CS414/415 Section 3
Project 3: Unreliable datagrams

Krzysztof Ostrowski

krzys@cs.cornell.edu

Slides modified from previous years' slides

What do you have to do?

- Implement unreliable communication
  - Simulate (parts of) the UDP/IP protocol
  - Build a datagram networking stack
    - Use the provided pseudo-network interface (see ”**`network.h`**”)
    - Interface in „**`minimsg.h`**”, skeleton code in „**`minimsg.c`**” provided to fill in
    - Implement ports to identify the endpoints
    - Build a *minimessage* layer for thread I/O

A glimpse at interface to implement

```
#define MINIMSG_MAX_MSG_SIZE (4096)
typedef struct miniport* miniport_t;
typedef char* minimsg_t;

void minimsg_initialize();

miniport_t miniport_local_create();
miniport_t miniport_remote_create(network_address_t addr, int id);
void miniport_destroy(miniport_t miniport);

int minimsg_send(miniport_t local, miniport_t remote, minimsg_t
    msg, int len);
int minimsg_receive(miniport_t local, miniport_t* remote, minimsg_t
    msg, int *len);
```

Networking pseudo-device (1)

- Allows communication between minithreads systems
- Interrupt-driven implementation
  - Network_handler
    - Similar to clock handler, same interrupts used
    - Executed separately for each received packet
    - Uses the stack of the current thread
    - Should finish as soon as possible
    - Initialized with ”`network_initialize()`”

Networking pseudo-device (2)

- Network_handler receives a structure:

```
typedef struct
{
        network_address_t addr;                          // sender
        char buffer[MAX_NETWORK_PKT_SIZE];               // hdr+data
        int size;                                        // size
} network_interrupt_arg_t;
```

  - Need to strip the header off the buffer

- Call "`network_initialize`" function
  - After clock_initialize()
  - Before enabling interrupts and running threads

Networking functions

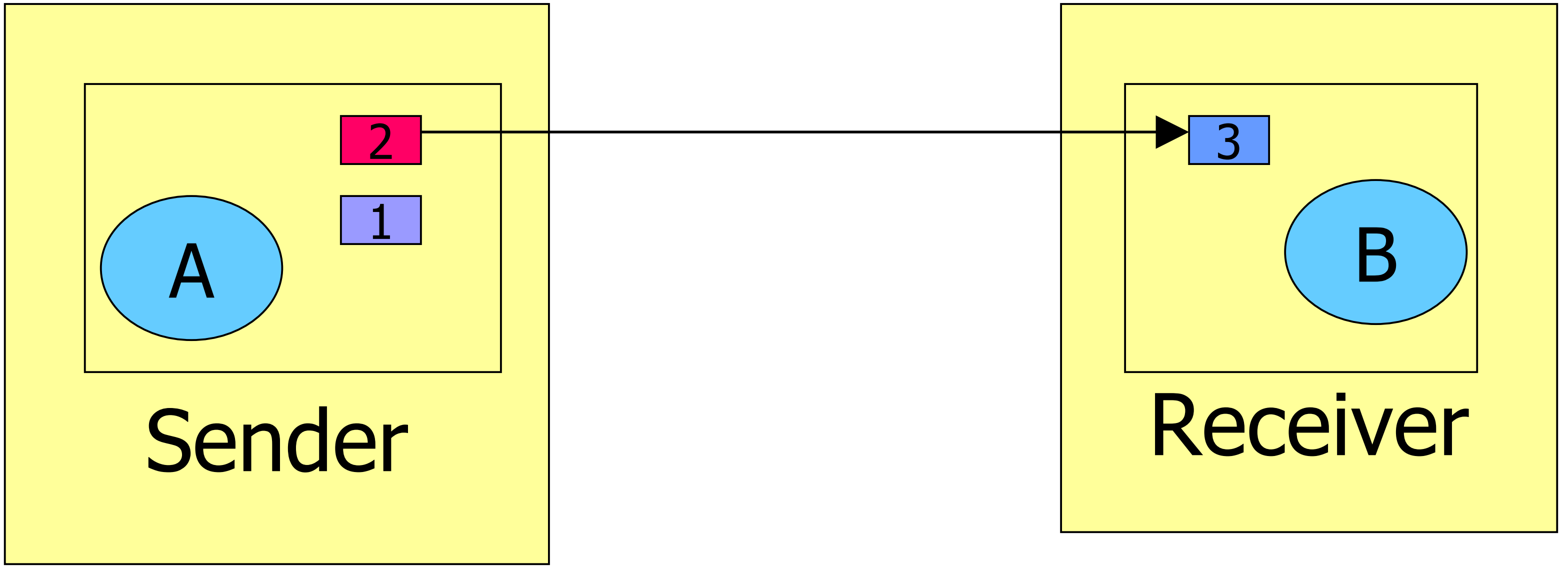
- Network_send_pkt – sends a packet
  - Destination
  - Header (body, length)
  - Data (body,length)
- Header:
  - Extra information
    - About the sender
    - About the receiver
  - As small as possible

