$,#0$G$"$k>l9g$O!"#M#B#P$K$*$ A`:n$O40A4$K CC !? CPU $HFHN)$G$"$j!" X_PEND ?.9fKh$k=*N;DLCN$O9TJolJ$$!#

J*!" invalidate_direct_req $OGQ;_$5l^7?!#

Cm#1!' invalidate_via_home_req $O!">>K\;EMM=q$N c_inv_req $KBP1~$7!"5~Bg;EMM=q$N Invalidation Request $KBP1~$9$k!#$3$N %Q%1%C%H$KBP9k%j%W%i%$$O rdinv_reply %Q%1%C%H$G9T$Jol$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%$%s%P%j%G!<%HBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	;HMQ7J$$
CCBL	CCBL %S%C%H$O#1$G$"$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"%$%s%P%j%G!<%HMW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9T$Jol$k 3H$r<($9
FE	;HMQ7J$$
SIZE[2:0]	<B$O!" SIZE %U%#!<%k%I$O don't care G"$k
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!# invalidate_via_home_req GO!"%7%j%"%i%$%:$K$D$$ $F#M#B#P$K@UG$$,$"$k$,!"%9%L!<%W$rMQ$$$k$?$a all $r;XDj$9kI,MW,$"$k!#
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!#
ACK	invalidate A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#

4.3.20 cflush_req

cflush_req $O!"%-%c%C%7%e%a%b%j$N%V%m%C%/$r%[!<%`$^$G%U%i%C%7%e$9$kL?Na$G$"$j!"%Q%1%C%HD9$O#5$G$"$I

ACK %U%#!<%k%I$,#1$G$"$k>l9g!" cflush_req $,=hM}Cf$G$"$k3H$,!" X_PEND ?.9f$Khj SID %U%#!<%k%I$G ;XDj$5lk CC $r7PM3$7$F CPU $KDLCN$5lk!# ACK %U%#!<%k%I$,#0$G$"$k>l9g$O!"#M#B#P$K$*$1$kA`:n$O40A CC !? CPU $HFHN)$G$"$j!" X_PEND ?.9fKh$k=*N;DLCN$O9TJolJ$$!#

cflush_req $NF0:n$O!" global $CLSH !a#1!K write_req $HN`;w$G$"$k$,!" home $^$G=q$-La$9$H6&$K!"B8:_$9 $kA4$F$N%3%T!<%Z!<%8$*hSA4FN%-%c%C%7%e>e%V%m%C%/$r invalidate 9k3H$,0[$JCF$$$k!#

cflush_req $,3F%-%c%C%7%e$*hS#M#B#PKh$j<uM}$5lk$H!"$^$: retry 9k3H$,8!::$5lk!#$^$?Fs<!%-% %7%eGO!" MSH,CRPLY ?.9f$O!"%V%m%C%/Fb>uBV$NG!2?K+$+$oi:>o$K assert 7J$$!#<!$K!"%/%i%9%?FbFs< %7%e$KB8:_9kEv3:%V%m%C%/$,A4$F>C5n5l!"%3%T!<%Z!<%8G"$k>l9g$O!"#M#B#P$,%/%i%9%?%a%b%j>e$+$i $7!" home XH writeback %G!<%?$rAwIU$9$k!# home %Z!<%8$G$"$k>l9gKO!"%/%i%9%?%a%b%j$X=q$-9~$`!#B3$$ home $+$iA4FN%3%T!<%Z!<%8$r;}$D%/%i%9%?$NEv3:%Z!<%8!?%V%m%C%/$r invalidate 7F=hM}$,=*N;$9$k!#

Cm#1!' cflush_req $O!">>K\;EMM=q$N c_writeback_to_home_with_inv $KBP1~$7, 5~Bg;EMM=qKOBP1~9k%j%/%(%9%H$OB8:_$7$J $$!#

Cm#2!' DID %U%#!<%k%I$O!"%9%L!<%W%"%/%;%9$JNG all $r;XDj$9$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%U%i%C%7%eBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	HOME $,#1 G"$k>l9g!" ADDR %U%#!<%k%I$G;XDj9kBP>]$, home page G"k3$H $r<($9
DUMMY	DUMMY $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$,%@%_!<%Z!<%8G"k3 Hr;XDj9k
OW_CH	OW_CH (Owner Change) $,#1$G$"$k>l9g!" ADDR %U%#!<%k%I$G;XDj$9$kBP>]$, Owner rBX(k3H,I,MW$J6&M-%"%/%;%9$G$"$k3H$r<($9!#
LARGE	LARGE $, #1 G"$k>l9g ADDR %U%#!<%k%I$G;XDj9kBP>]$, %i!<%8%Z!<%8 !J#2#5#6#K %P%$%HC10L!K$K$"$k3H$r<($9
FEPOL	;HMQ7J$$
CCBL	cflush_req O=$NK\<A>e CCBL %S%C%H$,#1G"$k!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
FE	E>Aw9k%V%m%C%/Cf$N3F double word $KBP1~$9$k full/empty %S%C%H
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#%5%$%: $, block G"$k>l9g!"#5%U%j%C%H$r;}$D%Q%1%C%H$HJk!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj!#%9%L!<%W$r9T$J$&$?$a!" all $r;XDj$9$k
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# cflush_req %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU2C9k
ACK	cflush A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#

4.3.21 localize_req

localize_req $O!" V3.0 0J9_ GQ;_$5l?!#%/%i%9%?%m!<%+%k$J%a%b%jNN0h$KBP9k update_reply $^$?$O invalidate_reply JIrAH_9go;$F<B8=$5lk!#

Cm#1!' localize_req $O!">>K\;EMM=q$N m_localize $*$h$S5~Bg;EMM=q$N Localize Request $KBP1~$9$k!#

4.3.22 control_read_req

control_read_req $O!"%P%9$K@\B3$5$l$?MM!9$J%G%P%$%9$NFbIt>pJsrFI_=P9?aKMQ$$$ilk!# control_read_
$N%Q%1%C%HD9$O#1G"$k!#3F%G%P%$%9$O%"%I%l%9$G;XDj5l$?%l%8%9%?!"%a%b%j$JIN>pJs$r control_read_reply
%1%C%H$rMQ$$$FJV$9!#

control_read_req O=$N@-<A>e%9%L!<%W$rMQ$$$J$$$?$a!">o$K9T$-@h%G%P%$%9%"%I%l%9$rM[$K;XDj9kI,MW$
$k!#

Cm#1!' control_read_req $O!">>K\;EMM=q!"5~Bg;EMM=qHb$KB8:_$7$J$$!#

Cm#2!' DID %U%#!<%k%I$O!">o$KBP>]%G%P%$%9$r;XDj9kI,MW$,$"$k!#$^$?!" CCBL %S%C%H$O>o$KL5;k$5lk!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	FI$_=P$7BP>]$r<($9%3%s%H%m!<%k!&%"%I%l%9!#>\:Y$O%G%P%$%9;EMM=q$r;2>H$N3H
HOME	%3%s%H%m!<%k%"%I%l%9$N0lIt$H7F07ol$k
DUMMY	%3%s%H%m!<%k%"%I%l%9$N0lIt$H7F07ol$k
OW_CH	%3%s%H%m!<%k%"%I%l%9$N0lIt$H7F07ol$k
LARGE	%3%s%H%m!<%k%"%I%l%9$N0lIt$H7F07ol$k
CCBL	;HMQ7J$$
SU	SU %S%C%H$,#1$G$"$k>l9g!"FI$_=P$7MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r<($9!#%f!<%6KFI^l?$/$J$$>pJsO3lGJ]8n9k
SIZE[2:0]	SIZE %U%#!<%k%IOFI_=P$7BP>]$N%G!<%?$N%5%$%:$r<($9!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# reply %Q%1%C%H$O SID 08$K$*$/il$k!#
ACK	PEND ?.9fKh$k40N;DLCN;XDj!#I,$:#0$r;XDj$9$k

4.3.23 control_write_req

control_write_req $O!"%P%9$K@\B3$5$l$?3F%G%P%$%9$N;}$D%l%8%9%?!"%a%b%jEyXN=q$-9~$_L?NaG"$j!"=q$ $_$,40N;9k$H%"%/%N%l%C%8!Jwrite_reply!KrJV9>l9g$,$"$k!# control_write_req $N%Q%1%C%HD9$O=q$-9~$_BP>]$ hj3HJj!"%V%m%C%/$,BP>]$N>l9g$O#5!"$=$l0J30$N>l9g$O#2$G$"$k!# control_write_req $N<g$J;H$$J}$O!"= 2=!"%G%P%0!"3d$j9~$_$N<B8=G"$k!#

