Seminar Report: Ordy

Marc Guinovart, Carles Salvador, Pol Valls

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1 Introduction

La tasca d'aquesta pràctica és implementar un servei de multicast que suporti diferents models d'ordenació de missatges. Tindrem un conjunt de "workers" que és comunicaran entre ells mitjançant un sistema de multicast. Els processos multicast estaran connectats entre ells i hauran de decidir en quin ordre entreguen els missatges als workers. Els processos multicast rebran els missatges sense un ordre específic, però hauran de ser precisos alhora de fer el "delivery" d'aquests. Tenim tres modes d'ordenació:

- Bàsic: En aquesta versió no disposem de cap mecanisme d'ordenació, simplement entreguem tots els missatges que rebem sense ordre específic.
- Causal: Els missatges relacionats són entregats de forma ordenada per tots els processos (també es respecte l'ordenació FIFO).
- **Total:** Tots els missatges són entregats en el mateix ordre per tots els processos.

2 Experiments

2.1 Basic

2.1.1 2000,0

En aquest cas ens trobem en un escenari on no tenim Jitter, per tant partim de la hipòtesis que tots els missatges haurien d'estar ordenats, ja que no tenim cap agent que faci que un missatge A enviat abans que un missatge B arribi als altres nodes abans.

```
P1 RECV( 1); From: P2( 1); Subject: kaxibrmz
P1 SEND( 1); Subject: Re:kaxibrmz
P1 RECV( 2); From: P1( 1); Subject: Re:kaxibrmz
P1 RECV( 3); From: P3( 1); Subject: Re:Re:kaxibrmz
P1 SEND( 2); Subject: Re:Re:kaxibrmz
P1 RECV( 4); From: P1( 2); Subject: Re:Re:Re:kaxibrmz
P1 RECV( 5); From: P4( 1); Subject: Re:Re:kaxibrmz
P1 RECV( 6); From: P2( 2); Subject: Re:hikmylas
```

```
P1 SEND(
               3)
7)
8)
4)
                      Subject:
P1 RECV(
                     From: P1(
From: P3(
                                      3); Subject: chlpotiv
2); Subject: Re:chlpotiv
   SEND
                     Subject: I
From: P1(
                                 Re:Re:chlpotiv
                                      4); Subject: Re:Re:chlpotiv
2); Subject: mqcgokrl
3); Subject: ehqrkvga
P1 RECV(
               9)
   RECV
                      From: P4(
P1 RECV
              11)
                     From: P3(
P2 SEND(
P2 RECV(
                     Subject: Re: kaxibrmz
From: P1( 1); Sub
From: P3( 1); Sub
                                      1); Subject: Re:kaxibrmz
1); Subject: Re:Re:kaxibrmz
               2)
P2 RECV
               3)
P2 SEND(
                                  Re: Re: Re: kaxibrmz
                      Subject:
From: P1(
                                             Subject: Re:Re:Re:kaxibrmz
Subject: hikmylas
                                      2) ;
1) ;
P2 RECV
               4)
P2 RECV(
                                  2); Subject: hikmylas
chlpotiv
                      From: P4(
               5)
P2 RECV(
P2 SEND(
                      From: P2
                     Subject:
From: P1(
From: P3(
                                      3); Subject: chlpotiv
2); Subject: Re:chlpotiv
P2 BECV
P2 RECV
P2 SEND
               4)
                      Subject: Re:Re:chlpotiv
                     From: P1(
From: P4(
                                      4) ;
2) ;
P2 RECV(
                                             Subject: Re:Re:chlpotiv
                                      2); Subject: mqcgokrl3); Subject: ehqrkvga
P2 RECV
              10)
P2 RECV
                     From: P3(
              11)
P3 RECV
                      From: P2(
From: P1(
                                             Subject: kaxibrmz
Subject: Re:kaxibrmz
P3 SEND
                                  Re: Re: kaxibrmz
               1)
                      Subject:
                                      1);
P3 RECV
                                             Subject:
                                                         Re:Re:kaxibrmz
                      From: P1
P3 RECV
               4)
                                             Subject:
                                                         Re:Re:kaxibrmz
P3 RECV
                      From: P4(
                                             Subject:
                                                         hikmylas
P3 RECV
               6)
                      From: P2
                                             Subject: Re: hikmvlas
P3 RECV(
P3 SEND(
               7)
                      From: P1
                                             Subject: chlpotiv
                                  Re: chlpotiv
                      Subject:
P3 RECV
                      From: P3(
                                             Subject: Re:chlpotiv
                                             Subject: Re:Re:chlpotiv
P3 RECV
                      From: P1
               9)
                                      4)
P3 RECV(
P3 SEND(
              10)
                      From: P4(
                                             Subject: mqcgokrl
                                  ehqrkvga
               3)
                      Subject:
P3 RECV
              11)
                     From: P3(
                                      3) ; Subject: ehqrkvga
                                             Subject: kaxibrma
P4 RECV
P4 RECV(
                      From: P1
               2)
                                             Subject: Re: kaxibrmz
P4 RECV
               3)
                      From: P3
                                             Subject: Re:Re:kaxibrmz
P4 RECV
                      From: P1(
                                      2)
                                             Subject: Re:Re:Re:kaxibrmz
               4)
P4 SEND
                      Subject:
                                  hikmylas
P4 RECV(
                      From: P4(
                                             Subject: hikmylas
               5)
                                      1);
P4 RECV
P4 RECV
                      From: P2(
From: P1(
                                      2)
3)
                                             Subject:
Subject:
                                                         Re: hikmylas
chlpotiv
                                             Subject: Re:chlpotiv
Subject: Re:Re:chlpotiv
P4 RECV
                      From: P3
                                      2)
4)
P4 RECV
                      From: P1(
P4 SEND
               2)
                      Subject:
                                  mqcgokrl
                     From: P4(
From: P3(
                                      2); Subject: mqcgokrl
3); Subject: ehqrkvga
P4 RECV
```

Com podem veure, en aquest cas es respecte el ordre FIFO, tots els missatges arriben en el ordre que han estat enviats.

