

Version 2.0

AirConditioner ::= DEVICE || HeatRegular || Conn_sys

HeatRegular ::= HeatCPU || HeatRAM || HeatSW || Conn_pro

HeatSW ::= Regular || HeaterCooler || Sensor || Conn_thr || SCHEDULE

###Schedule 抢占式优先级调度策略 ###

SCHEDULE ::= run_now:=0; run_prior:=0; ready_num:=0;

```
(  tranR_Reagular??prior;
  (run_prior<prior)->(BUSY; CHANGE(Regular,prior); ) ;
  (run_prior>prior) -> INSERT(Regular ,prior); ready_num := ready_num+1
||  tranR_HeaterCooler??prior;
  (run_prior<prior)->(BUSY;CHANGE(HeaterCooler,prior); );
  (run_prior>prior) -> INSERT(HeaterCooler ,prior); ready_num := ready_num+1
||  tranR_Sensor?? prior;
  (run_prior<prior)->(BUSY; CHANGE(Sensor,prior); ) ;
  (run_prior>prior) -> INSERT(Sensor ,prior); ready_num := ready_num+1
)*; DISPATCH*
```

```
BUSY ::=  (run_now="Regular") -> (busy_Regular!!);
          || (run_now="HeaterCooler") -> (busy_HeaterCooler!!);
          || (run_now="Sensor") -> (busy_Sensor!!);
```

```
CHANGE(thread,prior) ::=
  (thread ="Regular") -> (run_now:="Regular"; run_prior:=prior; run_Regular!!);
||  (thread ="HeaterCooler") ->
  (run_now:="HeaterCooler"; run_prior:=prior; run_HeaterCooler!!);
||  (thread ="Sensor") -> (run_now:="Sensor"; run_prior:=prior; run_Sensor!!);
```

INSERT (thread , prior) ::= ...

```
DISPATCH ::= free??;
  (ready_num>0) -> (CHANGE(first_ready, first_prior);ready_num :=ready_num-1 ; );
  (ready_num=0) -> (run_now:=0;run_prior := 0; )
```

###Schedule2 非抢占式优先级调度策略 ###

```
SCHEDULE2 ::= run_now:=0; run_prior:=0; ready_num:=0;
  ( tranR_Regular??prior; INSERT(Regular ,prior); ready_num := ready_num+1
  || tranR_HeaterCooler??prior; INSERT(HeaterCooler ,prior); ready_num := ready_num+1
  || tranR_Sensor?? prior; INSERT(Sensor ,prior); ready_num := ready_num+1
  )*; DISPATCH*
```

```
CHANGE(thread,prior) ::=
  (thread ="Regular") -> (run_now="Regular"; run_prior:=prior; run_Regular!!);
  || (thread ="HeaterCooler") ->
    (run_now="HeaterCooler"; run_prior:=prior; run_HeaterCooler!!);
  || (thread ="Sensor") -> (run_now="Sensor"; run_prior:=prior; run_Sensor!!);
```

```
INSERT (thread , prior) ::= ...
```

```
DISPATCH ::= free??;
  (ready_num>0) -> (CHANGE(first_ready, first_prior);ready_num :=ready_num-1 ; );
  (ready_num=0) -> (run_now:=0;run_prior := 0; )
```

THREAD Regular

```
Regular( period, deadline, priority, dispatch_protocal ) ::= ACT_Regular* || COM_Regular*
```

```
ACT_Regular ::= act_Regular !! ; wait period ;
```

```
COM_Regular ::= act_Regular ?? ;
  ( t:=0; isReady :=1 ; ( isReady -> Ready_Regular)*
  || c:=0; Running_Regular*
  || Await_Regular*
  )
```

```
Ready_Regular ::= (unblock_Regular ?? ct) -> (t :=ct) ; tranR_Regular !! priority ;
  { DOT(t) = 1; DOMAIN( t< deadline)
  INTERUPET ( run_Regular ?? -> resume_Regular !! t ; )
  };
  t=deadline -> isReady := 0 ;
```

```
Running_Regular ::= resume_Regular ?? t ;
  GetData(desiredTemp); GetData(measuredTemp);
  { DOT(t) = 1; DOT(c) =1; ANNEX_Regular ; DOMAIN( t< deadline)
  INTERUPET ( needResource_Regular ?? -> block_Regular!! t;free!!)
  AND
```

```

INTERUPET ( complete_Annex_Regular ?? -> SetData(command) ; free!! )
AND
INTERUPET ( busy_Regular ?? -> unblock_Regular!!t ; )
};
t=deadline -> free!!

