Appendix A

ECA Rule Editor

CLAPDAWN and ECLARI cross layer architectures implement cross layer interactions outside the network protocol stack. CLAPDAWN stores the cross layer interactions in its knowledge base in the form of ECA rules. ECLAIR implements cross layer interactions as optimizer. To make the development of cross layer interaction easy in both cases we have developed a rule editor. Current version of rule editor is menu driven text based editor. It generates two output files a) “.c” file which contains the ECLAIR implementation and “.kb” which contains the ECA rules for the CLAPDAWN implementation. Following screen shots show the working of our rule editor.

Figure A.1: Rule Editor with the file name for cross layer interaction to be stored in

Figure A.1 and A.2 show the rule editor screen. Here user gives the file name to which the generated cross layer interaction will be stored by the editor.
Figure A.2: Rule Editor asking for number of input parameters involved in cross layer interaction

Figure A.3: Rule Editor asking for layer for first input parameter

Figure A.4: Rule Editor, user entering first input parameter for physical layer
To generate it ask for the number of input parameters and output parameters. Figure A.3, A.4, A.5 and A.6 show the steps to configure input and output parameters. First it asks for the number of input parameters. Accepting number of input parameters, for each parameter it asks for layer name and parameter of that layer. This information is stored in parameter xml file. Same steps it repeats for output parameters.
After accepting the input and output parameters editor goes for the conditions. It first ask for the number of conditions required for this cross layer interaction and then it one by one accepts each conditions. Same steps are shown in figure A.7 and A.8.
After collecting conditions it ask for the action part. In the current version action part only accepts one action. Remaining actions can be added by modifying ".c" and ".kb" files. Figure A.9 and A.10 show the final steps. Any further modification can be made by modifying the `optimization()` function of the generated file or the rules of the kb file. Sample optimizer file for ECLAIR and CLAPDAWN rulebase file is given in appendix B and C respectively.
Appendix B

ECLAIR Implementation of CLI

/* ECLAIR Implementation of cross layer interaction discussed in chapter 4. */

Optimizer()
{
    /*
    Code
    */
    switch(frameType) {
        case 1:
            if(qlen1 < threshold1) {
                pri_i=1;
                done=1;
            }
            else if((qlen1 < threshold2)) {
                prob= rob0*(qlen1-threshold1)/(threshold2-threshold1);
                tmpx=Random();
                if(tmpx<prob)
                    if((qlen2 < threshold2))
                        pri_i =2;
                    else
                        pri_i =3;
                else
                    pri_i = 1;
                done=1;
            } 
        else if((qlen2 < threshold2)) {
            }
        else if((qlen1 < threshold2)) {
            }
    }
}
prob = prob0*(qlen2-threshold1)/(threshold2-threshold1);
tmpx=Random();
if(tmpx<prob)
    if((qlen3 < threshold2))
        pri_i=3;
    else
        pri_i=2;
else
    pri_i=2;
done=1;
}
else
{
    tmpx=Random();
    if(tmpx<prob0)
        if((qlen3< threshold2))
            pri_i=3;
        else
            pri_i=2;
    else
        pri_i=2;
    done=1;
}
break;
case 2:
    if((qlen1< threshold1))
    {
        pri_i=1;
        done=1;
    }
else if((qlen1 < threshold2))
    {
        prob= prob1*(qlen1-threshold1)/(threshold2-threshold1);
tmpx=Random();
if(tmpx<prob)
    if((qlen2< threshold2))
        pri_i=2;
    else
        pri_i=3;
else
    pri_i=1;
    done=1;
}
else if((qlen2< threshold2))
    {
        prob= prob1*(qlen2-threshold1)/(threshold2-threshold1);
tmpx=Random();
if(tmpx<prob)
    if((qlen3< threshold2))
        pri_i=3;
    else
        pri_i=2;
else
    pri_i=2;
done=1;
}
else
{
    tmpx=Random();
    if(tmpx<prob1)
        if((qlen3< threshold2))
            pri_i=3;
        else
            pri_i=2;
    else
        pri_i=2;
done=1;
}
break;
case 3:
if((qlen1< threshold1)){
    pri_i=1;
done=1;
}
else if((qlen1< threshold2))
{
    prob= prob2*(qlen1-threshold1)/(threshold2-threshold1);
tmpx=Random();
    if(tmpx<prob)
        if((qlen2< threshold2))
            pri_i=2;
        else
            pri_i=3;
    else
        pri_i=1;
done=1;
}
else if((qlen2< threshold2))
{
    prob= prob2*(qlen2-threshold1)/(threshold2-threshold1);
tmpx=Random();
    if(tmpx<prob)
        if((qlen3< threshold2))
        ...
pri_i=3;
else
  pri_i=2;
}
else
  pri_i=2;
done=1;
}
else {
tmpx=Random();
if(tmpx<prob2) {
  if((qlen3< threshold2))
    pri_i=3;
  else
    pri_i=2;
}
else
  pri_i=2;
done=1;
}
default:
  printf("Error in PriQ::pri_recv() frame type %d\n",frameType);
  break;
}/* Code */
Appendix C