Miniports

- Data structures that represents endpoints
  - Network Device does not control which thread processes a received packet
- Local ports:
  - Usually, used for listening
  - Not bound to any remote ports
  - Can receive from any remote port
- Remote ports:
  - Created when a packet is received
  - Bound to a “remote” port
  - Allows the receiver to reply

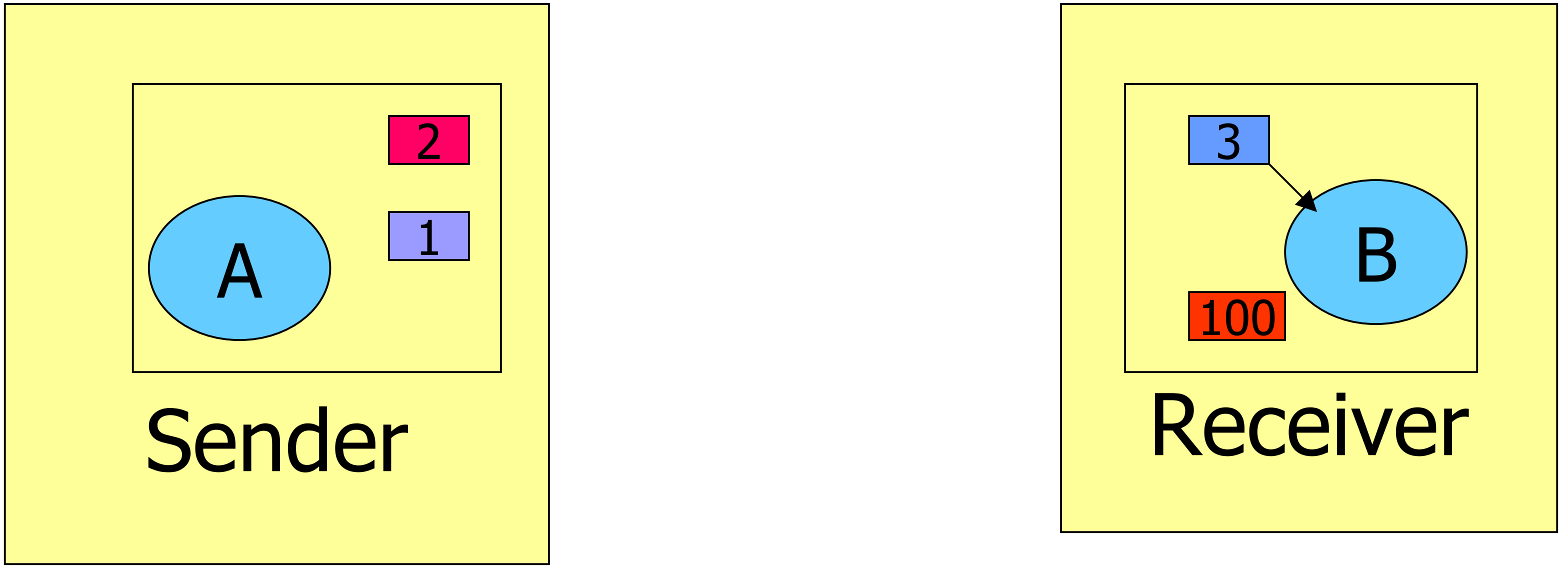
Miniports example (1)

- Ports 1,3 – local ports; 2 – remote port
- A,B - Threads
- Sender A sends a message to Receiver B



