BaseStation Based on GenericComm

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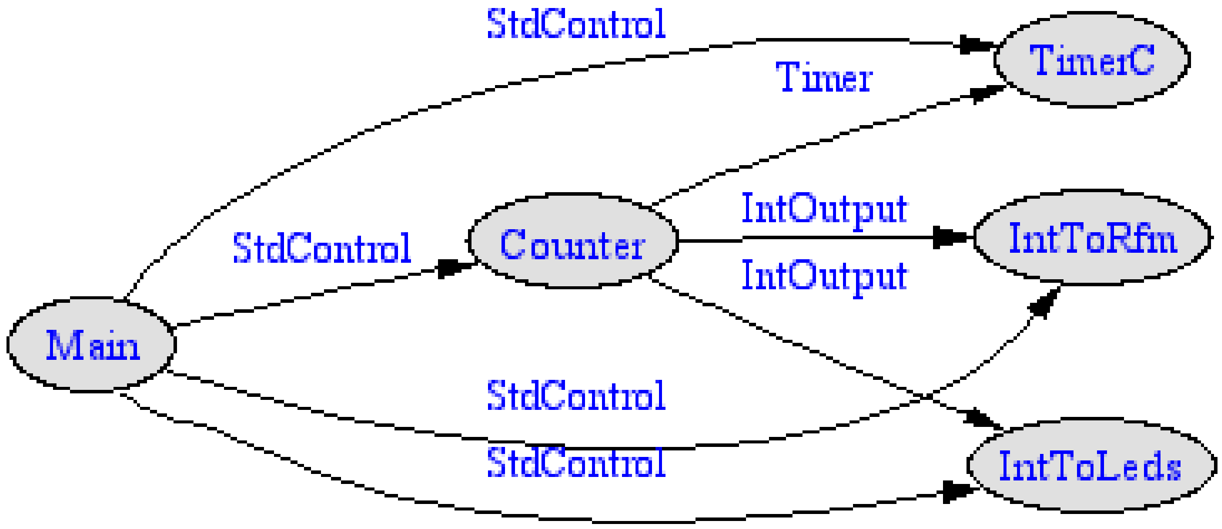
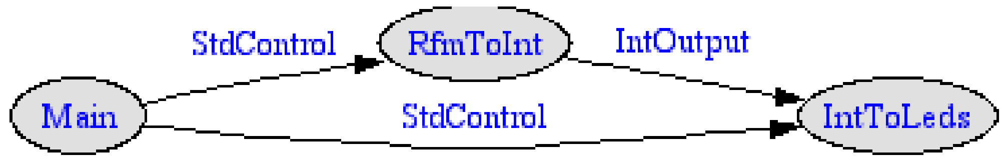
CntToLedsAndRfm.nc



CntToLedsAndRfm.nc

```
configuration CntToLedsAndRfm {
}
implementation {
  components Main, Counter, IntToLeds, IntToRfm, TimerC;

  Main.StdControl -> Counter.StdControl;
  Main.StdControl -> IntToLeds.StdControl;
  Main.StdControl -> IntToRfm.StdControl;
  Main.StdControl -> TimerC.StdControl;
  Counter.Timer -> TimerC.Timer[unique("Timer")];
  IntToLeds <- Counter.IntOutput;
  Counter.IntOutput -> IntToRfm;
}
```

RfmToLeds.nc



RfmToLeds.nc

```
configuration RfmToLeds {
}
implementation {
  components Main, RfmToInt, IntToLeds;

  Main.StdControl -> IntToLeds.StdControl;
  Main.StdControl -> RfmToInt.StdControl;
  RfmToInt.IntOutput -> IntToLeds.IntOutput;
}
```

types/am.h

```
typedef struct TOS_Msg
{
  /* The following fields are transmitted/received on the radio. */
  uint16_t addr;
  uint8_t type;
  uint8_t group;
  uint8_t length;
  int8_t data[TOSH_DATA_LENGTH];
  uint16_t crc;

  /* The following is added after the packet is received. */
  uint16_t strength;
  uint8_t ack;
  uint16_t time;
  uint8_t sendSecurityMode;
  uint8_t receiveSecurityMode;
} TOS_Msg;
```