CLAPDAWN Implementation of CLI

/* CLAPDAWN implementation of cross layer interaction discussed in chapter 4*/
RULE 1 PARA LL frametype 2 1
RULE 1 CONDITION 1 LL frametype CO 1 e
RULE 1 CONDITION 2 LL qlen1 LL threshold1 l
RULE 1 ACTION 1 LL pri_i CO 1 CO 0 d E

RULE 2 PARA LL frametype 3 4
RULE 2 CONDITION 1 LL frametype CO 1 e
RULE 2 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 2 CONDITION 3 LL qlen1 LL threshold2 l
RULE 2 ACTION 1 LO l1 LL threshold2 LL threshold1 d E
RULE 2 ACTION 2 LO l2 LL qlen1 LL threshold1 d E
RULE 2 ACTION 3 LO l3 LL prob0 LO l2 m E
RULE 2 ACTION 4 LO prob LO l3 LO l2 d E

RULE 3 PARA LL frametype 5 1
RULE 3 CONDITION 1 LL frametype CO 1 e
RULE 3 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 3 CONDITION 3 LL qlen1 LL threshold2 l
RULE 3 CONDITION 4 LL tmpx LO prob l
RULE 3 CONDITION 5 LL qlen2 LL threshold2 l
RULE 3 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 4 PARA LL frametype 5 1
RULE 4 CONDITION 1 LL frametype CO 1 e
RULE 4 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 4 CONDITION 3 LL qlen1 LL threshold2 l
RULE 4 CONDITION 4 LL tmpx LO prob l
RULE 4 CONDITION 5 LL qlen2 LL threshold2 ge
RULE 4 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 5 PARA LL frametype 4 1
RULE 5 CONDITION 1 LL frametype CO 1 e
RULE 5 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 5 CONDITION 3 LL qlen1 LL threshold2 l
RULE 5 CONDITION 4 LL tmpx LO prob ge
RULE 5 ACTION 1 LL pri_i CO 1 CO 0 d E

RULE 6 PARA LL frametype 3 4
RULE 6 CONDITION 1 LL frametype CO 1 e
RULE 6 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 6 CONDITION 3 LL qlen2 LL threshold2 l
RULE 6 ACTION 1 LO 11 LL threshold2 LL threshold1 d E
RULE 6 ACTION 2 LO 12 LL qlen2 LL threshold1 d E
RULE 6 ACTION 3 LO 13 LL prob0 LO 12 m E
RULE 6 ACTION 4 LO prob LO prob LO 13 LO 12 d E