2.1.2 1500,3000

Ara ens trobem en una situació on el temps de Jitter es major al temps d'Sleep, per tant, suposem que els missatges poden arribar desordenats als altres nodes, per tant esperem que en algun moment no es respecti el ordre FIFO.

```
Subject: hqwifgvb
From: P1( 1);
Subject: fejqizvh
From: P1( 2);
P1 SEND
P1 RECV
                                                               ; Subject: hqwifgvb
     SEND
                      2)
2)
                                                               ; Subject: fejqizvh
                                 Subject: whdxkyut
P1
     SEND
                      3)
                                Subject: whdxkyut
From: P1( 3); Subject: whdxkyut
From: P2( 1); Subject: mieysvzb
Subject: Re:mieysvzb
From: P1( 4); Subject: Re:mieysvzb
Subject: ithydjog
P1 RECV(
P1 RECV(
                      4)
     SEND (
     RECV(
P1 SEND(
```

```
5)
3)
2)
2)
1)
                                                                  Subject: ithydjog
Subject: Re:phifvdrz
P1 RECV(
                                From: P1(
P1 RECV(
P1 RECV(
                      7)
8)
9)
                                From: P3(
From: P3(
                                                                 Subject: lcuvtkdz
Subject: jxsoadeu
P1 RECV
                                From: P2(
P1 RECV
                                From: P3(
                                                             ; Subject: cjfplkyo
                    10)
                                                       6); Subject: qtkughxe
2); Subject: ruzntyem
3); Subject: ndzh-f
P1 SEND(
P1 RECV(
                                Subject:
From: P1(
                                                      kughxe
                    11)
P1 RECV(
P1 RECV(
                    12)
13)
                                From: P4(
From: P2(
                                From: P4(
From: P3(
                                                        1); Subject: phifvdrz
4); Subject: Re:mieysvzb
3); Subject: pzcuqmxy
P1 RECV
                    14)
P1 RECV
                    15)
P1 RECV
                    16)
                                From: P4(
                                Subject: zyuciowf
From: P1( 7); Subject: zyuciowf
From: P2( 4); Subject: cqvejgtz
P1 SEND(
                    7)
17)
P1 RECV
     RECV(
                     18)
P1 RECV(
P1 RECV(
                                From: P4(
From: P3(
                                                        7); Subject: fksbhwlg
6); Subject: hulkgsvm
                    19)
                    20)
                    21)
22)
                                From: P4(
From: P4(
                                                        4); Subject: havwdfsm
9); Subject: ijkyglrt
P1 RECV
P1 RECV
P1 SEND(
                      8)
                                Subject: Re: ijkyglrt
                                                       ---р2-
P2 SEND(
                      1)
                                Subject: mievsvzb
                                From: P2(
From: P1(
From: P3(
                                                        1); Subject: mieysvzb
1); Subject: hqwifgvb
1); Subject: cjfplkyo
P2 RECV(
P2 RECV
                      2)
3)
P2 RECV
                                Subject: jxsoadeu
P2 SEND
                      2)
                                                        2); Subject: jxsoadeu
3); Subject: whdxkyut
1); Subject: phifvdrz
                                From: P2(
P2 RECV
                                From: P1(
From: P4(
P2 RECV(
P2 RECV
                                Subject: ndzbrfxw
P2 SEND
                      3)
                                                       zbrfxw
3); Subject: ndzbrfxw
2); Subject: ruzntyem
2); Subject: lcuvtkdz
5); Subject: ithydjog
4); Subject: havwdfsm
4); Subject: Re:mieysvzb
                                From: P2(
From: P4(
P2 RECV
P2 RECV
P2 RECV
                                From: P3(
                                From: P1(
From: P4(
From: P1(
P2 RECV
                    10)
P2 RECV
P2 RECV
                    12)
                                                  4); Subject: Re:mieysvzb
cqvejgtz
4); Subject: cqvejgtz
4); Subject: Re:mieysvzb
5); Subject: dgketfzq
                                Subject:
From: P2(
P2 SEND
                      4)
P2 RECV(
                    13)
P2 BECV
                                From: P3(
From: P3(
                    14)
P2 RECV(
                    15)
                                                        3); Subject: dgketzq
3); Subject: Re:phifvdrz
2); Subject: fejqizvh
5); Subject: Re:cqvejgtz
6); Subject: Re:Re:mieysvzb
7); Subject: zyuciowf
3); Subject: pzcuqmxy
                                From: P3(
From: P1(
P2 RECV
                    16)
P2 RECV(
                    17)
                    18)
19)
P2 RECV
                                From: P4(
P2 RECV(
                                From: P4(
P2 RECV
                    20)
                                From: P1
P2 RECV(
                    21)
                                From: P4(
                                Subject: ikxnwabr
From: P2( 5); Subject: ikxnwabr
From: P1( 6); Subject: qtkughxe
P2 SEND
 P2 RECV(
                                From: P1(
P2 BECV
                    23)
P2 SEND
                      6)
                                                  woentafk
                                Subject:
                                                      oentafk
6); Subject: woentafk
10); Subject: Re:ndzbrfxw
7); Subject: ldqskwrc
                               From: P2(
From: P4(
From: P3(
P2 RECV
                    24)
P2 RECV(
                    25)
P2 BECV
                    26)
                                               -р3-
                               Subject: cjfplkyo
From: P3( 1); Subject: cjfplkyo
Subject: lcuvtkdz
From: P3( 2); Subject: lcuvtkdz
From: P4( 1); Subject: phifvdrz
Subject: Re: phifvdrz
From: P3( 3); Subject: Re: phifvdrz
From: P1( 1); Subject: hqwifgvb
From: P1( 2); Subject: fejqizvh
From: P2( 1); Subject: mieysvzb
Subject: Re: mieysvzb
From: P3( 4); Subject: Re: mieysvzb
Subject: dgketfzq
From: P3( 5); Subject: dgketfzq
From: P2( 2); Subject: jxsoadeu
Subject: hulkgsvm
From: P3( 6); Subject: hulkgsvm
P3 SEND(
P3 RECV
                      1)
P3 SEND
P3 RECV(
                      2)
P3 RECV
P3 SEND
                      3)
P3 RECV
P3 RECV
                      5)
P3 RECV
P3 RECV
P3 SEND
P3 RECV
P3 SEND
                      5)
P3 RECV(
                      9)
P3 BECV
                    10)
P3 SEND(
                      6)
                                                        6); Subject: hulkgsvm
6); Subject: Re:Re:mi
                                From: P3(
From: P4(
P3 RECV(
P3 RECV(
                    11)
12)
                                                                  Subject: Re:Re:mieysvzb
P3 RECV
                    13)
                                From: P2(
                                                        3)
                                                                  Subject: ndzbrfxw
                                                        4);
3);
7);
2);
P3 RECV(