Packet Format

```
7e 42 7d 5e 00 04 81 04 01 00 05 00 3d 24 7e
7e 42 7d 5e 00 04 81 04 02 00 05 00 e1 bf 7e
7e 42 7d 5e 00 04 81 04 03 00 05 00 55 c9 7e
7e 42 7d 5e 00 04 81 04 04 00 05 00 78 98 7e
 ______________________________________________
|   |   |         |   |   |   |           |       | |
|   |   |         |   |   |   |           |       | |
|___|___|_________|___|___|___|___________|_______|_|
 F    k     A       T   G   L    Payload      CR    F

F       = Framing byte, denoting start of packet
K       = Ack/noAck
A       = address 0x007e
T       = Type
G       = Group
L       = Length of Payload
Payload = Data payload
CR      = Two-byte CRC over S to end of Payload
F       = Framing byte denoting end of packet
```

Note that any data bytes (P - CR) equal to 0x7e or 0x7d will be escaped to 0x7d 0x5e or 0x7d 0x5d accordingly.

BaseStation

Scenario

- Have a node send a message to the basestation.
- Basestation forwards message to UART.
- Basestation sends a messages to other nodes based on a timer event.

AMStandard

- The implementation module of `GenericComm`
- `tos/system/AMStandard.nc`
- Message get sends with an `id` taken from the `type` field of the packet and used to identify the parametrized interface.
- Messages sent with a certain `id` has to be received with the same `id`.

```
DataToUARTM.Send -> Comm.SendMsg[id];
```

```
ReceiveDataM.ReceiveMsg ->
GenericComm.ReceiveMsg[id];
```

Sending Message

```
call Send.send(ADDR, sizeof(IntMsg), &data)
```

If ADDR=TOS_UART_ADDR send to UART

If ADDR=TOS_BCAST_ADDR send to all nodes over radio

SendMsg *AMStandard.nc*

```
// Command to accept transmission of an Active Message
command result_t SendMsg.send[uint8_t id](uint16_t addr, uint8_t length, TOS_MsgPtr data) {
  if (!state) {
    state = TRUE;
    if (length > DATA_LENGTH) {
      dbg(DBG_AM, "AM: Send length too long: %i. Fail.\n", (int)length);
      state = FALSE;
      return FAIL;
    }
    if (!(post sendTask())) {
      dbg(DBG_AM, "AM: post sendTask failed.\n");
      state = FALSE;
      return FAIL;
    }
    else {
      buffer = data;
      data->length = length;
      data->addr = addr;
      data->type = id;
      buffer->group = TOS_AM_GROUP;
      dbg(DBG_AM, "Sending message: %hx, %hhx\n\t", addr, id);
      dbgPacket(data);
    }
    return SUCCESS;
  }
```