RULE 7 PARA LL frametype 5 1
RULE 7 CONDITION 1 LL frametype CO 1 e
RULE 7 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 7 CONDITION 3 LL qlen2 LL threshold2 l
RULE 7 CONDITION 4 LL tmpx LO prob l
RULE 7 CONDITION 5 LL qlen3 LL threshold2 l
RULE 7 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 8 PARA LL frametype 5 1
RULE 8 CONDITION 1 LL frametype CO 1 e
RULE 8 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 8 CONDITION 3 LL qlen2 LL threshold2 l
RULE 8 CONDITION 4 LL tmpx LO prob l
RULE 8 CONDITION 5 LL qlen3 LL threshold2 ge
RULE 8 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 9 PARA LL frametype 5 1
RULE 9 CONDITION 1 LL frametype CO 1 e
RULE 9 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 9 CONDITION 3 LL qlen2 LL threshold2 l
RULE 9 CONDITION 4 LL tmpx LO prob l
RULE 9 CONDITION 5 LL qlen3 LL threshold2 ge
RULE 9 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 10 PARA LL frametype 3 1
RULE 10 CONDITION 1 LL frametype CO 1 e
RULE 10 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 10 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 10 ACTION 1 LO prob LL prob0 CO 0 d E

RULE 11 PARA  LL frametype 5 1
RULE 11 CONDITION 1 LL frametype CO 1 e
RULE 11 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 11 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 11 CONDITION 4 LL tmpx LO prob 1
RULE 11 CONDITION 5 LL qlen3 LL threshold2 1
RULE 11 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 12 PARA  LL frametype 5 1
RULE 12 CONDITION 1 LL frametype CO 1 e
RULE 12 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 12 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 12 CONDITION 4 LL tmpx LO prob 1
RULE 12 CONDITION 5 LL qlen3 LL threshold2 ge
RULE 12 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 13 PARA  LL frametype 4 1
RULE 13 CONDITION 1 LL frametype CO 1 e
RULE 13 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 13 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 13 CONDITION 4 LL tmpx LO prob ge
RULE 13 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 14 PARA  LL frametype 2 1
RULE 14 CONDITION 1 LL frametype CO 2 e
RULE 14 CONDITION 2 LL qlen1 LL threshold1 l
RULE 14 ACTION 1 LL pri_i CO 1 CO 0 d E

RULE 15 PARA  LL frametype 3 4
RULE 15 CONDITION 1 LL frametype CO 2 e
RULE 15 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 15 CONDITION 3 LL qlen1 LL threshold2 l
RULE 15 ACTION 1 LO l1 LL threshold2 LL threshold1 d E
RULE 15 ACTION 2 LO l2 LL qlen1 LL threshold1 d E
RULE 15 ACTION 3 LO l3 LL prob1 LO l2 m E
RULE 15 ACTION 4 LO prob LO l3 LO l2 d E

RULE 16 PARA  LL frametype 5 1
RULE 16 CONDITION 1 LL frametype CO 2 e
RULE 16 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 16 CONDITION 3 LL qlen1 LL threshold2 l
RULE 16 CONDITION 4 LL tmpx LO prob 1
RULE 16 CONDITION 5 LL qlen2 LL threshold2 l
RULE 16 ACTION 1 LL pri_i CO 2 CO 0 d E
RULE 17 PARA LL frametype 5 1
RULE 17 CONDITION 1 LL frametype CO 2 e
RULE 17 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 17 CONDITION 3 LL qlen1 LL threshold2 l
RULE 17 CONDITION 4 LL tmpx LO prob l
RULE 17 CONDITION 5 LL qlen2 LL threshold2 ge
RULE 17 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 18 PARA LL frametype 4 1
RULE 18 CONDITION 1 LL frametype CO 2 e
RULE 18 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 18 CONDITION 3 LL qlen1 LL threshold2 l
RULE 18 CONDITION 4 LL tmpx LO prob ge
RULE 18 ACTION 1 LL pri_i CO 1 CO 0 d E

RULE 19 PARA LL frametype 3 4
RULE 19 CONDITION 1 LL frametype CO 2 e
RULE 19 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 19 CONDITION 3 LL qlen2 LL threshold2 l
RULE 19 ACTION 1 LO l1 LL threshold2 LL threshold1 d E
RULE 19 ACTION 2 LO l2 LL qlen2 LL threshold1 d E
RULE 19 ACTION 3 LO l3 LL prob1 LO l2 m E
RULE 19 ACTION 4 LO prob LO l3 LO l2 d E