                                From: P4(
                    14)
                                                                  Subject: havwdfsm
                                                                  Subject: whdxkyut
Subject: fksbhwlg
P3 RECV
                    15)
                                From: P1(
P3 RECV(
                    16)
                                From: P4(
                                From: P4(
From: P1(

2); Subject: ruzntyem
5); Subject: ithydjog
5); Subject: Re:cqvejgtz

P3 RECV
                    17)
                    18)
P3 RECV(
P3 RECV
                    19)
                               From: P4(
```

```
P3 RECV(
                                                Subject: Re: mievsvzb
                       From: P1(
P3 RECV(
P3 SEND(
                       From: P1
                                                Subject: qtkughxe
                                    ldqskwrc
                       Subject:
   RECV
              22)
                       From: P3(
From: P4(
                                        7) ;
3) ;
                                                Subject: ldqskwrc
P3 RECV
                                                Subject: pzcuqmxy
Subject: ikxnwabr
              23)
                                        5)
4)
P3 RECV
                       From: P2
P3
   RECV
              25)
                       From: P2
                                            ; Subject:
                                                             cqvejgtz
                       Subject: From: P3(
                                    emrsnzau
   SEND
              8)
26)
                                        rsnzau
8) ; Subject: emrsnzau
9) ; Subject: pujqhbia
8) ; Subject: Re:dgketfzq
P3 RECV
                       From: P1(
From: P4(
P3 RECV
   RECV
              28)
P3 SEND
                       Subject:
                                    rxvcupsm
P3 RECV
                       From: P3(
From: P2(
                                        9);
7);
                                                Subject:
              29)
                                                             rxvcupsm
                                    7); Subject:
Re:Re:fksbhwlg
P3 RECV
              30 ĺ
                                                             Re: fksbhwlg
   SEND (
              10)
                       Subject:
P3 RECV(
P3 RECV(
              31)
32)
                       From: P3(
From: P1(
                                               Subject:
Subject:

  \begin{array}{ccc}
    10) & ; \\
    7) & ;
  \end{array}

                                                             Re:Re:fksbhwlg
                                                             zyuciowf
                       From: P1( 8); Subject: Subject: Re:Re:ijkyglrt
P3 RECV
              33)
                                                             Re: ijkyglrt
   SEND(
                      From: P3(
From: P4(
                                       11); Subject:
9); Subject:
P3 RECV
              34)
                                                Subject: Re:Re:ijkyglrt
P3 RECV
                                                            ijkyglrt
                       From: P1
P4 RECV
                                             ; Subject: hqwifgvb
                                    phifvdrz
   SEND (
                       Subject:
                       From: P4(
From: P2(
P4 RECV
                2)
3)
                                        \begin{pmatrix} 1 \\ 2 \end{pmatrix};
                                               Subject:
                                                             phifvdrz
                                                Subject:
                                                             jxsoadeu
                                                Subject:
Subject:
P4 RECV
                4)
                       From: P2
                                        1)
                                                             mieysvzb
P4 RECV
                                        3);
P4 RECV
                6)
                       From: P1(
                                                Subject:
                                                             whdxkvut
P4 RECV
                7)
                              P3 (
                                               Subject:
                                                             Re: phifvdrz
   SEND
                       Subject:
                                    ruzntyem
                       From: P4(
From: P1(
                                        2); Subject: ruzntyem
2); Subject: fejqizvh
P4 RECV
P4 RECV
P4 SEND
                       Subject: pzcuqmxy From: P4(3);
                                               ,
Subject: pzcugmxy
P4 RECV
              10)
                       Subject: I
From: P4(
From: P3(
                                    havwdfsm
   SEND (
                                               Subject: havwdfsm
P4 RECV
                                        4); 2);
               11)
P4 RECV
              12)
                                                Subject: lcuvtkdz
                                        5);
   RECV(
                       From: P1(
                                                Subject: ithydjog
               13)
P4 RECV
                       From: P2(
                                                Subject: cqvejgtz
   SEND(
                                    Re: cqvejgtz
                       Subject:
                       From: P4(
From: P3(
                                        5); Subject: Re:cqvejgtz
4); Subject: Re:mieysvzb
P4 RECV
   RECV
              16)
P4 SEND
                       Subject:
                                   Re: Re: mieysvzb
                       From: P4(
From: P1(
                                        6); Subject: Re:Re:mieysvzb
4); Subject: Re:mieysvzb
   RECV(
P4 RECV
   SEND (
                       Subject: fksbhwlg
                                                             fksbhwlg
   RECV (
                       From: P4(
From: P3(
Ρ4
                                        7);
5);
                                                Subject:
                                                Subject: dgketfzq
              20)
                       Subject: Re:dgketfzq
From: P4( 8); Subject: Re:dgketfzq
From: P1( 6); Subject: qtkughxe
   SEND
   RECV(
P4 RECV
              22)
    SEND (
                       Subject:
From: P4(
From: P1(
                                    ijkyglrt
9);
                                               Subject: ijkyglrt
P4 RECV
              23)
    RECV (
              24)
                                                Subject:
                                                             zyuciowi
                       From: P2( 3); Sul
Subject: Re:ndzbrfxw
   RECV
              25)
                                                Subject: ndzbrfxw
    SEND(
               10)
                                       10); Subject: Re:ndzbrfxw
9); Subject: pujqhbia
                       From: P4(
From: P1(
   RECV
```