SendTask *AMStandard.nc*

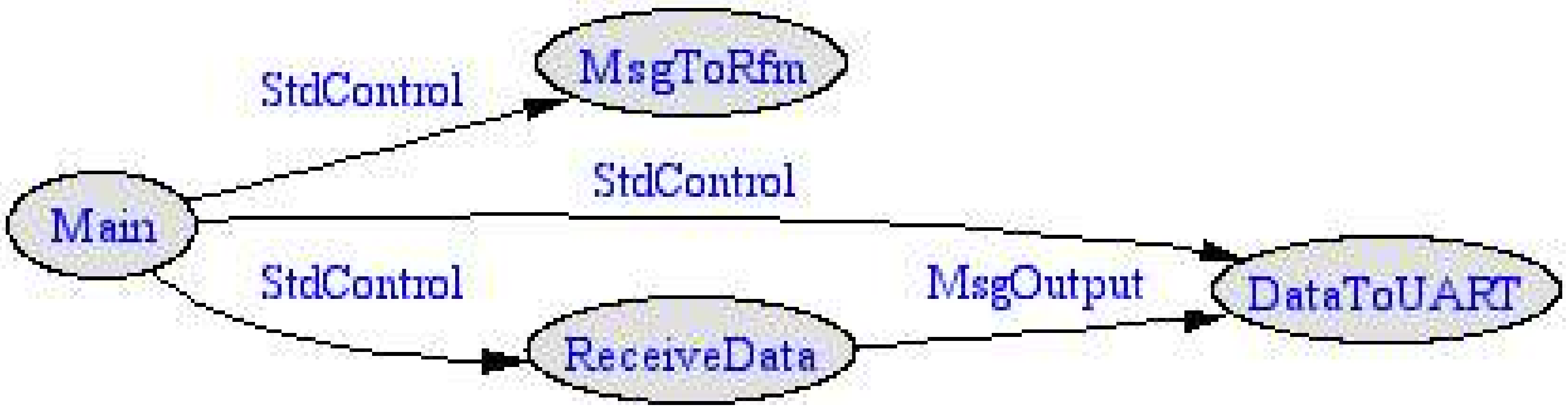
```
// This task schedules the transmission of the Active Message
task void sendTask() {
  result_t ok;
  TOS_MsgPtr buf;
  buf = buffer;
  if (buf->addr == TOS_UART_ADDR)
    ok = call UARTSend.send(buf);
  else
    ok = call RadioSend.send(buf);

  if (ok == FAIL) // failed, signal completion immediately
    reportSendDone(buffer, FAIL);
}
```

Reception of Msgs

AMStandard.nc

```
  // Handle the event of the reception of an incoming message
  TOS_MsgPtr received(TOS_MsgPtr packet)  __attribute__ ((C, spontaneous)) {
    uint16_t addr = TOS_LOCAL_ADDRESS;
    counter++;
    dbg(DBG_AM, "AM_address = %hx, %hhx; counter:%i\n", packet->addr, packet->type, (int)counter);

    if (packet->crc == 1 && // Uncomment this line to check crcs
        packet->group == TOS_AM_GROUP &&
        (packet->addr == TOS_BCAST_ADDR ||
         packet->addr == addr))
      {

        uint8_t type = packet->type;
        TOS_MsgPtr tmp;
        // Debugging output
        dbg(DBG_AM, "Received message:\n\t");
        dbgPacket(packet);
        dbg(DBG_AM, "AM_type = %d\n", type);

        // dispatch message
        tmp = signal ReceiveMsg.receive[type](packet);
        if (tmp)
          packet = tmp;
      }
    return packet;
  }
```