ACK %U%#!<%k%I$,#1$G$"$k>l9g!" control_write_req $,=hM}Cf$G$"$k3H$,!" X_PEND ?.9f$Khj SID %U%#!< %k%I$G;XDj$5lk CC $r7PM3$7$F CPU $KDLCN$5lk!# ACK %U%#!<%k%I$,#0$G$"$k>l9g$O!"#M#B#P$K$*$1$kA` 40A4$K CC !? CPU $HFHN)$G$"$j!" X_PEND ?.9fKh$k=*N;DLCN$O9TJolJ$$!#

Cm#1!' control_write_req $O!">>K\;EMM=q$N c/m_cntrl_write_req, $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbNOJ$$!#

3l$iF0:n$O!"=q$-9~$_BP>]Kh$j;XDj$5lk!#>\:Y$O%G%P%$%9;EMM=q$r;2>H$N3H!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	=q$-9~$_BP>]$r<($9%3%s%H%m!<%k!&%"%I%l%9
HOME	%"%I%l%9$N0lIt$H7F;HMQ9k
DUMMY	%"%I%l%9$N0lIt$H7F;HMQ9k
OW_CH	%"%I%l%9$N0lIt$H7F;HMQ9k
LARGE	%"%I%l%9$N0lIt$H7F;HMQ9k
FEPOL	;HMQ7J$$
CCBL	;HMQ7J$$
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
F/E bits	;HMQ7J$$
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj
ACK	control_write A`:n$N=*N;$r X_PEND ?.9f$GDLCN$9k3HrA*Br9k!#

4.3.24 demap_req

demap_req $O!"%P%9$K@\B3$5$l$?3F%-%c%C%7%e$*hS CPU K?$$$9$k demap MW5a$G$"$k!#3l$O V3.0 $K?7@ 5l$?!#%Q%1%C%H$*hSF0:n$N>\:Y$O Fs<!%-%c%C%7%e%3%s%H%m!<%i;EMM=q$r;2>H$N3H!# Cm#1!' demap_req $O!">>K\;EMM=q$N demap_req, !"5~Bg;EMM=q$N Demap Request $KBP1~$9$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%G%^%C%WBP>]$r<($9%/%i%9%?!&%"%I%l%9
HOME	;HMQ7J$$
DUMMY	;HMQ7J$$
OW_CH	;HMQ7J$$
LARGE	demap 9k%Z!<%8NBg-5r<($9
FEPOL	;HMQ7J$$
CCBL	;HMQ7J$$
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
F/E bits	;HMQ7J$$
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj
ACK	PEND ?.9fKh$k40N;DLCN;XDj!#I,$:#0$r;XDj$9$k

4.3.25 interrupt_req

interrupt_req $O!"%P%9$K@\B3$5$l$?3F%-%c%C%7%e$*hS CPU K?$$$9$k 3d$j9~$_MW5a$G$"$k!#3l$O V3.0 ?7@_$5l?!#%Q%1%C%H$*$h$SF0:n$N>\:Y$O Fs<!%-%c%C%7%e%3%s%H%m!<%i;EMM=q$r;2>H$N3H!# Cm#1!' demap_req $O!">>K\;EMM=q$N m_interrupt_req, !"5~Bg;EMM=q$N Interrupt Request $KBP1~$9$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	3d$j9~$_$N%"!<%.%e%a%s%H!#Fs<!%-%c%C%7%e%3%s%H%m!<%i;EMM=q$r;2>H$N3H
HOME	;HMQ7J$$
DUMMY	;HMQ7J$$
OW_CH	;HMQ7J$$
LARGE	;HMQ7J$$
FEPOL	;HMQ7J$$
CCBL	;HMQ7J$$
SU	SU %S%C%H$,#1$G$"$k>l9g!"=q$-9~$_MW5a$,FC8"!J%+!<%M%k!K%b!<%I$G9TJolk3H$r <($9
F/E bits	;HMQ7J$$
SIZE[2:0]	SIZE %U%#!<%k%I$O=q$-9~$_BP>]$N%G!<%?$N%5%$%:$r<($9!#
DID[2:0]	%Q%1%C%H$N9T$-@h%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj

4.3.26 read_reply

read_reply $O read_req NFI_=P$7MW5a$KBP7F$N%j%W%i%$%Q%1%C%HG"$k!#%j%W%i%$%Q%1%C%H$OMW5a%Q%1%C%
Hf3S7F9b$$M%@hEY$G=hM}$5lk!#

read_reply %Q%1%C%HGO!"=hM}9bB.2=N?$aMW5aBP>]$G$"$k%"%I%l%9$r4^$` double word $r%Q%1%C%H$N%G!<%?
:G=iK*$/$j!"=g<!>:=g$G=hM}$9$k!# read_reply $N%Q%1%C%HD9$O!"%-%c%C%7%e%a%b%j$+$i$N%V%m%C%/MW5a$N%j%
$N>l9g!"#5$G$"$j$=$l0J30$N>l9g#2$G$"$k!# read_reply $N3F%G!<%?%U%j%C%H$N [0]$OE "WWE double word K*
1k R-WAIT $NB8:_!"$9Jo$A!"FI$_=P7rBTCF$$$k=q$-9~$^l?%G!<%?$,$"k3Hr [1]$OE "WWE
double word K*1k R-WAIT 9JoA=q$-9~$_rBTC$F$$$kFI$_=P$7%j%/%(%9%H$,$"k3HrDLCN9k!#

$^$?!" read_reply %Q%1%C%H$N@hF,$G$"$k %"%I%l%9%U%j%C%HCf$N FE %U%#!<%k%I$G$O!" double word C10L$G$
full/empty %U%i%0NCMrJV$9!# FE %U%#!<%k%I$O>o$K%V%m%C%/C10L$N%"%/%;%9K*1k%V%m%C%/@hF,$+$i$N0L
full/empty >pJsrJV9$3$H$KCm0U$9kI,MW,$"$k!#=>CF!" double word 0J2<$N%5%$%:$N read_reply %Q%1%C%H$G$
ADDR[4:3]$,<($90LCV$K full/empty >pJs$,F~CF$$$k!#

read_reply $O!"$=$N860x$HJC$?%G%P%$%9XFI_=P$7%G!<%?$rJVAw9kHHbK!" INJ_MASK %U%#!<%k%I$N
$9%-%c%C%7%e$KBP7F%-%c%C%7%e%$%s%8%'%/%7%g%s$r;X<(9k!#=>CF!" read_req KBP9$k read_reply GO INJ_
$OA4$F#0$K@_Dj$7F"kI,MW,$"$k!#

J*!"2<5-%j%W%i%$%Q%1%C%H$O!"5-=R9k:3>/$JE@$r=|$-!" read_reply %Q%1%C%H$HF1MM$JF0:n$r9TJ&:

non_coherent_read_reply non_coherent_read_req KBP9$k%j%W%i%$!#E>Aw$,Hs%3%R!<%l%s%H$G$"$k3H$,0[$J$C
$F$$$k!#

allread_reply allread_req KBP9$k%j%W%i%$!#%j%W%i%$%Q%1%C%H$NF0:nH7FO read_reply $HA4$/F10lG"k,!"
INJ_MASK $KHsNmMWAG$,$"$k3HGb6hJL5l$k!K

swap_reply swap_request KBP9$k%j%W%i%$!# swap A0$N%a%b%jCM$G$"$k!#

swap_M_reply swap_M_request KBP9$k%j%W%i%$!##M#B#P8F$S=P$7$NJVCM$G$"$k!#

control_read_reply control_read_request KBP9$k%j%W%i%$!#07$$$O read_reply $HA4$/F1$8$H9M$($ilk!#