La nostre hipòtesis es compleix, podem veure com s'han desordenat gran quantitat de missatges. Per posar un exemple, en el procés 2 rebem el primer missatge procedent del P1, i el segon missatge que rebem d'aquest mateix procés és el número 3, i no és fins al cap d'un temps que rebem el número 2. Per tant estem veient com rebem missatges desordenats. Això és degut a que el temps entre enviaments de nous missatges (Sleep) pot ser menor al temps que tarda un missatge en arribar al seu destí (Jitter).

2.2 Causal

i) Set up the causal order multicast system, and repeat the previous tests.

2.2.1 2000,0

```
1) ; Subject: glrdftzq
1) ; Subject: Re:glrdftzq
P1 RECV(
                           From: P4(
P1 RECV(
P1 SEND(
                  2)
1)
                           From: P2
                          Subject: gqfcmivl
From: P1(1); S
                          Subject: gqfcmivl
From: P1( 1); Subject: gqfcmivl
From: P2( 2); Subject: Re:gqfcmivl
From: P3( 1); Subject: qjxnolvi
Subject: Re:qjxnolvi
From: P1( 2); Subject: Re:qjxnolvi
From: P2( 3); Subject: ljscxtrp
From: P4( 2); Subject: ixgmdvkw
Subject: Re:ixgmdvkw
Subject: Re:ixgmdvkw
P1 BECV
P1 RECV
                  5)
2)
P1 RECV
    SEND(
P1 RECV
P1 RECV(
                  8)
3)
P1 RECV
    SEND(
                          From: P1(
From: P3(
P1
P1
    RECV(
                                              3); Subject: Re:ixgmdvkw
2); Subject: Re:ixgmdvkw
                 10)
P1 RECV
                 11)
                           From: P4(
                                              3); Subject: Re:Re:ixgmdvkw
                          SEND(
Ρ1
    RECV
                 12)
                 13)
    RECV(
P1
    SEND
                  5)
    RECV(
                 14)
                 15)
16)
Ρ1
    BECV(
P1 RECV
                         P1
    SEND
                 6)
17)
    RECV
                 18)
7)
19)
P1 RECV
P1 SEND(
P1 RECV(
                          From: P4( 1); Subject: glrdftzq
Subject: Re: glrdftzq
From: P2( 1); Subject: Re: glrdftzq
From: P1( 1); Subject: gqfcmivl
P2 RECV
P2 SEND(
P2 RECV(
P2 RECV(
                         From: P2( 1); Subject: 67
From: P1( 1); Subject: 67
Subject: Re:gqfcmivl
From: P2( 2); Subject: Re:gqfcmivl
From: P3( 1); Subject: qjxnolvi
From: P1( 2); Subject: Re:qjxnolvi
                  3)
P2 SEND(
P2 RECV(
P2 RECV
                  5)
P2 RECV
P2 SEND
                          From: P2(
From: P4(
From: P3(
P2 RECV(
                                                      Subject: ljscxtrp
                                              3);
2);
2);
P2 RECV(
P2 RECV(
                                                      Subject: ixgmdvkw
Subject: Re:ixgmdvkw
                  9)
                                              3);
3);
P2 RECV
                 10)
                           From: P1(
                                                       Subject: Re:ixgmdvkw
P2 RECV(
                           From: P4(
                                                      Subject: Re:Re:ixgmdvkw
                 11)
P2 RECV
                 12)
13)
                           From: P1
                                              4)
3)
                                                      Subject: xkmeazfy
Subject: Re:xkmeazfy
P2 RECV
                           From: P3(
P2 RECV(
P2 SEND(
                 14)
4)
                          From: P1(
Subject:
                                              5)
                                                      Subject: Re:Re:xkmeazfy
                                         uwthxkza
                 15)
16)
17)
                           From: P2(
P2 BECV
                                              4);
4);
                                                      Subject: uwthxkza
                          From: P4(
P2 RECV
                                                      Subject:
                                                      Subject: qknivtce
Subject: Re: qknivtce
                                              6)
P2 RECV
                          From: P1(
P2 RECV
                 18)
                           From: P3(
                                                      Subject: stgxnozi
Subject: Re:stgxnozi
P2 RECV
                 19)
                          From: P1
P3 RECV(
                           From: P4(
                                              1)
                                                       Subject: glrdftzq
                                                      Subject: Re: glrdftzq
Subject: gqfcmivl
Subject: Re: gqfcmivl
P3 RECV(
P3 RECV(
                  2)
3)
                          From: P2(
From: P1(
                                              1)
P3 RECV
                  4)
                           From: P2
                                              2)
P3 SEND
                          Subject:
From: P3(
                                         qjxnolvi
                                                      Subject: qjxnolvi
Subject: Re:qjxnolvi
Subject: ljscxtrp
P3 RECV
                  5)
                                              1);
2);
P3 RECV
                  6)
7)
                           From: P1(
P3 RECV
                           From: P2
                                              3)
P3 RECV
                           From: P4(
                                                       Subject: ixgmdvkw
                          From: F4( 2), Subject: Re:ixgmdvkw
From: P3( 2); Sub
From: P1( 3); Sub
P3 SEND
                  2)
                                                      Subject: Re:ixgmdvkw
P3 RECV
                                                      Subject: Re:ixgmdvkw
Subject: Re:Re:ixgmdvkw
P3 RECV
                 10)
P3 RECV
                                              3);
4);
P3 RECV
                 12)
                           From: P1
                                                      Subject: xkmeazfy
                                        Re:xkmeazfy
( 3); Subject: Re:xkmeazfy
( 5); Subject: Re:Re:xkmea
P3 SEND(
P3 RECV(
                          Subject:
From: P3(
                 13)
P3 RECV(
                 14)
                           From: P1(
                                                      Subject: Re:Re:xkmeazfy
                           From: P2(
                                                      Subject: uwthxkza
                 15)
                                              4);
                          From: P4(
From: P1(
P3 RECV
                 16)
                                              4);
6);
                                                      Subject: qknivtce
Subject: Re:qknivtce
P3 RECV
                 17)
P3 SEND
                  4)
                           Subject:
                                         stgxnozi
                                              4) ; Subject: stgxnozi
7) ; Subject: Re:stgxnozi
                           From: P3(
P3 RECV
                 18)
                          From: P1(
P3 RECV
                 19)
                  1); Subject: glrdftzq
1); From: P4(1); Subject: glrdftzq
P4 SEND(
P4 RECV
```

```
1);
1);
2);
1);
2);
P4 RECV(
                                                     Subject: Re: glrdftzq
                         From: P2(
P4 RECV(
P4 RECV(
                         From: P1(
From: P2(
                                                     Subject: gqfcmivl
Subject: Re:gqfcmivl
                  3)
                  4)
P4 RECV
                          From: P3(
                                                     Subject: qjxnolvi
Subject: Re:qjxnolvi
P4 RECV
                          From: P1(
                  6)
P4 RECV(
P4 SEND(
                  7)
                          From: P2
                                             3)
                                                  ; Subject:
                          Subject:
                                        ixgmdvkw
P4 RECV(
P4 RECV(
                         From: P4(
From: P3(
                                             2) ; Subject: ixgmdvkw
2) ; Subject: Re:ixgmdvkw
                  8)
9)
P4 SEND(
P4 RECV(
                3)
10)
                          Subject: Re:Re:ixgmdvkw
From: P1( 3); Subject: Re:ixgmdvkw
                                             3);
3);
P4 RECV
                11)
                          From: P4(
                                                     Subject: Re:Re:ixgmdvkw
                         From: P1(
From: P3(
P4 RECV(
                                                     Subject: xkmeazfy
Subject: Re:xkmeazfy
Subject: Re:Re:xkmeazfy
                                             4);
3);
5);
                12)
P4 RECV
                13)
P4 RECV(
                14)
                          From: P1(
P4 RECV(
P4 SEND(
                15) \\ 4)
                         From: P2(
Subject:
                                             4)
                                                     Subject: uwthxkza
                                         qknivtce
                16)
17)
                         From: P4(
From: P1(
                                             4);
6);
                                                     Subject: qknivtce
Subject: Re:qknivtce
P4 RECV
P4 RECV
                      ; From: P3(
; From: P1(
                                             4) ; Subject: stgxnozi
7) ; Subject: Re:stgxnozi
P4 RECV
                18)
P4 RECV(
                19)
```