BaseStation.nc

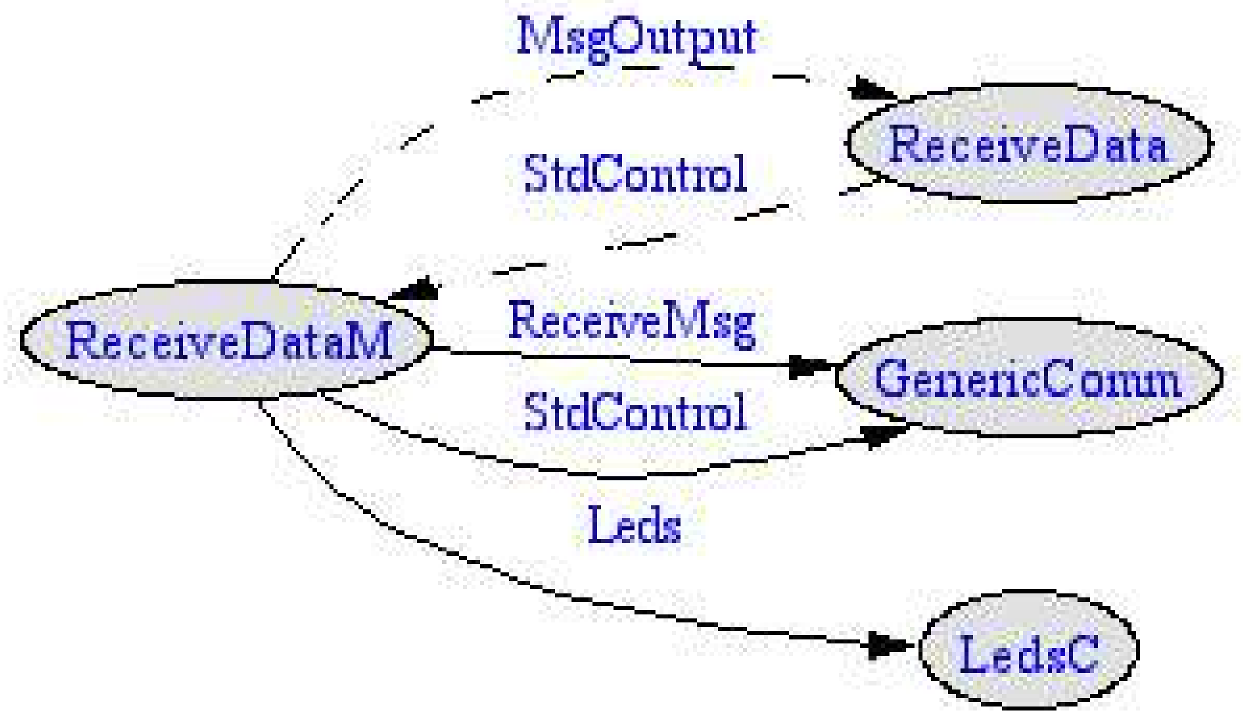


BaseStation.nc

```
configuration BaseStation {
}
implementation {
  components Main, ReceiveData, DataToUART, MsgToRfm;

  Main.StdControl -> ReceiveData.StdControl;
  Main.StdControl -> DataToUART.StdControl;
  Main.StdControl -> MsgToRfm.StdControl;
  ReceiveData.MsgOutput -> DataToUART;
}
```

`MsgOutput` is based on `IntOutput` but it sends the entire data field instead of an single int value

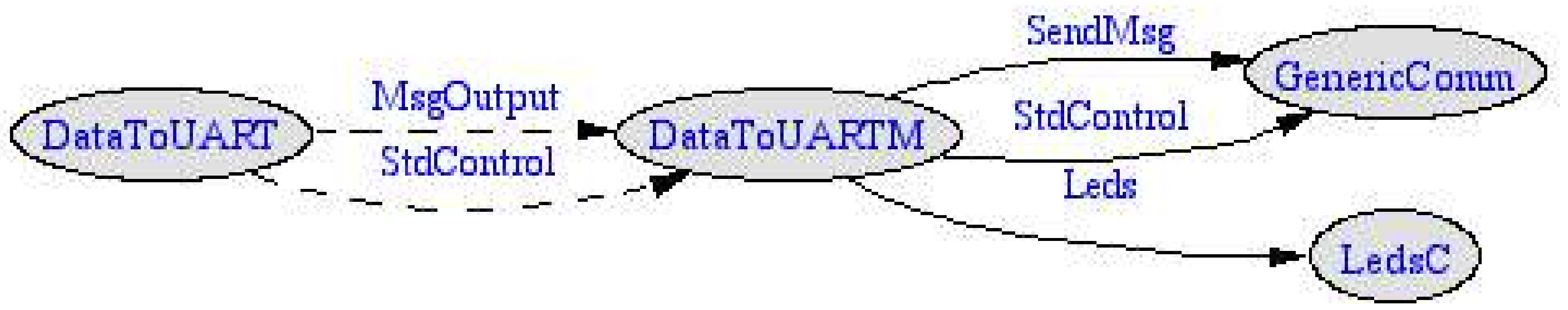
ReceiveData.nc



ReceiveData.nc

```
includes IntMsg;

configuration ReceiveData {
  provides interface StdControl;
  uses interface MsgOutput;
}
implementation {
  components ReceiveDataM, GenericComm, LedsC;

  MsgOutput = ReceiveDataM;
  StdControl = ReceiveDataM;
  ReceiveDataM.ReceiveMsg -> GenericComm.ReceiveMsg[AM_INTMSG];
  ReceiveDataM.CommControl -> GenericComm;
  ReceiveDataM.Leds -> LedsC;

}
```