Cm#1!' read_reply $O!">>K\;EMM=q$N c_reply, m_reply 5~Bg;EMM=q$N Read Reply $KBP1~$9$k!#
Cm#2!' DID %U%#!<%k%I$O!"BP1~$9$k request %Q%1%C%H$N SID $,$=N^$^MQ$$$ilk!J>l9g$,KX$sIG$"$k!K!#%9%L!<%WF0:n
$k%-%c%C%7%e%$%s%8%'%/%7%g%s$O>o$K9TJolk!#
Cm#3!'%j%W%i%$%Q%1%C%H$O7h7F X_BRETRY ?.9fKh$j%j%H%i%$$5lJ$$$3H,I,MWG"$k!#$9Jo$A!"0lC6%j%W%i%$%
%H$K4X$9$k%P%9E>Aw$,3+;O5lkH!"Ev3:%Q%1%C%H$OI,$:<uM}5lk3H,I,MWG"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%j%W%i%$BP>]$r<($9%/%i%9%?!&%"%I%l%9
OW_CH	;HMQ7J$$
DUMMY	;HMQ7J$$
HOME	;HMQ7J$$
LARGE	;HMQ7J$$
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"$k 3H$r<($9!##0G"$k>l9g$O!"%N%s%-%c%C%7%c%V%kG"k3Hr<($9!#
SU	SU %S%C%H$,#1$G$"$k>l9g!"%j%W%i%$$,FC8"!J%+!<%M%k!K%b!<%I$G9T$Jolk3Hr<($9
FE	3F double word Kh$N Full / Empty %S%C%H$r<($9!# FE $N0LCV$O!">o$K%V%m%C%/Fb%"%I%l %9$N0LCVKCV+lk
FEPOL	;HMQ7J$$
SNOOP_CNTL[2:0]	SNOOP_CNTL %U%#!<%k%I$O!"%Q%1%C%H$,%9%L!<%WA`:n$rH<$&>l 9g$K;HMQ$5lk!#2<0L%S%C%H$+$i!' **CLSH** CLSH %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$NBP>]$,%/%i%9 %?4V$G6&M-$5lF$$$k3H$r<($9!##0G"$k>l9g!"%Q%1%C%H $NBP>]$,%/%i%9%?4V$G6&M-$5lF$$$k2DG=@-$,$J$$$3Hr <($9!# read_reply %Q%1%C%H$N>l9g$O!" reply $r<uM}$9$k%G%P%$%9 K*$$$F!" CLSH $^$?$O CLPR $r6hJL$9k?aK!"%j%W%i %$$9$k#M#B#P$^$?$O#C#C$,Ev3:%V%m%C%/$N>pJs$K4p$E$$$F Aw=P9k!# **DRTY** DRTY %S%C%H$,#1$G$"$k>l9g!"Ev3:%Q%1%C%HKh$j%-%c%C %7%e$K%m!<%I9k%V%m%C%/$NB0@-$, dirty G"k3Hr<($9!##0$G$"$k>l9gKO clean G"k3Hr<($9!# DRTY %S%C %H$O!" request %Q%1%C%HGO>o$KL5;k$5lk!# reply %Q%1%C %HGO%j%W%i%$$9$k#M#B#P$^$?$O#C#C$,Ev3:%V%m%C%/$N>u BV$r8+$F7hDj9k!# **MSH_RPLY** MSH_RPLY %S%C%H$O!" reply %Q%1%C%H$K$*$$$F!" %j%/%(%9%H;~K*1k MSH ?.9f@~$N7k2L$r<($9!#$9Jo$A!" read_reply $N7k2L:n@.$9$k%V%m%C%/$,!" private G"k3 Hr@_Dj9k$?$a$K;HMQ$5lk
SIZE[2:0]	SIZE %U%#!<%k%I$O%j%W%i%$BP>]$N%G!<%?$N%5%$%:$r<($9!#%5%$%: $, block G"$k>l9g!"#5%U%j%C%H$r;}$D%Q%1%C%H$HJj!"$=$l0J 30$N>l9g #2%U%j%C%H$r;}$D%Q%1%C%H$HJk!# reply %Q%1%C%HGO masked block $O;HMQ$7$J$$!#
DID[2:0]	%j%W%i%$$N9T$-@h%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# %j%W%i%$ %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU2C9k
DATA[63:0]	FI$_=P$7$?%G!<%?!#%V%m%C%/$NFI$_=P$7$r9T$JC?>l9g$O!"%"%I%l%9$G;XDj5l$? double word $,:G=i$KE>Aw5l$k
WWE[1:0]	FI$_=P$5l? double word $KBP1~$9$k R/W-WAIT %S%C%H>pJs!# W-WAIT!"9JoA WWE[1]$,N)$C$F$$$k double word $O=q$-9~$_$rBTCF$$$kFI$_=P$7MW5a$,B8:_$9k3$H $r<($7!" R-WAIT!"9JoA WWE[0]OFI_=P7rBTCF$$$k=q$-9~$^l?%G!<%?$,B8 :_$9k3Hr<($9!#

4.3.27 rdinv_reply

rdinv_reply $O rdinv_req !" invalidate_via_home_req Ey$NMW5a$KBP7F$N%j%W%i%$%Q%1%C%HG"$k!#3F%-%c%C %7%e%a%b%j$O%9%L!<%W$r9T$J$$!" DID $G<($9bN0J30$N%-%c%C%7%e$KB8:_9k%V%m%C%/$OA4$F%$%s%P%j%G!<% $k!#

rdinv_reply $ODL>o%-%c%C%7%c%V%k%"%/%;%9$rBP>]$H9k$?$a!"%V%m%C%/%G!<%?$r;}$A!"#5G"k,!"b7$= 30$N%G!<%?%5%$%:$G$"$k>l9gKO#2G"$k!#

J*!"2<5-%j%W%i%$%Q%1%C%H$O!"5-=R9k:3>/$JE@$r=|$-!" rdinv_reply %Q%1%C%H$HF1MM$JF0:n$r9TJ&!#$^ rdinv_reply KO CMD H7$F alias $,$"k3HKCm0U9k3H:

rdinv_P_reply rdinv_P_req $KBP1~$9$k%j%W%i%$!# Memory-Based FIFO $r:n$kF14|%W%j%_%F%#%V$N%j%W%i%$$G$" $kE@$,0[JC$F$$$k!# rdinv_P_reply $rFs<!%-%c%C%7%e$,<uM}9k$H!$r null (9) CPU $KD>$AKJV9!#

rdinv_Q_reply rdinv_Q_req $KBP1~$9$k%j%W%i%$!# Memory-Based FIFO $r:n$kF14|%W%j%_%F%#%V$N%j%W%i%$$G $"$kE@$,0[$JCF$$$k!# rdinv_Q_reply $r<uM}$9kH!"Fs<!%-%c%C%7%e$ODL>o CPU $K3d$j9~$_!"FI$_=P$7 fail H7$FDLCN9k

Cm#1!' rdinv_reply $O!">>K\;EMM=q$N c_reply_inv, m_reply_inv $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbN$,$J$$!#

Cm#2!' DID %U%#!<%k%I$O!"BP1~$9$k request %Q%1%C%H$N SID $,$=N^$^MQ$$$ilk!J>l9g$,KX$sIG$"$k!K!#%9%L!<%WF0:n $K9T$Jol$k!#

Cm#3!'%j%W%i%$%Q%1%C%H$O7h7F X_BRETRY ?.9fKh$j%j%H%i%$$5lJ$$$3H,I,MWG"$k!#$9Jo$A!"0lC6%j%W%i%$% %H$K4X$9$k%P%9E>Aw$,3+;O5lkH!"Ev3:%Q%1%C%H$OI,$:<uM}5lk3H,I,MWG"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%j%W%i%$BP>]$r<($9%/%i%9%?!&%"%I%l%9
OW_CH	;HMQ7J$$
DUMMY	;HMQ7J$$
HOME	;HMQ7J$$
LARGE	;HMQ7J$$
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"$k 3H$r<($9!##0G"$k>l9g$O!"%N%s%-%c%C%7%c%V%kG"k3Hr<($9!# rdinv_reply $G O=$N@-<A>e>o$K#1$r;XDj9k
SU	SU %S%C%H$,#1$G$"$k>l9g!"%j%W%i%$$,FC8"!J%+!<%M%k!K%b!<%I$G9T$Jolk3Hr<($9
F/E bits	BP1~9k%V%m%C%/$K double word C10L$GIU1ilF$$$k Full / Empty %S%C%H$r<($9!# read_reply $N9`L\$r;2>HN3$H
FEPOL	;HMQ7J$$
SNOOP_CNTL[2:0]	SNOOP_CNTL %U%#!<%k%I$O!"%Q%1%C%H$,%9%L!<%WA`:n$rH<$&>l 9g$K;HMQ$5lk!#2<0L%S%C%H$+$i!' **CLSH** CLSH %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$NBP>]$,%/%i%9 %?4V$G6&M-$5lF$$$k3H$r<($9!##0G"$k>l9g!"%Q%1%C%H $NBP>]$,%/%i%9%?4V$G6&M-$5lF$$$k2DG=@-$,$J$$$3Hr <($9!# rdinv_reply %Q%1%C%H$N>l9g$O!"I,$:%/%i%9%?%m!<%+%k$J%V %m%C%/H7FJVk$?$a!" CLSH=0 $rJVCM$9$k!# **DRTY** DRTY %S%C%H$,#1G"$k>l9g!"Ev3:%Q%1%C%HKh$j%-%c%C %7%e$K%m!<%I9k%V%m%C%/$NB0@-$, dirty G"k3Hr<($9!##0G"$k>l9gKO clean G"k3Hr<($9!# rdinv_reply %Q%1%C%HGO%j%W%i%$$9$k#M#B#P$^$?$O#C#C$,Ev3:%V%m%C%/ $N>uBV$r8+$F7hDj$9$k!# **MSH_RPLY** rdinv_reply GO MSH_RPLY %S%C%H$O>o$K 0 $H 7FJV$k!#
SIZE[2:0]	SIZE %U%#!<%k%I$O%j%W%i%$BP>]$N%G!<%?$N%5%$%:$r<($9!#%5%$%: $O block G"$j!"#5%U%j%C%H$r;}$D%Q%1%C%H$HJk!##3#2%S%C%H C10L$G!" WWE %S%C%H$Khj%G!<%?$NM-8z@-$r<($7!"M-8zG"$k 8l$@1,%j%W%i%$BP>]HJ$k!#%j%W%i%$%Q%1%C%HGO masked block $O;HMQ$7$J$$
DID[2:0]	%j%W%i%$$N9T$-@h%G%P%$%9$N;XDj!# rdinv_reply %Q%1%C%H$O>o$K%9%L!<%W5lk,!" valid $J%V%m%C%/$r:n@.9k%G%P%$%9$r;XDj9k$?$a$KMQ$$$ilk
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# %j%W%i%$ %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU2C9k
DATA[63:0]	FI$_=P$7$?%G!<%?!#%V%m%C%/$NFI$_=P$7$r9T$JC?>l9g$O!"%"%I%l%9$G;XDj5l$? double word $,:G=i$KE>Aw5l$k
WWE[1:0]	FI$_=P$5l? double word $KBP1~$9$k R/W-WAIT %S%C%H>pJs!# W-WAIT!"9JoA WWE[1]$,N)$C$F$$$k double word $O=q$-9~$_$rBTCF$$$kFI$_=P$7MW5a$,B8:_$9k3$H $r<($7!" R-WAIT!"9JoA WWE[0]OFI_=P7rBTCF$$$k=q$-9~$^l?%G!<%?$,B8 :_$9k3Hr<($9!#