2.2.2 1500,3000

```
Subject: gtvsdqxh
From: P1( 1); Subject: gtvsdqxh
From: P3( 1); Subject: jrhqvfsz
P1 SEND(
P1 RECV(
P1 RECV(
                             2)
                                         From: P3( 1); Subject: Jinqvioz
Subject: wsitrdun
From: P1( 2); Subject: wsitrdun
From: P4( 1); Subject: knisfjve
From: P3( 2); Subject: Re:gtvsdqxh
Ρ1
P1 SEND(
P1 RECV(
                                      From: P4( 1); Sue,
From: P4( 1); Sue,
From: P4( 1); Subject: Re:give...
Subject: cfmbawok
From: P1( 3); Subject: cfmbawok
Subject: ioudnxzy
From: P1( 4); Subject: ioudnxzy
From: P3( 3); Subject: evgjrfnh
Subject: lqzjtunf
From: P1( 5); Subject: lqzjtunf
; Subject: gldbywxn
; From: P1( 6); Subject: gldbywxn
; From: P2( 1); Subject: qdoriubk
; From: P2( 2); Subject: xfkqiyad
P1 RECV
                              4)
P1 RECV
                             5)
P1 SEND(
P1 RECV(
                             3)
6)
P1 SEND(
P1 RECV(
P1 RECV(
P1 SEND(
P1 RECV
                             9)
P1 SEND(
P1 RECV(
                             6)
                           10)
P1 RECV(
P1 RECV
                           12)
                                          rrom: P1( 1); Subject: gtvsdqxh
Subject: qdoriubk
From: P2( 1); Sn1.
From: P2/
P2 RECV(
P2 SEND
                             1)
                                                                   qdoriubk

1); Subject: qdoriubk
1); Subject: jrhqvfsz
 P2 RECV
P2 RECV
                             3)
                                           From: P3
                                          From: P3( 1); Subject: jrhqvfsz
Subject: xfkqiyad
From: P2( 2); Subject: xfkqiyad
Subject: plxwkbvt
From: P2( 3); Subject: plxwkbvt
From: P3( 2); Subject: Re:gtvsdc
P2 SEND(
P2 RECV
                             4)
P2 SEND
                                          Subject: plxwkbvt
From: P2( 3); Subject: plxwkbvt
From: P3( 2); Subject: Re:gtvsdqxh
From: P3( 3); Subject: evgjrfnh
Subject: mpcvfowt
From: P2( 4); Subject: mpcvfowt
From: P3( 4); Subject: wtrsjxhp
Subject: dloyvftq
From: P2( 5); Subject: dloyvftq
P2 RECV
                             5)
P2 RECV
P2 RECV
P2 SEND(
P2 RECV(
P2 RECV(
P2 SEND(
                             5)
                                                                         5); Subject: dloyvftq
1); Subject: knisfjve
                                          From: P2(
From: P4(
P2 RECV(
P2 RECV(
                           11)
                                                                         2); Subject: esifdobn
3); Subject: ldoqhstc
4); Subject: bonujzis
2); Subject: wsitrdun
                                          From: P4(
From: P4(
From: P4(
P2 RECV
                           12)
P2 RECV
                           13)
P2 RECV
                           14)
                                          From: P1(
P2 RECV(
                           15)
                                                                --р3-
                                          P3 SEND(
P3 RECV(
                             1)
1)
                             2)
2)
P3 RECV
P3 SEND(
                             3)
3)
P3 RECV
P3 SEND(
P3 RECV
                             4)
P3 SEND(
                              4)
P3 RECV
P3 RECV
                                         From: P4( 1); Subject: knisfjve
Subject: Re:knisfjve
From: P3( 5); Subject: Re:knisfjve
From: P4( 2); Subject: esifdobn
Subject: Re:esifdobn
From: P3( 6); Subject: Re:esifdobn
Subject: drwxjkvb
                             5)
7)
P3 SEND
P3 RECV
P3 SEND
P3 RECV
P3 SEND(
```

```
From: P3( 7);
P3 RECV(
                                                         7) ; Subject: drwxjkvb
                                Subject: 1
From: P3(
P3 SEND(
P3 RECV(
                     8)
11)
                                                         8) ; Subject: lxbynuda
      SEND
                                 Subject: phbgdxly
From: P3(9);
                                                                    Subject: phbgdxly
P3 RECV
                     12)
                                                         9);
3);
1);
                                                                    Subject: phogaz,
Subject: ldoqhstc
Subject: qdoriubk
Subject: xfkqiyad
                                 From: P4(
From: P2(
P3 RECV
                     13)
P3
     RECV (
                     14)
                                 From: P2(
From: P2(
                                                         2); Subject: xfkqiyad
3); Subject: plxwkbvt
D3 BECV
P3 RECV(
                                 From: P1( 1); Subject: gtvsdqxh
Subject: knisfjve
From: P4( 1); Subject: knisfjve
P4 RECV
P4 SEND
                       2)
2)
P4 RECV
P4 SEND
                                 Subject: esifdobn
                                 Subject: esifdobn
From: P4( 2); Subject: esifdobn
Subject: ldoqhstc
From: P4( 3); Subject: ldoqhstc
Subject: bonujzis
P4 RECV(
P4 SEND(
P4 RECV
P4 SEND
                                 From: P4(
P4 RECV
                       5)
                                                        4)
                                                               ; Subject: bonujzis
                                Subject: gcawmdlo
From: P4( 5); 5
From: P3( 1); 5
P4 SEND
                                                         wmdlo
5); Subject: gcawmdlo
1); Subject: jrhqvfsz
2); Subject: wsitrdun
2); Subject: Re:gtvsdqxh
                       6)
7)
P4 RECV
P4 RECV
P4 RECV
                                 From: P1(
P4 RECV
                                 From: P3(
                                 Subject: mixdruqz
From: P4( 6); Subject: mixdruqz
From: P2( 1); Subject: qdoriubk
P4 SEND
P4 RECV
                               From: P2( 1); Subject: qdoriubk
Subject: qwwemupr
From: P4( 7); Subject: qwwemupr
Subject: dmyqrohk
From: P4( 8); Subject: dmyqrohk
Subject: elwomuya
From: P4( 9); Subject: elwomuya
From: P1( 3); Subject: cfmbawok
Subject: Re:cfmbawok
From: P4( 10); Subject: Re:cfmbawok
Subject: kuidshqb
From: P4( 11); Subject: kuidshqb
P4 RECV
                     11)
P4 SEND
P4 RECV
                     12)
     SEND (
P4 RECV
                     13)
     SEND
P4 RECV
                     14)
P4 RECV(
P4 SEND(
                     10)
P4 RECV
      SEND
```

Amb la implementació d'aquesta versió podem veure com efectivament es compleix que l'ordre en els missatges que estan relacionats entre si, és a dir, cap instància d'erlang mai entregarà les contestacions d'un missatge abans que el propi missatge.