RULE 20 PARA LL frametype 5 1
RULE 20 CONDITION 1 LL frametype CO 2 e
RULE 20 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 20 CONDITION 3 LL qlen2 LL threshold2 l
RULE 20 CONDITION 4 LL tmpx LO prob l
RULE 20 CONDITION 5 LL qlen3 LL threshold2 l
RULE 20 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 21 PARA LL frametype 5 1
RULE 21 CONDITION 1 LL frametype CO 2 e
RULE 21 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 21 CONDITION 3 LL qlen2 LL threshold2 l
RULE 21 CONDITION 4 LL tmpx LO prob l
RULE 21 CONDITION 5 LL qlen3 LL threshold2 ge
RULE 21 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 22 PARA LL frametype 5 1
RULE 22 CONDITION 1 LL frametype CO 2 e
RULE 22 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 22 CONDITION 3 LL qlen2 LL threshold2 l
RULE 22 CONDITION 4 LL tmpx LO prob l
RULE 22 CONDITION 5 LL qlen3 LL threshold2 ge
RULE 22 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 23 PARA LL frametype 3 1
RULE 23 CONDITION 1 LL frametype CO 2 e
RULE 23 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 23 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 23 ACTION 1 LO prob LL prob1 CO 0 d E

RULE 24 PARA LL frametype 5 1
RULE 24 CONDITION 1 LL frametype CO 2 e
RULE 24 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 24 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 24 CONDITION 4 LL tmpx LO prob l
RULE 24 CONDITION 5 LL qlen3 LL threshold2 l
RULE 24 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 25 PARA LL frametype 5 1
RULE 25 CONDITION 1 LL frametype CO 2 e
RULE 25 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 25 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 25 CONDITION 4 LL tmpx LO prob l
RULE 25 CONDITION 5 LL qlen3 LL threshold2 ge
RULE 25 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 26 PARA LL frametype 4 1
RULE 26 CONDITION 1 LL frametype CO 2 e
RULE 26 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 26 CONDITION 3 LL qlen2 LL threshold2 ge
RULE 26 CONDITION 4 LL tmpx LO prob ge
RULE 26 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 27 PARA LL frametype 2 1
RULE 27 CONDITION 1 LL frametype CO 3 e
RULE 27 CONDITION 2 LL qlen1 LL threshold1 l
RULE 27 ACTION 1 LL pri_i CO 1 CO 0 d E

RULE 28 PARA LL frametype 3 4
RULE 28 CONDITION 1 LL frametype CO 3 e
RULE 28 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 28 CONDITION 3 LL qlen1 LL threshold2 l
RULE 28 ACTION 1 LO l1 LL threshold2 LL threshold1 d E
RULE 28 ACTION 2 LO l2 LL qlen1 LL threshold1 d E
RULE 28 ACTION 3 LO l3 LL prob2 LO l2 m E
RULE 28 ACTION 4 LO prob LO l3 LO l2 d E

RULE 29 PARA LL frametype 5 1
RULE 29 CONDITION 1 LL frametype CO 3 e
RULE 29 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 29 CONDITION 3 LL qlen1 LL threshold2 1
RULE 29 CONDITION 4 LL tmpx LO prob l
RULE 29 CONDITION 5 LL qlen2 LL threshold1 l
RULE 29 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 30 PARA LL frametype 5 1
RULE 30 CONDITION 1 LL frametype CO 3 e
RULE 30 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 30 CONDITION 3 LL qlen1 LL threshold2 1
RULE 30 CONDITION 4 LL tmpx LO prob l
RULE 30 CONDITION 5 LL qlen2 LL threshold2 ge
RULE 30 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 31 PARA LL frametype 4 1
RULE 31 CONDITION 1 LL frametype CO 3 e
RULE 31 CONDITION 2 LL qlen1 LL threshold1 ge
RULE 31 CONDITION 3 LL qlen1 LL threshold2 1
RULE 31 CONDITION 4 LL tmpx LO prob ge
RULE 31 ACTION 1 LL pri_i CO 1 CO 0 d E