4.3.28 update_req

update_req $O update_via_home_req Ey$NFI$_=P$7MW5aKBP7FN%j%W%i%$%Q%1%C%H$G$"$k$,!"%Q%1%C%H$NM%@h
EYH7FO%j%/%(%9%H %Q%1%C%HG"k?$a!" V3.2 $+$i update_req $HJQ99$9$k!#3F%-%c%C%7%e%a%b%j$O%9%L!<%
9T$J$$!"BP>]0J30$N%-%c%C%7%e$KB8:_9k%V%m%C%/$rA4$F update 9k!#

update_req $O>o$K#M#B#P$,@8@.$7!"%/%i%9%?Fb$N3F%-%c%C%7%e$KB8:_9k%G!<%?$r update 9k!#=>CF!" up
date_req KBP9$k%j%W%i%$%Q%1%C%H$OB8:_$7$J$$!#

J*!"2<5-%Q%1%C%H$O!"5-=R$9$k:3>/$JE@$r=|$-!" update_req %Q%1%C%H$HF1MM$JF0:n$r9T$J$&:

update_S_reply update_S_req $KBP1~$9$k%j%W%i%$!# s-write $r:n$kF14|%W%j%_%F%#%V$N%j%W%i%$$G$"$kE@$,0[
JC$F$$$k!#

update_Q_reply update_Q_req $KBP1~$9$k%j%W%i%$!# q-write $r:n$kF14|%W%j%_%F%#%V$N%j%W%i%$$G$"$kE@$,0[
JC$F$$$k!#

Cm#1!' update_reply $O!">>K\;EMM=q$N c_update, m_update $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbN$,$J$$!#
Cm#2!' DID %U%#!<%k%I$O!"BP1~$9$k request %Q%1%C%H$N SID $,$=N^$^MQ$$$ilk!J>l9g$,KX$sIG$"$k!K!#%9%L!<%WF0:n
$K9T$Jol$k!#
Cm#3!'%j%W%i%$%Q%1%C%H$O7h7F X_BRETRY ?.9fKh$j%j%H%i%$$5lJ$$$3H,I,MWG"$k!#$9Jo$A!"0lC6%j%W%i%$%
%H$K4X$9$k%P%9E>Aw$,3+;O5lkH!"Ev3:%Q%1%C%H$OI,$:<uM}5lk3H,I,MWG"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%j%W%i%$BP>]$r<($9%/%i%9%?!&%"%I%l%9
OW_CH	;HMQ7J$$
DUMMY	;HMQ7J$$
HOME	;HMQ7J$$
LARGE	;HMQ7J$$
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"k3Hr<($9!##0$G$"$k>l9g$O!"%N%s%-%c%C%7%c%V%k$G$"$k3H$r<($9!# update_req GO$=$NK\<A>e #1 $r;XDj$9$k
SU	SU %S%C%H$,#1$G$"$k>l9g!"%j%W%i%$$,FC8"!J%+!<%M%k!K%b!<%I$G9T$Jolk3Hr<($9
F/E bits	BP1~9k%V%m%C%/$K double word C10L$GIU1ilF$$$k Full / Empty %S%C%H$r<($9!# read_reply $N9`$r;2>HN3$H
FEPOL	;HMQ7J$$
SNOOP_CNTL[2:0]	SNOOP_CNTL %U%#!<%k%I$O!"%Q%1%C%H$,%9%L!<%WA`:n$rH<$&>l9g$K;HMQ$5lk!#2<0L%S%C%H$+$i!' **CLSH** CLSH %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$NBP>]$,%/%i%9%?4V$G6&M-$5lF$$$k3H$r<($9!##0G"$k>l9g!"%Q%1%C%H$NBP>]$,%/%i%9%?4V$G6&M-5l$F$$$k2DG=@-$,$J$$$3Hr<($9!# update_req %Q%1%C%H$N>l9g$O!"<uM}$9$k%G%P%$%9K*$$$F!" CLSH $^$?$O CLPR $r6hJL$9k?aK!"%j%W%i%$$9$k#M#B#P$,Ev3:%V%m%C%/$N>pJs$K4p$E$$$FAw=P9k!# **DRTY** DRTY %S%C%H$,#1$G$"$k>l9g!"Ev3:%Q%1%C%HKh$j%-%c%C%7%e$K%m!<%I9k%V%m%C%/$NB0@-$, dirty G"k3Hr<($9!##0$G$"$k>l9gKO clean G"k3Hr<($9!# update_req %Q%1%C%H$G$ODL>o clean $J%V%m%C%/$r5"9,!"%j%W%i%$$9$k#M#B#P$^$?$O#C#C$,Ev3:%V%m%C%/$N>uBV$r8+$F7hDj9k!# **MSH_RPLY** MSH_RPLY %S%C%H$O!" reply %Q%1%C%H$K$*$$$F!"%j%/%(%9%H;~K*1k MSH ?.9f@~$N7k2L$r<($9!#$9Jo$A!" update_reply $N7k2L:n@.$9$k%V%m%C%/$,!" private G"k3Hr@_Dj9k$?$a$K;HMQ$5lk
SIZE[2:0]	SIZE %U%#!<%k%I$O%j%W%i%$BP>]$N%G!<%?$N%5%$%:$r<($9!#%j%W%i%$%Q%1%C%HGO masked block $O;HMQ$7$J$$
DID[2:0]	%j%W%i%$$N9T$-@h%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# %j%W%i%$ %Q%1%C%H$N>l9gFC$KOUL#$,$J$$$,!"JX59>eIU2C9k
DATA[63:0]	FI$_=P$7$?%G!<%?!#%V%m%C%/$N update $r9T$JC?>l9g$O!"%"%I%l%9$G;XDj5l$? double word $,:G=i$KE>Aw5l!"$"$H$O>:=g$GAwil$k
WWE[1:0]	FI$_=P$5l? double word $KBP1~$9$k R/W-WAIT %S%C%H>pJs!# W-WAIT!"9JoA WWE[1]$,N)$C$F$$$k double word $O=q$-9~$_$rBTCF$$$kFI$_=P$7MW5a$,B8:_$9k3Hr<($7!" R-WAIT!"$9Jo$A WWE[0]$OFI$_=P$7rBTC$F$$$k=q$-9~$^l?%G!<%?$,B8:_$9k3Hr<($9!#