2.3 Total

i) Set up the total order multicast system, and repeat the previous tests.

2.3.1 2000,0

```
From: P4(
                                              1); Subject: oawtzpmh
P1 RECV
                          Subject: rzwxofvs
From: P1( 1); Subject: rzwxofvs
From: P3( 1); Subject: stdcmyeo
P1 SEND
P1 RECV(
P1 RECV(
P1 SEND(
                  3)
2)
                          From: 16, Subject: vwbdckoa
From: P1( 2); Subject: vwbdckoa
From: P2( 1); Subject: mvwhegir
P1 RECV(
P1 RECV(
P1 SEND
                  3)
P1 SEND(
P1 RECV(
P1 SEND(
P1 RECV(
P1 RECV(
                                        ( 2); Subject: Re:mvwhegir
Re:Re:mvwhegir
                          From: P3(
                  4)
                          Subject:
                          From: P1(
From: P2(
                                                                     Re: mvwhegir
                                                      Subject:
                                              3);
2);
                                                      Subject: Re:Re:mvwhegir
Subject: Re:Re:mvwhegir
P1 RECV
                          From: P1(
P1 RECV(
P1 RECV(
                 10)
11)
                          From: P3(
From: P2(
                                              3)
                                                      Subject: Re:Re:mvwhegir
Subject: Re:Re:mvwhegir
P1 RECV(
P1 SEND(
P1 RECV(
                 12)
5)
                          From: P4(
                                              2)
                                                   ; Subject: Re:Re:Re:mvwhegir
                          Subject:
From: P1(
                                         gazdpvmr
                                                      Subject: gazdpvmr
                                              5);
3);
                 13)
    \operatorname{RECV}
                 14)
                          From: P4(
                                                       Subject: Re:gazdpvmr
                                    P3 (
     RECV
                 15)
                          From:
                                                       Subject:
                                                                     iklwxfbe
                                                      Subject: fgkjlenm
```

```
5)
4)
6)
                                                  Subject: qcposgdu
Subject: Re:qcposgdu
Subject: Re:Re:qcposgdu
P1 RECV(
                        From: P3(
                        From: P2(
From: P3(
P1 RECV
P1
   RECV
               19)
P1 SEND(
P1 RECV(
                6 )
                        Subject:
From: P2(
                                      Re:Re:Re:qcposgdu
                                                  Subject: upmwshcq
Subject: Re:Re:Re:qcposgdu
               20)
                                          5);
6);
P1
P1
                        From: P1(
From: P2(
   RECV
   RECV
               22)
                                          6)
                                                  Subject: tykpqzin
                        Subject:
From: P1(
                                     Re:tykpqzin
( 7); Subject: Re:tykpqzin
( 7); Subject: Re:tykpqzin
( 7); Subject: Re:Re:tykpq
( 5); Subject: Re:Re:ty
               7)
23)
Р1
   SEND
P1 RECV(
                                                  Subject: Re:Re:tykpqzin
Subject: Re:Re:tykpqzin
P1 RECV(
P1 RECV(
               24)
25)
                        From: P2(
From: P4(
P1 RECV
               26)
                        From: P2
                                          8)
                                                  Subject: gmyqwiab
                        From: P2(
                                          9)
P1 RECV
               27)
                                                  Subject: qlyzbjgf
                                    Re: qlyzbjgf
( 8); Subject: Re: qlyzbjgf
( 10); Subject: Re:Re: qlyzb
( 6); Subject: labyrdkj
P1 SEND
                8)
                        Subject:
                        From: P1(
   RECV (
               28)
P1 RECV(
P1 RECV(
                        From: P2(
From: P4(
                                                  Subject: Re:Re:qlyzbjgf
Subject: labyrdkj
               29)
               30)
                        Subject:
From: P1(
                                      aezdyhmf
9); Subject: aezdyhmf
7); Subject: hftnpews
P1 SEND
                9)
P1 RECV
               31)
P1 RECV
               32)
                        From: P3(
                          ъ2-
P2 RECV
                        From: P4(
                                          1)
                                                  Subject: oawtzpmh
                                               ;
                        From: P1(
From: P3(
                                          1)
1)
                                              ;
                                                  Subject: rzwxofvs
Subject: stdcmyeo
P2 RECV
                2)
P2 RECV
P2 RECV
                4)
1)
                        From: P1(
                                          2)
                                                  Subject: vwbdckoa
                                          1); Subject: mvwhegir
2); Subject: D
                        Subject: mvwhegir
From: P2(1);
From: P3(2);
    SEND
P2 RECV
                5)
P2 RECV
                                                  Subject: Re: mvwhegir
                2)
7)
3)
P2 SEND
                        Subject: Re: Re: mywhegir
                        From: P1(3); Subject
Subject: Re:Re:mvwhegir
P2 RECV
                                              ; Subject: Re: mvwhegir
P2 SEND
                        From: P2(
From: P1(
P2 RECV
                8)
9)
                                          2)
                                              ;
                                                  Subject: Re:Re:mvwhegir
P2 RECV
                                                  Subject: Re:Re:mvwhegir
P2 RECV(
               10)
                        From: P3
                                          3)
                                                  Subject:
                                                               Re:Re:mvwhegir
                        From: P2(
                                          3)
               11)
                                                  Subject:
                                                               Re: Re: mvwhegir
P2 RECV(
P2 RECV(
               12)
                        From: P4(
From: P1(
                                                  Subject: Re:Re:mvwhegir
                                          5)
3)
                                                  Subject: gazdpvmr
Subject: Re:gazdpvmr
               13)
P2 RECV
               14)
                        From: P4(
P2 RECV
               15)
                        From: P3(
                                                  Subject: iklwxfbe
                                          4);
                                          4); Subject: fgkjlenm
5); Subject: qcposgdu
               16)
17)
                        From: P4(
From: P3(
P2 RECV
P2 RECV
                       P2 SEND(
P2 RECV(
                4)
               18)
               5)
19)
P2 SEND
P2 RECV(
                                          6); Subject: Re:Re:qcposgdu
5); Subject: upmwshcq
6); Subject: Re:Re:qcposgdu
P2 RECV
               20)
P2 RECV
               21)
                        Subject: tykpqzin
From: P2( 6); Subject: tykpqzin
From: P1( 7); Subject: Re:tykpqzin
Subject: Re:Re:tykpqzin
P2 SEND(
P2 RECV(
               6)
22)
P2 RECV(
P2 SEND(
               23)
7)
                        From: P2( 7); Subject: Re:Re:tykpqzin
From: P4( 5); Subject: Re:Re:tykpqzin
P2 RECV
               24)
P2 RECV
               25)
                        Subject: gmyqwiab
From: P2( 8); Subject: gmyqwiab
Subject: qlyzbjgf
P2 SEND
                8)
P2 RECV
               26)
                        Subject: 6
From: P2(
From: P1(
P2 SEND
                9
                                          9); Subject: qlyzbjgf
8); Subject: Re:qlyzb
P2 RECV
               27)
P2 RECV(
P2 SEND(
                                      8); Subject: Re:qlyzbjgf
Re:Re:qlyzbjgf
               28)
                        Subject: I
From: P2(
From: P4(
               10)
                                                  Subject: Re:Re:qlyzbjgf
                                        10); Subject: Re:Re:ql
6); Subject: labyrdkj
P2 RECV
               29)
P2 RECV
               30)
                        From: P1
                                          9); Subject: aezdyhmf
7); Subject: hftnpews
P2 RECV
               31)
P2 RECV(
                        From: P3(
P3 RECV(
                                          1) ;
1) ;
                                                  Subject: oawtzpmh
                        From: P4(
P3 RECV
                2)
                        From: P1(