```

```

Await_Regular ::= block_Regular?? t ;
                { DOT(t) = 1; DOMAIN( t< deadline )
                INTERUPET ( haveResource_Regular ?? -> unblock_Regular !! t )
                };

```

###THREAD HeaterCooler ###

```

HeatCooler( period, deadline, priority, dispatch_protocal )
                ::= ACT_HeaterCooler* || COM_HeaterCooler*

```

```

ACT_HeaterCooler ::= act_HeaterCooler !! ; wait period ;

```

```

COM_HeaterCooler ::= act_HeaterCooler ?? ;
(   t:=0; isReady :=1 ; ( isReady -> Ready_HeaterCooler )*
  || c:=0; Running_HeaterCooler*
  || Await_HeaterCooler*
)

```

```

Ready_HeaterCooler ::=
    (unblock_HeaterCooler ?? ct) -> (t :=ct) ;
    tranR_HeaterCooler !! priority ;
    { DOT(t) = 1; DOMAIN( t< deadline )
      INTERUPET ( run_HeaterCooler ?? -> resume_HeaterCooler !! t ; )
    };
    t=deadline -> isReady := 0 ;

```

```

Running_HeaterCooler ::=
    resume_Regular ?? t ;
    GetData(command);
    { DOT(t) = 1; DOT(c) =1; ANNEX_HeaterCooler ; DOMAIN( t< deadline )
      INTERUPET ( needResource_HeaterCooler ?? -> block_HeaterCooler!! t; free!! )
      AND
      INTERUPET(complete_Annex_HeaterCooler??->SetEvent(heating);
                  SetEvent(cooling); free!! )

      AND
      INTERUPET ( busy_HeaterCooler ?? -> unblock_HeaterCooler!! t; )
    };
    t=deadline -> free!!

```

```

Await_HeaterCooler ::= block_HeaterCooler ?? t ;
    { DOT(t) = 1; DOMAIN( t< deadline )
    INTERUPET ( haveResource_HeaterCooler ?? -> unblock_HeaterCooler !! t )
};

```

###THREAD Sensor ###

```

Sensor( period, deadline, priority, dispatch_protocol ) ::= ACT_Sensor* || COM_Sensor*

```

```

ACT_Sensor ::= act_Sensor !! ; wait period ;

```

```

COM_Sensor ::= act_Sensor ?? ;
    (   t:=0; isReady :=1 ; ( isReady -> Ready_Sensor )*
    || c:=0; Running_Sensor*
    || Await_Sensor*
    )

```

```

Ready_Sensor ::= (unblock_Sensor ?? ct) -> ( t :=ct ) ;
    tranR_Sensor !! priority ;
    {   DOT(t) = 1; DOMAIN( t< deadline )
        INTERUPET ( run_Sensor?? -> resume_Sensor !! t ; )
    };
    t=deadline -> isReady := 0 ;

```

```

Running_Sensor ::=
    resume_Sensor ?? t ;
    GetData(heaterTemp);
    { DOT(t) = 1; DOT(c) =1; ANNEX_Sensor ; DOMAIN( t< deadline )
    INTERUPET ( needResource_Sensor ?? -> block_Sensor !! t ;free!!)
    AND
    INTERUPET(complete_Annex_Sensor ?? -> SetData(measuredTemp); free!! )
    AND
    INTERUPET(busy_Sensor ?? -> unblock_Sensor!!t )
    };
    t=deadline -> free!!