4.3.29 invalidate_req

invalidate_req $O invalidate_req Ey$NFI$_=P$7MW5aKBP7FNJVEzG"k,!"=hM}$NET9g>e request %l%Y%k$G$" k?$a!" V3.2 0J9_ invalidate_req HJC?!#=>CF!" invalidate_req $KBP1~$9$k%j%W%i%$%Q%1%C%HOJ$$!#

invalidate_req $r<uM}$7$?3F%-%c%C%7%e$*hS#M#B#P$O!"$^$:%j%H%i%$>r7o$r%A%'%C%/$9$k!#>r7o$,@.N)7 9g$O %j%H%i%$$9$k!#%j%H%i%$$5lJ$+$C$?>l9g!" MSH ?.9f$H CRPLY ?.9fODMK assert 7J$$!#!J$?$H$(!' %L!<%W%R%C%H$9$k%V%m%C%/$,B8:_9k>l9gGb!K

3F%-%c%C%7%e%a%b%j$O%9%L!<%W$r9T$J$$!"BP>]0J30$N%-%c%C%7%e$KB8:_9k%V%m%C%/$rA4$F invalidate 9k!

invalidate_reply $ODL>o%-%c%C%7%c%V%k%"%/%;%9$rBP>]$H$7!"%Q%1%C%HD9$O#1G"$k!#

Cm#1!' invalidate_reply $O!">>K\;EMM=q$N c_invalidate, m_invalidate $KBP1~$7!"5~Bg;EMM=qKOBP1~9kbN$,$J$$!#

Cm#2!' DID %U%#!<%k%I$O!"BP1~$9$k request %Q%1%C%H$N SID $,$=N^$^MQ$$$ilk!J>l9g$,KX$sIG$"$k!K!#%9%L!<%WF0:n $K9T$Jol$k!#

Cm#3!'%j%W%i%$%Q%1%C%H$O7h7F X_BRETRY ?.9fKh$j%j%H%i%$$5lJ$$$3H,I,MWG"$k!#$9Jo$A!"0lC6%j%W%i%$%Q %H$K4X$9$k%P%9E>Aw$,3+;O5lkH!"Ev3:%Q%1%C%H$OI,$:<uM}5lk3H,I,MWG"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%$%s%P%j%G!<%HBP>]$r<($9%/%i%9%?!&%"%I%l%9
OW_CH	;HMQ7J$$
DUMMY	;HMQ7J$$
HOME	;HMQ7J$$
LARGE	;HMQ7J$$
CCBL	CCBL %S%C%H$,#1$G$"$k>l9g!"%Q%1%C%H$,9T$J$&%a%b%jA`:n$,%-%c%C%7%c%V%kG"$k 3H$r<($9!##0G"$k>l9g$O!"%N%s%-%c%C%7%c%V%kG"k3Hr<($9!# rdinv_reply $G O=$N@-<A>e>o$K#1$r;XDj9k
SU	SU %S%C%H$,#1$G$"$k>l9g!"%j%W%i%$$,FC8"!J%+!<%M%k!K%b!<%I$G9T$Jolk3Hr<($9
F/E bits	;HMQ7J$$
FEPOL	;HMQ7J$$
SIZE[2:0]	;HMQ7J$$
DID[2:0]	BP1~9k invalidate_via_home $rH/$7$?%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# %j%W%i%$ %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU2C9k

4.3.30 demap_ack

demap_ack $O demap_req $NMW5a$KBP7F$N%j%W%i%$%Q%1%C%HG"$j!"F0:n$,=*N;7?3H$rDLCN$9$k!#%j%W
%$%Q%1%C%H$OMW5a%Q%1%C%H$HHf3S$7$F9b$$M%@hEY$G=hM}$5lk!# demap_ack $N%Q%1%C%HD9$O#2G"$k!#

demap_ack %Q%1%C%H$O double word $N%G!<%?$r1?$V!#%G!<%?$NFbMF$O!"Ez$(kY$-MW5a$Khj3HJk!#

Cm#1!' demap_ack $O!">>K\;EMM=q$N c_demap_ack, m_demap_ack 5~Bg;EMM=q$N Acknowledgment $KBP1~$9$k!#

Cm#2!' DID %U%#!<%k%I$O!"BP1~$9$k request %Q%1%C%H$N SID $,$=N^$^MQ$$$ilk!J>l9g$,KX$sIG$"$k!K!#%9%L!<%WF0:n
$K9T$Jol$J$$!#

Cm#3!'%j%W%i%$%Q%1%C%H$O7h7F X_BRETRY ?.9fKh$j%j%H%i%$$5lJ$$$3H,I,MWG"$k!#$9Jo$A!"0lC6%j%W%i%$%Q%1%C
%H$K4X$9$k%P%9E>Aw$,3+;O5lkH!"Ev3:%Q%1%C%H$OI,$:<uM}5lk3H,I,MWG"$k!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	%"%/%N%l%C%8BP>]$r<($9%/%i%9%?!&%"%I%l%9!JBP1~9kMW5a$N%"%I%l%9!K
OW_CH	;HMQ7J$$
DUMMY	;HMQ7J$$
HOME	;HMQ7J$$
LARGE	;HMQ7J$$
CCBL	;HMQ7J$$
SU	SU %S%C%H$,#1$G$"$k>l9g!"%j%W%i%$$,FC8"!J%+!<%M%k!K%b!<%I$G9T$Jolk3Hr<($9
F/E bits	;HMQ7J$$
FEPOL	;HMQ7J$$
SIZE[2:0]	BP1~9kD9$5$r;XDj9k
DID[2:0]	%j%W%i%$$N9T$-@h%G%P%$%9$N;XDj
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# %j%W%i%$ %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU2C9k

4.3.31 nop

nop $O 2?$b7J$$F0:n$N%Q%1%C%H$G$"$j!"EvA32?$N%j%W%i%$$b0z$-5/$3$5$J$$!# nop %Q%1%C%H$O=P$7$+$1 %/%(%9%H$r<h$j>C$9;~$JIK;Hol$k!# nop $N%Q%1%C%HD9$O!"%"%I%l%9%U%j%C%H$K [k:0] WWE j$5$l $k!#

Cm#1!’ write_ack $O!">>K\;EMM=q$*hS5~Bg;EMM=q$KB8:_$7$J$$!#

Cm#2!’ nop %Q%1%C%H$N>l9g!"KX$s$IA4$F$N%U%#!<%k%I$,L50UL#G"k,!"%"!<%S%H%l!<%7%g%s$,@5>o$K9TJo aK$O!"MW5a$HF1$8%5%$%:$r;XDj$9kI,MW,$"$k!#

Cm#3!’ nop %Q%1%C%H$O 2?$b7J$$ $H$$$&@-<A>e X_BRETRY Kh$k%j%H%i%$$r9TJo$J$$$3H,K>$^$7$$!#

%U%#!<%k%IL>	5-=R
ADDR27:0]	;HMQ7J$$
OW_CH	;HMQ7J$$
DUMMY	;HMQ7J$$
HOME	;HMQ7J$$
LARGE	;HMQ7J$$
CCBL	;HMQ7J$$
SU	;HMQ7J$$
F/E bits	;HMQ7J$$
FEPOL	;HMQ7J$$
SIZE[2:0]	;HMQ7J$$
DID[2:0]	;HMQ7J$$
SID[2:0]	%Q%1%C%H$NAw?.85$N;XDj!# nop %Q%1%C%H$N>l9gFC$K0UL#$,$J$$$,!"JX59>eIU2C9k
INJ_MASK[3:0]	;HMQ7J$$

5 %(%i%9%F%#%C%/!&%P%j%"

K\@aGO!" JUMP-1 K*1k%(%i%9%F%#%C%/!&%P%j%"$N<B8=J}<0$r=RYk!#%(%i%9%F%#%C%/!&%P%j%"$N4pK\
$O!">>K\$NO@J8$K>\=R$5lk$,!"$3$3$G$O6qBNE*<B8=J}<0$KE*$r9J$C$F=R$Y!"<!$$$G7k@~J}<0$r=R$Y$k!#