                                                  Subject: rzwxofvs
P3 SEND
                1)
                        Subject:
                                      stdcmyeo
                                          1);
2);
1);
P3 RECV
                        From: P3(
                                                  Subject: stdcmyeo
                        From: P1(
From: P2(
P3 RECV
                4)
                                                  Subject: vwbdckoa
                5)
P3 RECV
                                          1)
                                                  Subject: mvwhegir
P3 SEND
                        Subject: Re: mvwhegir
                        From: P3(
From: P1(
                                          2) ;
3) ;
                                                 Subject: Re:mvwhegir
Subject: Re:mvwhegir
P3 RECV
                6)
7)
P3 RECV
                        Subject:
From: P2(
From: P1(
P3 SEND(
P3 RECV(
                3)
8)
                                      Re:Re:mvwhegir
2); Subject:
                                                               Re:Re:mvwhegir
                                          2)
4)
                                              ;
P3 BECV
                9)
                                                  Subject: Re:Re:mvwhegir
                        From: P3(
From: P2(
                                                  Subject: Re:Re:mvwhegir
Subject: Re:Re:mvwhegir
P3 RECV
                                          3)
               10)
P3 RECV
               11)
P3 RECV(
               12)
                        From: P4(
                                          2)
                                                  Subject: Re:Re:mvwhegir
                        From: P1(
From: P4(
                                               ; Subject: gazdpvmr
; Subject: Re:gazdpvmr
P3 RECV
               13)
                                          5)
                                          3)
P3 RECV
               14)
                                     iklwxfbe
P3 SEND
                4)
                        Subject:
```

```
4); Subject: iklwxfbe
4); Subject: fgkjlenm
P3 RECV(
                                    From: P3(
P3 RECV(
P3 SEND(
                       16)
5)
17)
                                     From: P4(
                                     Subject: qcposgdu
                                    From: P3(
From: P2(
P3 RECV
                                                                5);
4);
                                                                           Subject: qcposgdu
Subject: Re:qcposgdu
P3 RECV(
                       18)
                                    Subject:
From: P3(
From: P2(
From: P1(
P3 SEND(
P3 RECV(
                       6)
19)
                                                                       qcposgdu
                                                                6)
5)
6)
                                                                            Subject: Re:Re:qcposgdu
                                                                       ;
                       20) \\ 21)
                                                                           Subject: upmwshcq
Subject: Re:Re:Re:qcposgdu
P3 BECV
P3 RECV(
                                                                           Subject: tykpqzin
Subject: Re:tykpqzin
Subject: Re:Re:tykpqzin
Subject: Re:Re:tykpqzin
Subject: Re:ge:tykpqzin
Subject: gmyqwiab
P3 RECV(
P3 RECV(
                                    From: P2(
From: P1(
                                                                6)
7)
7)
                       22)
                       23)
P3 RECV
                       24)
                                    From: P2
                                    From: P4(
From: P2(
From: P2(
P3 RECV
                       25)
                                                                5)
8)
                                                                      ;
                                                                                                gmyqwiab
qlyzbjgf
                       26)
27)
P3 RECV
P3 RECV
                                                                9)
                                                                           Subject:
P3 RECV(
P3 RECV(
                       28)
29)
                                    From: P1(
From: P2(
                                                              8)
10)
                                                                           Subject: Re:qlyzbjgf
Subject: Re:Re:qlyzbjgf
                       30)
31)
                                    From: P4(
From: P1(
                                                                6)
9)
                                                                       ; Subject: labyrdkj
; Subject: aezdyhmf
P3 RECV
P3 RECV
                                                         hftnpews
7); Subject: hftnpews
P3 SEND
                                     {\tt Subject}:
P3 RECV(
                                    From: P3(
                                    P4 Subject: oawtzpmh
From: P4( 1);
From: P1( 1);
From: P3( 1);
P4 SEND(
                                                                      ; Subject: oawtzpmh
P4 RECV(
                                                               1); Subject: oawtzpmh
1); Subject: rzwxofvs
1); Subject: stdcmyeo
2); Subject: wwbdckoa
1); Subject: mvwhegir
2); Subject: Re:mvwhegir
3); Subject: Re:Re:mvwhegir
4); Subject: Re:Re:mvwhegir
3); Subject: Re:Re:mvwhegir
3); Subject: Re:Re:mvwhegir
P4 RECV
                         2)
3)
P4 RECV
P4 RECV
                         4)
5)
                                    From: P1
P4 RECV(
P4 RECV(
                                    From: P2(
From: P3(
                         6)
7)
8)
P4 RECV(
P4 RECV(
                                    From: P1(
From: P2(
P4 RECV(
P4 RECV(
                                    From: P1(
From: P3(
                       10)
P4 RECV(
P4 SEND(
                                     From: P2(
                                    Subject: Re:Re:Re:mvwhegir
From: P4( 2); Subject: Re:Re:Re:mvwhegir
From: P1( 5); Subject: gazdpvmr
                                    Subject: Re:Re:Re:mvwhegir
From: P4( 2); Subject: Re:Re:Re:mv
From: P1( 5); Subject: gazdpvmr
Subject: Re:gazdpvmr
From: P4( 3); Subject: Re:gazdpvmr
From: P3( 4); Subject: iklwxfbe
Subject: fgkjlenm
From: P4( 4); Subject: fgkjlenm
From: P3( 5); Subject: qcposgdu
From: P2( 4); Subject: Re:qcposgdu
                         2)
P4 RECV(
P4 RECV(
                       12)
                       13)
P4 SEND
                         3)
P4 RECV(
                       14)
P4 RECV(
P4 SEND(
                       15)
4)
                                                                4); Subject: fgkjlenm
5); Subject: qcposgdu
4); Subject: Re:qcpos
P4 RECV(
P4 RECV(
                       16)
17)
                                                                           Subject: qeposgdu
Subject: Re:qeposgdu
Subject: Re:Re:qeposgdu
Subject: upmwshcq
Subject: Re:Re:Re:qeposgdu
                                                                5)
4)
                                    From: P3(
From: P2(
From: P3(
From: P2(
From: P1(
                       18)
19)
P4 RECV
P4 RECV
                                                                6);
5);
6);
P4 RECV(
P4 RECV(
                       20)
                       21)
                                                                6);
7);
7);
P4 RECV(
P4 RECV)
                       22)
23)
                                    From: P2(
From: P1(
                                                                           Subject: tykpqzin
Subject: Re:tykpqzin
P4 RECV(
P4 SEND(
                       24)
5)
                                    From: P2( 7); Subject: Re:Re:tykpqzin
Subject: Re:Re:tykpqzin
                                                                : Re: Re: tykpqzin
5); Subject: Re: Re: Re: tykpqzin
8); Subject: gmyqwiab
9); Subject: qlyzbjgf
8); Subject: Re: qlyzbjgf
                                    From: P4(
From: P2(
P4 RECV
                       25)
P4 RECV
                       26)
P4 RECV
                       27)
                                     From: P2
P4 RECV(
P4 RECV(
                                     From: P1(
                                                              8)
10)
                                    From: P2(
Subject:
From: P4(
From: P1(
                       29)
                                                                           Subject: Re:Re:qlyzbjgf
P4 SEND
                         6)
                                                          labyrdkj
                                                                6); Subject: labyrdkj
9); Subject: aezdyhmf
7); Subject: hftnpews
                       30)
31)
P4 RECV
                       31); From: P1(
32); From: P3(
P4 RECV
```