```

```

Await_Sensor ::= block_Sensor ?? t ;
    { DOT(t) = 1; DOMAIN( t< deadline )
    INTERUPET ( haveResource_Sensor?? -> unblock_Sensor !! t )
};

```

资源调度

```
ResourceApplication ::=
    needResource_Regular??; GETRESOURCE; haveResorce_Regular!!;
    needResource_HeaterCooler??; GETRESOURCE; haveResorce_HeaterCooler!!;
    needResource_Sensor??; GETRESOURCE; haveResorce_Sensor!!;
```

Connection

```
Conn_sys ::= Settings?? x ; HeatRegulator_desiredTemp!! x ;
    || HeatRegulator_currentTemp ??x ; Temperature!! x;
    || HeatRegulator_heating ?? ; HeaterStatus_red!!;
    || HeatRegulator.cooling ?? ; HeaterStatus.green!!;
```

```
Conn_pro ::= HeatRegular_desiredTemp ??x; HeaterSW_desiredTemp!! x ;
    || HeaterSW_heating ?? ; HeatRegular_heating !! ;
    || HeaterSW_cooling ?? ; HeatRegular_cooling !! ;
    || HeaterSW_measuredTemp ??x ; HeatRegular_currentTemp !!x ;
```

```
Conn_thr ::= HeaterSW_desiredTemp ??x ; Regulator_desiredTemp!! x ;
    || HeaterCooler_heating ?? ; HeaterSW_heating!! ;
    || HeaterCooler_cooling ?? ; HeaterSW_cooling!! ;
    || Sensor_measuredTemp ??x ; HeaterSW_measuredTemp !! x ;
    || Regulator_heaterCommand??x ; HeaterCooler_command!! x ;
    || HeaterCooler_temperature??x ; Sensor_heaterTemp !! x ;
    || Sensor_measuredTemp ??x ; Regulator_measuredTemp!! x;
```