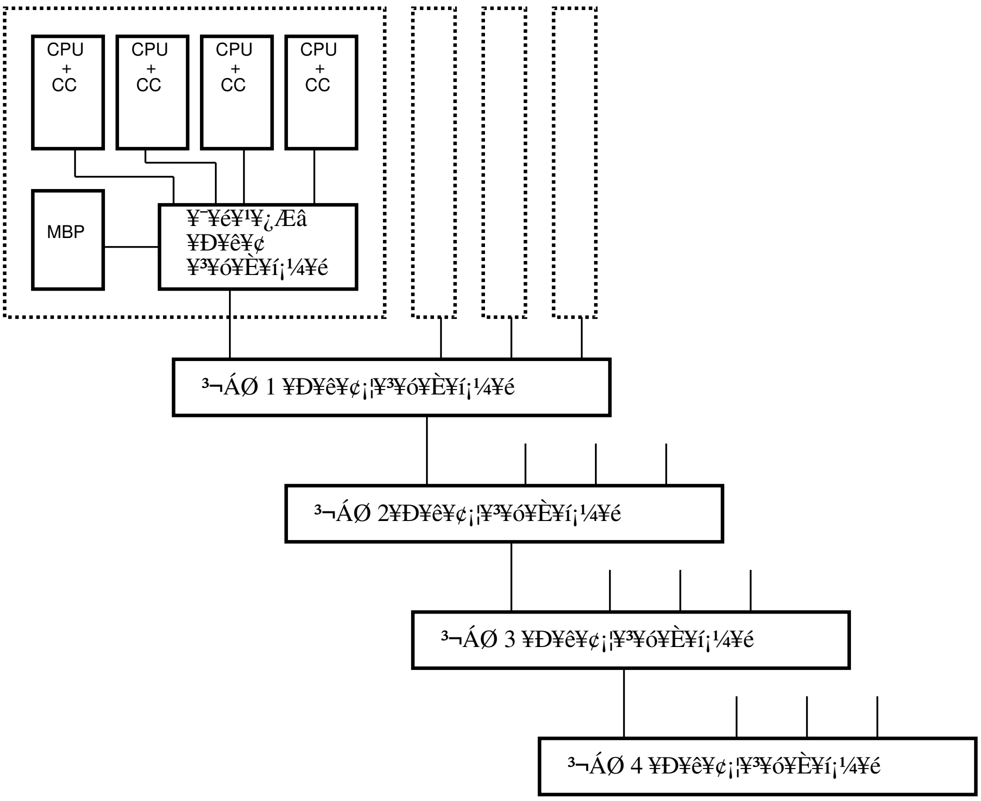
5.1 JUMP-1 K*1k Elastic Barrier J}<0$N35MW

Elastic Barrier $O=EJ#2DG=$G!"F14|MW5a$HF14|>5G'$rJL8D$K07$($kJ}<0$N%P%j%"F14|G"$k!#%W%m%0%i%`$+$
kH!"%P%j%"$O PREQ, RREQ, APRV $N#3<o$N%W%j%_%F%#%V$+$i9=@.5l!"3F!9%W%m%;%C%5C10L$G!"F14|$NM=L
F14|$NH=Dj!"F14|$X$N;22C$r<B8=9k!#

JUMP-1 K*1k<BAuGO99$K!"0J2<$N=t9`L\$r9MN8$9$kI,MW$,$"$k!'

1. JUMP-1 $O!" OS $N@)8f$N2<!"%7%9%F%`A4BN$r%Q!<%F%#%7%g%s$KJ,3d7F%f!<%6$,;HMQ$9$k>l9g$,$"$k!#%
   %"$b%Q!<%F%#%7%g%s$K=>CFJ,3dF0:n9kI,MW$,$"$k
2. %Q!<%F%#%7%g%s$N7A>u$O!"0lJU$ND9$5$,#2$N%Y%->hG"$k@5J}7A$+!"$=$N@5J}7A$r#28D$"o;$?D9J}7A$G
3. %Q!<%F%#%7%g%sFbItGb!"%^%k%A%W%m%0%i%_%s%0$,9T$Jol!"%P%j%">uBV$r;q8;$H7F=i4|2=$d save / res
   9kI,MW$,$"$k!#
4. JUMP-1 $O#13,AX$N%P%j%"$G<B8=$9kK$O5,LO$,Bg$-2a$.k?$a!">/$J$/$H$bJ*M}E*$K$OB?3,AX$N<B8=J}
   I,MW
5. <BAuJ}<0H7$F!"%/%i%9%?!&%\!<%I!"#8%/%i%9%?$N%^%6!<%\!<%I!"%^%6!<%\!<%I4V$N7k@~$N#33,AX$,$"$k
6. %(%i%9%F%#%C%/!&%P%j%"$N3,AXE*@)8f2sO)$O!"#M#B#Pb7$/$O#C#P#U$,FbIt%l%8%9%?$N save/restore $r9T$
   I,MW@-$,$"k?$a!"%/%i%9%?!&%\!<%I$K<BAu9kI,MW$,$"$k

>e5-MW5a9`L\$rK~$?$9$?$a!"%(%i%9%F%#%C%/!&%P%j%"$O?^ 15$K<($99=@.$r<h$k!#



?^ 15: %(%i%9%F%#%C%/!&%P%j%"$NA4BN9=@.

?^Cf!" CPU $+$i$N%a%b%j%"%/%;%9$r %(%i%9%F%#%C%/!&%P%j%"?.9f$KJQ49$9k?aK!"Fs<!%-%c%C%7%e%3%s%
%iCf$N EB 2sO) $rMQ$$$k!# EB 2sO) GO M=$a;XDj$5l?%"%I%l%9KBP7$F!" load / store half word L?Na$r<B9T$
k3HKhj!"%(%i%9%F%#%C%/%P%j%"KBP9$k#3<o$N4pK\L?Na!JPREQ, RREQ, APRV!K$*$h$S%+%&%s%?$N%/%
!JCLR!KEy$r<B9T$9$k!# MBP $+$i$N%P%j%"MW5aEy$O!" MBP $+$iD>@\=PNO5l$k!#

%(%i%9%F%#%C%/%P%j%"$NBh0l3,AX$O!" CPU !J%-%c%C%7%e%3%s%H%m!<%i!K$H#M#B#P$+iN%P%j%"$rE}9g$7!"
3,AXKEA($kF/$-r9$k!#FbIt%+%&%s%?$O!" CPU $^$?$O#M#B#P$+iFI_=q$-2DG=$G$"$k!J2>#M#B#PHGGO!"
$+$iFI$_=q$-2DG=G"$k!K%P%j%"$NF0:n$,%/%i%9%?Fb$KJD8F$$$k>l9g!"9JoA!"%Q!<%F%#%7%g%s%5%$%:$,
%9%?G"$k>l9g$O!"Bh0l3,AX$GF0:n$,JD8k!#

%Q!<%F%#%7%g%s%5%$%:$,#20J>e$N>l9g!"%P%j%"F0:n$OBg$-$5$K1~$8$FBh#2$+$iBh#43,AX$^$G5Z$V!#J*!" J
1 K*$$$F$O#1BP#1$^$?$O#1BP#2D9J}7A%Q!<%F%#%7%g%s$r86B' H7$FMQ$$$k$?$a!"3F3,AX$O2<0L3,AX$,@5J}7A
5l$k#4?JLZ$rJ9!#

3F3,AXGO!"2<0L3,AX$+$i$NMW5a$r7W?t9k%+%&%s%?$H!"%Q!<%F%#%7%g%s$r<B8=9k$?$a$N5!9=$,Hw$($i$
$F!"99$K>e0L3,AXXNMW5a$r=P$9%a%+%K%:%`HJCF$$$k!#