2.3.2 1500,3000

```
-р1-
                                Subject: bthrxwqu
Subject: dfquaevy
P1 SEND(
                      \begin{pmatrix} 1 \\ 2 \end{pmatrix}
P1 SEND(
                               Subject: xkmypwvu
From: P2( 3); Subject: ivsmaqbg
From: P3( 1); Subject: zvlbefxu
P1 SEND(
P1 RECV(
                      3)
1)
P1 RECV
                      2)
                                       -p2--
                                Subject: prtmshiu
Subject: chmkdqlu
Subject: ivsmaqbg
P2 SEND
                      2)
                                Subject: ivsmaqog
Subject: zxoavjgi
Subject: bnfkuheg
- - P2( 3); Subject: ivsmaqbg
P2 SEND(
                      3)
P2 SEND(
P2 SEND(
                      4)
5)
                           ; From: P2(3); ; Subject: typxwulq
P2 RECV
P2 SEND(
P3 SEND(

    Subject: zvlbefxu
    Subject: egldrnim

P3 SEND(
```

```
P3 SEND
                     Subject:
P3 RECV(
                     From: P2(
From: P3(
                                            Subject:
                                            Subject:
                                                        zvlbefxu
   RECV
                             P2 (
P3 RECV
                     From: P4
               4)
                                            Subject:
                                                        nbaiuhlp
P3 RECV
                             P2(
                                            Subject:
P3 RECV
                     From:
                                            Subject:
P3 RECV
                                            Subject:
P4 SEND
                     Subject: nbajuhlp
P4 SEND(
P4 SEND(
                     Subject:
                     Subject: fjrmgkvs
P4 SEND(
P4 RECV(
                     Subject:
                                            Subject:
                     From: P2(
P4 RECV(
P4 RECV(
                     From: P3(
From: P2(
                                           Subject: zvlbefxu
Subject: prtmshiu
                                           Subject: nbaiuhlp
Subject: chmkdqlu
P4 RECV
               4)
5)
                     From:
                     From:
P4 SEND
                     Subject:
                                 cgrwhkug
```

ii) We have a lot of messages in the system. Derive a theoretical quantification of the number of messages needed to deliver a multicast message as a function of the number of workers and check experimentally that your formulation is correct (you can modify the source code as needed to count the messages)

Per a cada missatge, el mètode total, consumeix un nombre de missatge de sincronització per tal de poder finalment mostrar el missatge original. Podem deduïr-ne la fòrmula com :

$$TotalMessages = 1_{SEND} + nodes * 1_{MULTICAST} + nodes * 1_{PROPOSAL} + nodes * 1_{AGREED} + nodes * 1_{DELIVER}$$
(1)

iii) Compare with the basic multicastimplementation regarding the number of messages needed.

Per a cada missatge, el mètode bàsic, a diferència del total, consumeix un nombre de missatges inferior per a finalment mostrar el missatge original. Podem dir que la fòrmula és :

$$BasicMessages = 1_{SEND} + nodes * 1_{MULTICAST} + nodes * 1_{DELIVER}$$
(2)

3 Open questions

3.1 Basic

Are the posts displayed in FIFO, causal, and total order? Justify why?

No es compleix cap dels tres ordres. Com hem pogut veure en l'apartat anterior dels experiments, forçant un temps de Jitter major que el temps d'Sleep ens trobem que no es compleix ni una ordenació FIFO, per tant tampoc estarem complint ordenacions causals ni totals.

3.2 Causal

Are the posts displayed in FIFO, causal, and total order? Justify why.

Podem observar l'ordre FIFO i el causal, però no podrem assegurar mai que quan s'enviïn dos missatges no relacionats entre si (des de nodes diferents), es rebin en l'ordre real d'enviament (simplement correrà a la sort de la xarxa o altres factors donats en aquella situació i precís moment).

3.3 Total

Are the posts displayed in FIFO, causal, and total order? Justify why.

Sí, tal i com es pot veure en els extractes dels diferents processos, podem observar que cada procés els mostra tant en ordre d'arribada com en ordre total.

4 Personal opinion

Amb aquesta pràctica hem aconseguit entendre i plasmar en codi tres maneres d'ordenació de missatges multicast que havíem vist prèviament a teoria. Hem necessitat mirar un altre cop els algorismes de cada una d'aquestes ordenacions, fet que ens ha ajudat a consolidar els conceptes necessaris per entendre-ho. Creiem que ha sigut una molt bona pràctica per entendre aquest apartat de teoria, i per tant considerem que hauria de ser inclosa en el curs vinent.