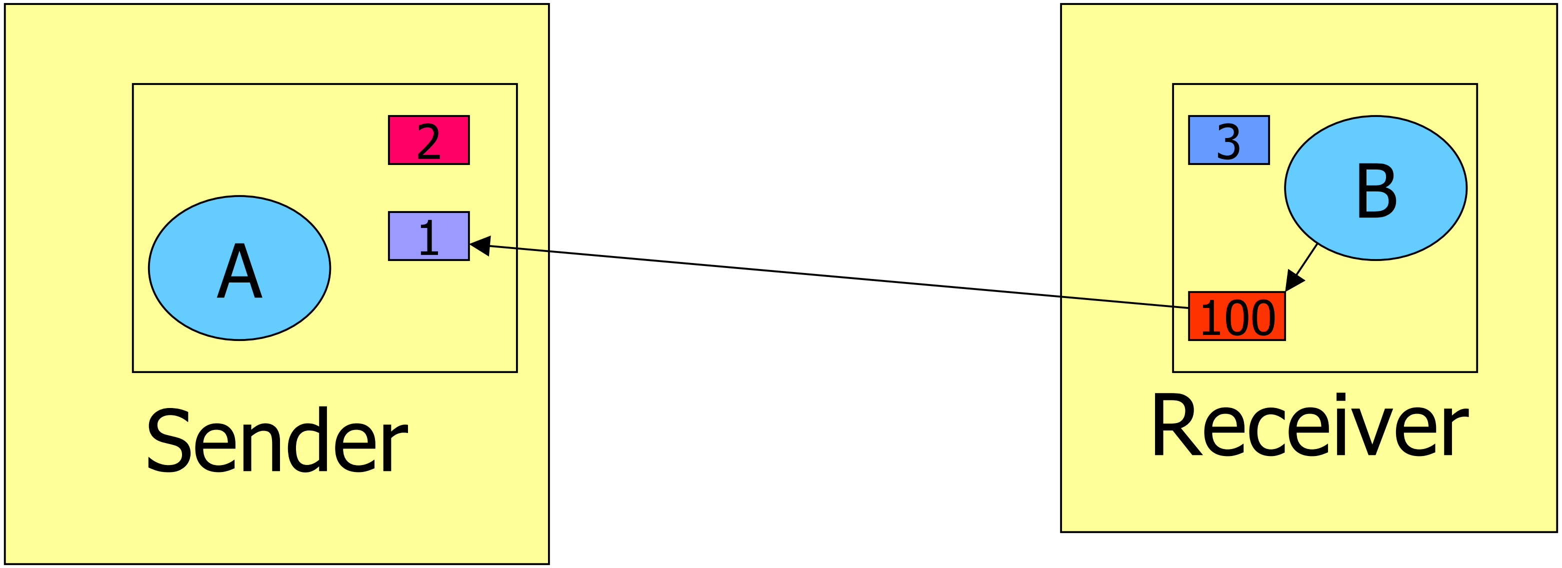
Miniports example (2)

- Minithread system creates the remote port 100
- Message is delivered to the local port
- B receives the message;



Miniports example (3)

- B replies to A using the newly created remote port
- The message is relayed to A’s local port



Miniports – how would they look like?

```
typedef struct miniport {
    char port_type;
    int port_number;

    queue_t msg_queue;
    semaphore_t msg_sem;
    semaphore_t msg_mutex;

    network_address_t remote_address;
    int remote_port;
    int remote_is_local;
} miniport;
```

Miniports – you can use unions

```
struct miniport {
   char type;
   unsigned int portno;
   union {
        struct {
               queue_t receiver_queue;
               semaphore_t queue_lock;
               semaphore_t data_ready;
        } loc;
        struct {
               unsigned int portno;
               network_address_t addr;
        } rem;
   } u;
};
```

Miniports - hints

- Local communication
  - Note that **`miniport_destroy`** function will be called by the receiver
  - **`remote_miniport`** as a pointer to a local port
  - **`miniport_send`** implemented based on the "remote port"
- Miniports
  - Identified by numbers
  - Assigned them successive numbers
  - Local miniports – start from 0
  - Remote miniports – start from 32768

Minimsg layer

- Identifies the end-points of the communication (ports)
  - The sender assembles the header used to identifies the endpoints
  - The receiver
    - examines the header
    - Identifies destination
    - Enqueues the packet in the right place, wakes up any sleeping threads

Minimsg functions

- Minimsg_send:
  - Non-blocking
  - Parameters:
    - local and remote ports
    - The message and its length
  - Appends the header to the message
  - Sends the entire data using network_send
- Minimsg_receive:
  - Blocks the thread until it receives a message on the specified port
  - Receives information about the remote port – used to reply

Implementation hints

- Do not add unnecessary data to the header
  - Include the address of the sender (used later by the ad-hoc routing protocol later)
- Port operations must be O(1)
- Do not waste resources
- Make sure a port in use is not reassigned
- Remote miniports are destroyed by the application
- **`network_initialize`** returns the ip address of the machine
- Build other test cases