5.2 Elastic Barrier $N<BAuJ}<0

5.2.1 Elastic Barrier $r9=@.$9$k?.9f@~

%(%i%9%F%#%C%/%P%j%"@)8f?.9f@~

?.9fL>	?.9fK\?t	5-=R
CLK	1	F~NO!"C1J}8~!"@5O@M}!#%P%9KBP9$k%/%m%C%/!##1#5#M#H z %/%m%C%/$rF~NO$9$k!#%/%m%C%/$O#L"*#H$N%(%C%8$rMQ$$!"#H"*#L$N%(%C%8$OMxMQ7J$$!#J*!"3l$O CPU %/%m%C%/$N#1!?#4G"$j!"A4%/%i%9%?$G%U%'!<%:$rB7$(kI,MW,$"$k
X_EBRQ_I	1	F~NO!"C1J}8~!"IiO@M}$N%Q%k%9!#%(%i%9%F%#%C%/!&%P%j%"MW5a?.9f@~!#%-%c%C%7%e%3%s%H%m!<%i$^$?$O#M#B#P$, F14\|MW5a$r=P$9$H!"#18D!"#1%/%m%C%/;~4V$N%Q%k%9$,H/@8$7!"F14\|MW5aHJ$k!# X_EBRDY_O $, assert 5l$F$$$J$$>l9gKO!" assert 5lk^$GJ];}$9$k!# X_EBRDY_ $, assert 5l$F$$$k>l9gKO!"I,$:<!%/%m%C%/$G X_EBRQ_I $r negate 9k3H
X_EBRDY_O	1	=PNO!"C1J}8~!"IiO@M}$N%l%Y%k!#%(%i%9%F%#%C%/!&%P%j%"KBP7$F X_E ?.9f$KhjF14\|MW5a$r=P$7$FNI$$$3Hr<($9!# X_EBRDY $, assert 5l$F$$$J$$;~$KH/@8$7$? X_EBRQ $O<uM}$5lJ$$!#3N3H$+$i!" X_EBRDY_O $, negate 5l$F$$$k%/%m%C%/GN X_EBRQ $O:FAw$9k3H,I,MWG"$k
X_EBGRT_O	1	=PNO!"C1J}8~!"IiO@M}$N%Q%k%9!#%(%i%9%F%#%C%/!&%P%j%"@.N)?.9f@~!# X_EBRQ $G2a5n$KMW5a7?%P%j%"F14|MW5a$,0l$D@.N)7?3H$r<($9%Q%k%9!##18D#1%/%m%C%/$N;~4VF~NO$5lk!#$^$?!" X_EBCLR ?.9f$, assert 5l$F$$$k>l9g$O!"%(%i%9%F%#%C%/!&%P%j%"$N%/%j%"$,40N;7?3H$r<($9%Q%k%9H7$F2r<a$5lk!#
X_EBCLR_I	1	F~NO!"C1J}8~!"IiO@M}$N%l%Y%k!#3F3,AX$N%(%i%9%F%#%C%/!&%P%j%"2sO)KBP7$F!"%+%&%s%?Ey$N%/%j%"!J=i4\|2=!K$rMW5a$9$k?.9f@~!#%-%c%C%7%e%3%s%H%m!<%i$*$h$S#M#B#P$,MW5a$7!">e5- X_EBGRT $,%Q%k%9$H7FJVCF$/$k$^$G;}B3$9$kI,MW$,$"$j!"$^$?!"%Q%k%9$H7FJVCF$-$?<!$N%/%m%C%/$G 2r=|5lk3H,I,MWG"$k!#
X_HEBGRT_I	1	F~NO!"C1J}8~!"IiO@M}$N%Q%k%9!#<!3,AX$+iN%(%i%9%F%#%C%/!&%P%j%"@.N)?.9f@~!#>e0L3,AXK*$$$F!"2a5n$KMW5a$7$?%P%j%"F14\|MW5a$,@.N)9k$H#18D!"#1%/%m%C%/$N4\|4VF~NO9k!#$^$?!"2<5- X_HEBCLR ?.9f$, assert 5l$F$$$k4|4VGO!"%/%j%"A`:n$N=*N;$r#18D!"#1%/%m%C%/$N%Q%k%9$GDLCN9k
X_HEBRDY_I	1	F~NO!"C1J}8~!"IiO@M}$N%l%Y%k!#<!3,AX$X X_HEBRQ $GF14\|MW5a$r=P7FNI$$$3Hr<($9!# X_HEBRDY $, assert 5l$J$$4|4VGN X_REBR XN%Q%k%9=PNO7k2L$OJ]>Z$5lJ$$
X_HEBRQ_O	1	=PNO!"C1J}8~!"IiO@M}$N%Q%k%9!#<!3,AX$X$N%(%i%9%F%#%C%/!&%P%j%"F14|MW5a?.9f@~!#
X_HEBCLR_I	1	=PNO!"C1J}8~!"IiO@M}$N%l%Y%k!#<!3,AX$N%(%i%9%F%#%C%/!&%P%j%"$K%/%j%"MW5a$rAw$k?.9f@~!# X_HEBGRT $+$i%Q%k%9$,JV$k$^$G;}B3$9$kI,MW$,$"$k

5.2.2 %-%c%C%7%e%3%s%H%m!<%iK*1k Elastic Barrier <BAu

%-%c%C%7%e%3%s%H%m!<%i$O!" CPU $+$i%a%b%j%"%/%;%9$r<u$1<h$j!"3F CPU $+$i$N Elastic Barrier MW5a%3%^%I$r2r<a$9kHHb$K!"%3%^%s%I$K4p$E$$$/%P%j%"!&%+%&%s%?$NA}8:$*hS!"30ItXN Elastic Barrier ?.9f@~$X%s%?!<%U%'%$%9$r9T$J$&!#
Cm!'3N9`$O!"8e$Khj>\:Y2=5l$kM=Dj$G$"$k

CLR Ev3: CPU $,;22C$7$F$$$k%(%i%9%F%#%C%/!&%P%j%"$r=i4\|2=$9$k%3%^%s%I!# CPU $+$i$O!" **sth xxxxxx** H

$&%a%b%j%"%/%;%9$G<B8=5l$k!#

K\%3%^%s%I$,<B9T$5lk$H!"%-%c%C%7%e%3%s%H%m!<%i$OFbIt$KbD EB 4X78$N%+%&%s%?$r#0%j%;%C%H9

bK!"30It$K X_EBCLR ?.9f$r assert $7!" X_EBGRT ?.9f$,JVk^$G;}B3$5$;$k!#

CLR F0:n$N40N;$O!" X_EBGRT ?.9f$+$i@8@.5l$kFbIt EB_CNTL %l%8%9%?$rFI$_=P$9$3$H$G8!::$9$k

PREQ PREQ $NF0:n$r9T$J$$!"30It$K X_EBRQ ?.9f$r=PNO9kHHbK!"F14|BT$A9g$o$;?t%+%&%s%?$rA}2C$5

$k!# CPU $+$i$N sth L?Na$G<B8=5l$k

RREQ RREQ $NF0:n$r9T$J$$!"F14|BT$A9g$o$;?t%+%&%s%?$r8!::$7!"F14|$N@.N)$r8!=P$9$k!# CPU $+$i ldh

NaEy$G<B8=$5$l!"BT$A9go;OFI_=P7?>uBVKh$k>r7oJ,4tEy$G<B8=5l$k

APRV APRV $NF0:n$r9T$J$$!"FbIt%+%&%s%?$rJQ2=$5$;$kHHbK!"30It$K X_EBRQ ?.9f$KhkF14|MW5a$rH/

$k!# CPU $+$i$O sth L?Na$G<B8=5l$k

SAVE Fs<!%-%c%C%7%e!&%3%s%H%m!<%iCf$N%P%j%"4X78%+%&%s%?CM$rFI$_=P$9

3F%-%c%C%7%e%3%s%H%m!<%i$+$i$N#4K\$N Elastic Barrier ?.9f@~$O!"%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$K@\B3$

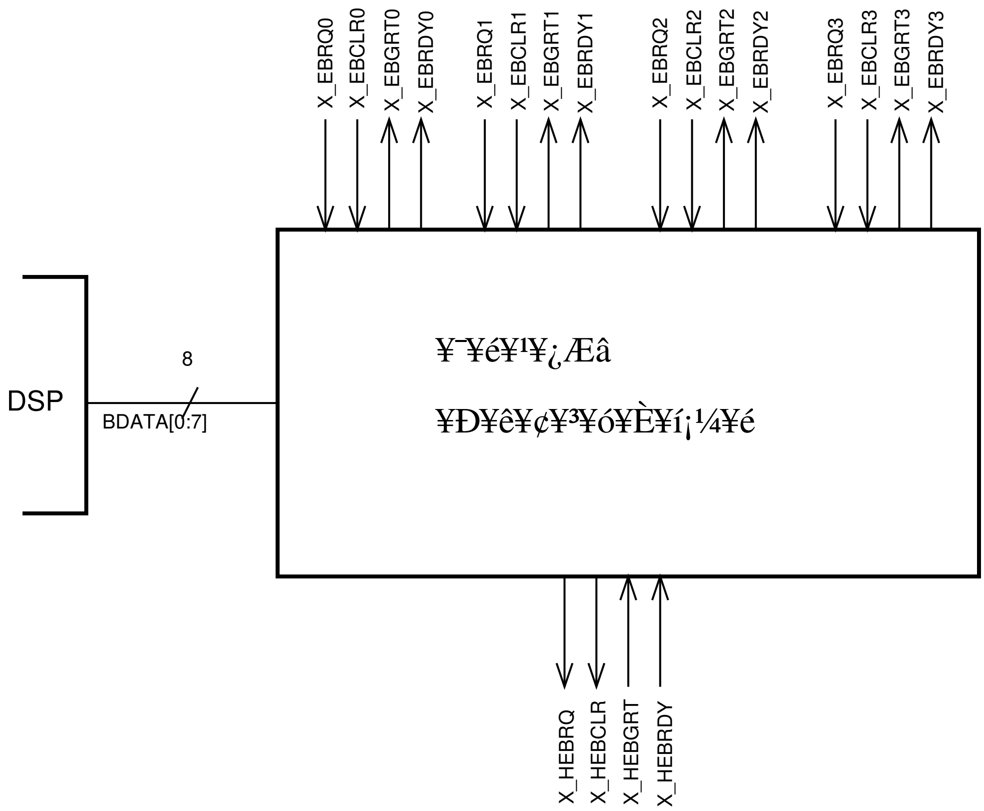
$k!#

5.2.3 2>#M#B#PK*1k<BAu

DSP $rMQ$$$?<BAuGO!"%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$O DSP $NF~=PNO%]!<%H$KhjD>@\@\B3$5$l!"%3

%m!<%iFb3F%l%8%9%?$N read/write $*$h$S%3%^%s%I$NH/9T$rEv3:F~=PNO%]!<%H7PM3$G<B8=9k!#=>CF!"2>#M#B

Au$KBP1~$9$k%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$O?^ 16$K<(9bNHJk!# DSP $+$i$O!"0J2<$K<($9F0:n$r9T$J



?^ 16: %/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$N9=@.