DataToUART.nc



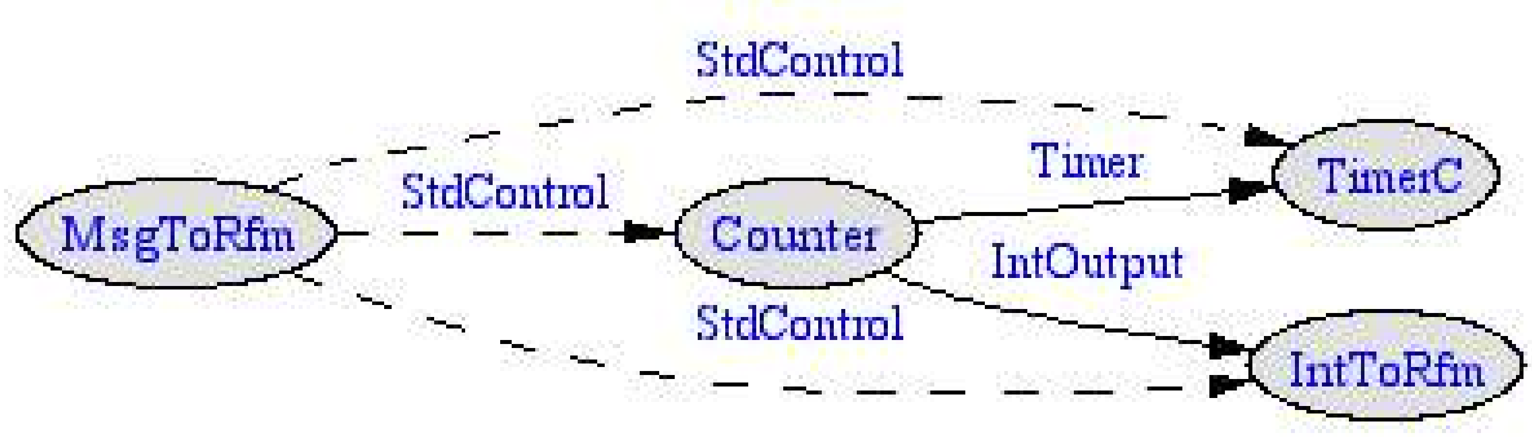
DataToUART.nc

```
includes IntMsg;

configuration DataToUART
{
  provides {
    interface MsgOutput;
    interface StdControl;
  }
}
implementation
{
  components DataToUARTM, GenericComm as Comm, LedsC;

  MsgOutput = DataToUARTM;
  StdControl = DataToUARTM;

  DataToUARTM.Send -> Comm.SendMsg[AM_INTMSG];
  DataToUARTM.SubControl -> Comm;
  DataToUARTM.Leds -> LedsC;
}
```

DataToUARTM.nc

```
                                        .
                                        .
                                        .
     command result_t MsgOutput.output(IntMsg msg)
      {
        IntMsg *message = (IntMsg *)data.data;
        if (!pending)
          {
          pending = TRUE;
          call Leds.yellowOn();
          atomic{
              *message = msg;
            }
          if (call Send.send(TOS_UART_ADDR, sizeof(IntMsg), &data))
            return SUCCESS;

          pending = FALSE;
          }
        return FAIL;
      }
                                        .
                                        .
                                        .
```

MsgToRfm.nc


StdControl
MsgToRfm
StdControl
Counter
Timer
TimerC
IntOutput
StdControl
IntToRfm

MsgToRfm.nc

```
configuration MsgToRfm {
  provides interface StdControl;
}
implementation {
  components Main, Counter, IntToRfm, TimerC;

  StdControl = Counter.StdControl;
  StdControl = IntToRfm.StdControl;
  StdControl = TimerC.StdControl;
  Counter.Timer -> TimerC.Timer[unique("Timer")];
  Counter.IntOutput -> IntToRfm;
}
```

Output

- Node 1 is running CntToLedsAndRfm, the leds blink to represent the counter at a high rate.
- Node 2 is running BaseStation and forwards the incoming msg from CntToLedsAndRfm to the UART. Based on a 1sec timer it will also send a counter to Node 3.
- Node 3 running RfmToLeds displays the counter at a slower rate than Node 1.
- Because of packet id the Node 3 will not process data received from Node 1 and if BaseStation is not running the Leds will not run.