RULE 32 PARA LL frametype 3 4
RULE 32 CONDITION 1 LL frametype CO 3 e
RULE 32 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 32 CONDITION 3 LL qlen2 LL threshold2 1
RULE 32 ACTION 1 LO l1 LL threshold2 LL threshold1 d E
RULE 32 ACTION 2 LO l2 LL qlen2 LL threshold1 d E
RULE 32 ACTION 3 LO l3 LL prob2 LO l2 m E
RULE 32 ACTION 4 LO prob LO l3 LO l2 d E

RULE 33 PARA LL frametype 5 1
RULE 33 CONDITION 1 LL frametype CO 3 e
RULE 33 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 33 CONDITION 3 LL qlen2 LL threshold2 1
RULE 33 CONDITION 4 LL tmpx LO prob l
RULE 33 CONDITION 5 LL qlen3 LL threshold1 l
RULE 33 ACTION 1 LL pri_i CO 3 CO 0 d E

RULE 34 PARA LL frametype 5 1
RULE 34 CONDITION 1 LL frametype CO 3 e
RULE 34 CONDITION 2 LL qlen1 LL threshold2 ge
RULE 34 CONDITION 3 LL qlen2 LL threshold2 1
RULE 34 CONDITION 4 LL tmpx LO prob l
RULE 34 CONDITION 5 LL qlen3 LL threshold2 ge
RULE 34 ACTION 1 LL pri_i CO 2 CO 0 d E

RULE 35 PARA LL frametype 5 1
RULE 35 CONDITION 1 LL frametype CO 3 e  
RULE 35 CONDITION 2 LL qlen1 LL threshold2 ge  
RULE 35 CONDITION 3 LL qlen2 LL threshold2 l  
RULE 35 CONDITION 4 LL tmpx LO prob l  
RULE 35 CONDITION 5 LL qlen3 LL threshold2 ge  
RULE 35 ACTION 1 LL pri_i CO 2 CO 0 d E  

RULE 36 PARA LL frametype 3 1  
RULE 36 CONDITION 1 LL frametype CO 3 e  
RULE 36 CONDITION 2 LL qlen1 LL threshold2 ge  
RULE 36 CONDITION 3 LL qlen2 LL threshold2 ge  
RULE 36 ACTION 1 LO prob LL prob2 CO 0 d E  

RULE 37 PARA LL frametype 5 1  
RULE 37 CONDITION 1 LL frametype CO 3 e  
RULE 37 CONDITION 2 LL qlen1 LL threshold2 ge  
RULE 37 CONDITION 3 LL qlen2 LL threshold2 ge  
RULE 37 CONDITION 4 LL tmpx LO prob l  
RULE 37 CONDITION 5 LL qlen3 LL threshold2 l  
RULE 37 ACTION 1 LL pri_i CO 3 CO 0 d E  

RULE 38 PARA LL frametype 5 1  
RULE 38 CONDITION 1 LL frametype CO 3 e  
RULE 38 CONDITION 2 LL qlen1 LL threshold2 ge  
RULE 38 CONDITION 3 LL qlen2 LL threshold2 ge  
RULE 38 CONDITION 4 LL tmpx LO prob l  
RULE 38 CONDITION 5 LL qlen3 LL threshold2 ge  
RULE 38 ACTION 1 LL pri_i CO 2 CO 0 d E  

RULE 39 PARA LL frametype 4 1  
RULE 39 CONDITION 1 LL frametype CO 3 e  
RULE 39 CONDITION 2 LL qlen1 LL threshold2 ge  
RULE 39 CONDITION 3 LL qlen2 LL threshold2 ge  
RULE 39 CONDITION 4 LL tmpx LO prob ge  
RULE 39 ACTION 1 LL pri_i CO 2 CO 0 d E