CLR Ev3:%/%i%9%?$N%(%i%9%F%#%C%/!&%P%j%"$r=i4|2=9k%3%^%s%I!# DSP $+$iD>@\BP1~9k%+%&%s%?$r%/%j

kH6&$K!">e0L3,AX$KMW5a9k%l%8%9%?$r%;%C%H$9k3HKhj!" X_HEBCLR ?.9f$r assert 9k!# >e0L

AX$+$i X_HEBGRT $,JV$CFMhk3HKh$j!"%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$N>uBV%l%8%9%?$r%;%C%H$
DSP $+$iFI$_=P$9!#

PREQ PREQ $NF0:n$r9T$J$$!"%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%iFbIt$K X_EBRQ ?.9f$KBP1~9k?.9f$r=PNO$9
HHbK!"%3%s%H%m!<%iFb$K:n@.$5l?F14|BT$A9g$o$;?t%+%&%s%?$rA}2C5;$k!#

RREQ RREQ $NF0:n$r9T$J$$!"%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%iFbIt$K:n$il? DSP MQF14|BT$A9g$o$;?t%+%
%?$r8!::$7!"F14|$N@.N)$r8!=P9k!# BT$A9g$o$;$OFI$_=P$7$?>uBV$Khk>r7oJ,4tEy$G<B8=$5lk

APRV APRV $NF0:n$r9T$J$$!"%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%iFbIt$K:n$il?%+%&%s%?$rJQ2=$5$;$kHH$b
X_EBRQ ?.9f$KBP1~$9$kFbIt?.9f$KhkF14|MW5a$rH/$9$k!#

SAVE %/%i%9%?Fb!&%3%s%H%m!<%iCf$N%P%j%"4X78%+%&%s%?CM$rFI$_=P$9

5.2.4 %/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i

%/%i%9%?%\!<%IKO3F#18D!"%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$,@_CV$5lk!#2>#M#B#P%/%i%9%?MQ%\!<%I$
%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$, DSP $+$i$N%P%j%"!&%$%s%?!<%U%'%$%9$r7sMk!#J*!"2>#M#B#PHG<BAu$
%/%i%9%?Fb$rJ#?t$N%P%j%"$KJ,3d$9k3HOIT2DG=G"$j!">o$KA4FN CPU $*$h$S DSP $,01$D$N%P%j%"$K;2
$k!#

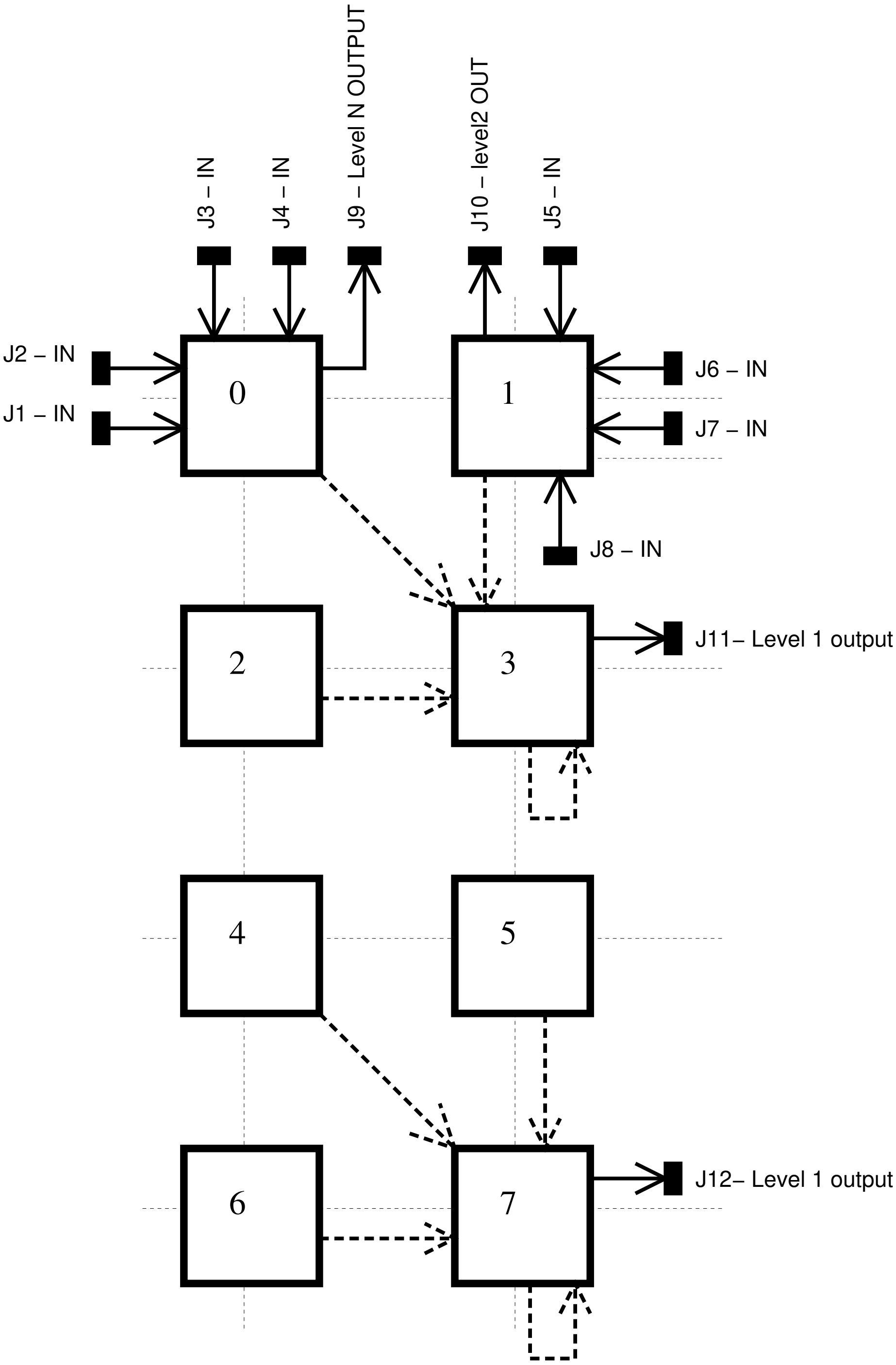
%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$O#18D$N#F#P#G#A$G<B8=$5$l!"#1#5#M#H z %/%m%C%/$GF0:n9k!#!JJ*!'
$H6&$KMQ$$$k>l9gKO!"#1#2!%#5#M#H z %/%m%C%/$GF0:n$9$k!K

%/%i%9%?Fb%P%j%"!&%3%s%H%m!<%i$+$i>e0L3,AXXN@\B3$O!"A4$F0lEY%^%6!<%\!<%I$X=PNO$7!":F$SF10l%^%6
%IFb$N%/%i%9%?%\!<%I$XLa$j>e0L3,AX$N%P%j%"!&%3%s%H%m!<%i$X@\B3$5lk!#

5.2.5 >e0L3,AX%P%j%"!&%3%s%H%m!<%i

>e0L3,AX%P%j%"!&%3%s%H%m!<%i$O!"2<0L%3%s%H%m!<%i$,@5J}7AHJ$k#4?JLZ$H7F>e0L%3%s%H%m!<%i$K@\
$k!#>e0L%3%s%H%m!<%i$O?^17$K<($5lkh&$K!"%^%6!<%\!<%IFb$N0LCVKh$j!"3,AX$,;XDj5l$k!#$J$*!">e
4V$N7k@~$G!"%^%6!<%\!<%I4V$K8Y$k?.9f$O!"%^%6!<%\!<%I>e$N ECL %I%i%$%P$Khj?.9f%l%Y%k$,JQ49$5lF<
lk!#

J*!"2>#M#B#PHG<BAuGO!"%/%i%9%?Fb%P%j%"%3%s%H%m!<%i$H!">e0L3,AX%P%j%"!&%3%s%H%m!<%i$O#18D$N
#AK^Ha$F<BAu$5lk!#



Wiring to/from outside (buffered)

Wiring within the backboard (simple wiring)

?^ 17: %^%6!<%\!<%IFb$N9=@.