附：AADL 代码

```
1  -----
2  -- Air Conditioner
3  -- AADL Inspector
4  -- (c) Ellidiss Technologies
5  -- Updated: January 2017
6  -----
7
8  PACKAGE AirConditioner_Pkg
9  PUBLIC
10 WITH Ellidiss::Math::Int;
11 RENAMES Ellidiss::Math::Int::ALL;
12 WITH Ellidiss::Gui;
13 RENAMES Ellidiss::Gui::ALL;
14 WITH AI;
15
16 SYSTEM AirConditioner
17 END AirConditioner;
18
19 SYSTEM IMPLEMENTATION AirConditioner.others
20 SUBCOMPONENTS
21   Settings : DEVICE IntSelector;
22   Temperature : DEVICE IntDisplay;
23   HeaterStatus : DEVICE Light;
24   HeatRegulator : SYSTEM HeatRegulator.others;
25 CONNECTIONS
26   cnx_0 : PORT Settings.value -> HeatRegulator.desiredTemp;
27   cnx_1 : PORT HeatRegulator.currentTemp -> Temperature.value;
28   cnx_2 : PORT HeatRegulator.heating -> HeaterStatus.red;
29   cnx_3 : PORT HeatRegulator.cooling -> HeaterStatus.green;
30 PROPERTIES
31   -- required by Ocarina
32   AI::root_system => "SELECTED";
33 END AirConditioner.others;
34
35 SYSTEM HeatRegulator
36 FEATURES
37   desiredTemp : IN DATA PORT int;
38   heating : OUT EVENT PORT;
39   cooling : OUT EVENT PORT;
40   currentTemp : OUT DATA PORT int;
41 END HeatRegulator;
42
43 SYSTEM IMPLEMENTATION HeatRegulator.others
44 SUBCOMPONENTS
45   HeaterSW : PROCESS HeaterSW.others;
46   HeaterCPU : PROCESSOR HeaterCPU;
47   HeaterRAM : MEMORY HeaterRAM;
48 CONNECTIONS
49   cnx_0 : PORT desiredTemp -> HeaterSW.desiredTemp;
50   cnx_1 : PORT HeaterSW.heating -> heating;
51   cnx_2 : PORT HeaterSW.cooling -> cooling;
52   cnx_3 : PORT HeaterSW.measuredTemp -> currentTemp;
53 PROPERTIES
54   Actual_Processor_Binding => ( reference(HeaterCPU) ) applies to HeaterSW;
55   Actual_Memory_Binding => ( reference(HeaterRAM) ) applies to HeaterSW;
56 END HeatRegulator.others;
```

```

57
58 PROCESS HeaterSW
59 FEATURES
60   desiredTemp : IN DATA PORT int;
61   heating : OUT EVENT PORT;
62   cooling : OUT EVENT PORT;
63   measuredTemp : OUT DATA PORT int;
64 END HeaterSW;
65
66 PROCESS IMPLEMENTATION HeaterSW.others
67 SUBCOMPONENTS
68   Regulator : THREAD Regulator.others;
69   HeaterCooler : THREAD HeaterCooler.others;
70   Sensor : THREAD Sensor.others;
71 CONNECTIONS
72   cnx_0 : PORT desiredTemp -> Regulator.desiredTemp;
73   cnx_1 : PORT HeaterCooler.heating -> heating;
74   cnx_2 : PORT HeaterCooler.cooling -> cooling;
75   cnx_3 : PORT Sensor.measuredTemp -> measuredTemp;
76 1  cnx_4 : PORT Regulator.heaterCommand -> HeaterCooler.command;
77   cnx_5 : PORT HeaterCooler.temperature -> Sensor.heaterTemp;
78   cnx_6 : PORT Sensor.measuredTemp -> Regulator.measuredTemp;
79 END HeaterSW.others;
80
81 THREAD Regulator
82 FEATURES
83   desiredTemp : IN DATA PORT int;
84   measuredTemp : IN DATA PORT int;
85   heaterCommand : OUT DATA PORT int;
86 END Regulator;
87
88 THREAD IMPLEMENTATION Regulator.others
89 PROPERTIES
90   Dispatch_Protocol => Periodic;
91   Priority => 8;
92   Deadline => 20ms;
93   Period => 20ms;
94 ANNEX Behavior_Specification {**
95 VARIABLES diff, gain : int;
96 STATES s : INITIAL COMPLETE FINAL STATE;
97 TRANSITIONS t : s -[ON DISPATCH]-> s
98   { gain := 2;
99     diff := desiredTemp - measuredTemp;
100    heaterCommand := diff * gain };
101 **};
102 END Regulator.others;
103
104 THREAD HeaterCooler
105 FEATURES
106   command : IN DATA PORT int;
107   temperature : OUT DATA PORT int;
108   heating : OUT EVENT PORT;
109   cooling : OUT EVENT PORT;
110 END HeaterCooler;
111
112 THREAD IMPLEMENTATION HeaterCooler.others
113 SUBCOMPONENTS
114   Temp : DATA int;
115 PROPERTIES
116   Dispatch_Protocol => Periodic;
117   Priority => 6;
118   Deadline => 20ms;
119   Period => 20ms;
120 ANNEX Behavior_Specification {**
121 STATES s : INITIAL COMPLETE FINAL STATE;
122 TRANSITIONS t : s -[ON DISPATCH]-> s
123   { if (command >= 0) heating!; Temp := Temp + 1 end if;
124     if (command < 0) cooling!; Temp := Temp - 1 end if;
125     temperature := Temp };
126 **};
127 END HeaterCooler.others;

```

```

128
129THREAD Sensor
130FEATURES
131  heaterTemp : IN DATA PORT int;
132  measuredTemp : OUT DATA PORT int;
133END Sensor;
134
135THREAD IMPLEMENTATION Sensor.others
136PROPERTIES
137  Dispatch_Protocol => Periodic;
138  Priority => 10;
139  Deadline => 20ms;|
140  Period => 20ms;
141ANNEX Behavior_Specification {**
142VARIABLES e : int;
143STATES s : INITIAL COMPLETE FINAL STATE;
144TRANSITIONS t : s -[ON DISPATCH]-> s
145  { err!(2,e); measuredTemp := heaterTemp + e };
146**};
147END Sensor.others;
148
149PROCESSOR HeaterCPU
150PROPERTIES
151  Scheduling_Protocol => (HPF);
152END HeaterCPU;
153
154MEMORY HeaterRAM
155END HeaterRAM;
156
157END AirConditioner_Pkg;

```