

CSMC 417

Computer Networks

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Set 4

An Information-centric View of Communications

What information is needed where and why?

Who Communicates

- Two autonomous entities
 - Capable of independent operations
 - » Timing
 - » What if not independent
 - Master-Slave operation
 - I/O Devices
- What do they communicate ?
 - Information
 - Convert to message – Has meaning only to the two entities



Message

- Encoding and decoding known/agreed upon by the sender/receiver
- Representable in a form so that it can be manipulated by processors
 - Stored
 - Moved
 - (Not Necessarily Interpreted)

Communications Between Two Entities



- S and R need to communicate
- Sender S needs to send information I to receiver R and be assured that R has received it
- All assumptions have to be true by design or due to the physical properties

Entities

- Sender
 - Capable of autonomous action
 - Has access to information I
 - » How long does it take for it to access I ?
 - Has ability to send and receive signals to/from the medium
- Receiver
 - Capable of autonomous action
 - Has ability to send and receive signals to/from the medium
- Medium
 - Can move signals from S to R and R to S
 - » What additional properties must M have?

Who to Communicate with

- How does the sender know to communicate with the receiver?
 - Based on additional information
 - Hard Coded
 - Search engines
 - » Has to know the name/address of search engines
- What does sender know about the Receiver?
 - Name
 - Address
 - Some other properties

Expectations

- Does the Sender expect the Receiver to take some specific action on receiving the message?
 - Based on additional information
 - How does it know that the action was taken by the Receiver?
 - » Confirmation
 - » Response
 - » ...
 - How does it know that the receiver received the message intact?

Receiver

- How does it know that Sender is sending a message?
- When should it listen?
 - Always listening
 - At some agreed upon times
 - Some other mechanism
 - » Signal
 - How does it know to listen for the signal
 - ...

Message Movement

- Message Representation
 - Bit String
- Movement
 - Medium
 - IPC
 - » On the same computer
 - » OS Mechanisms
 - » Shared memory
 - On different computers
 - » Medium permits movement of message encoded as bit string from one machine to the other

Medium

- Capabilities
 - Can move messages
 - What can we assume about the capabilities
 - » Functionality – storage, order, processing
 - » Performance
- Topology
 - Point to point – one sender/one receiver
 - Broadcast – one sender/multiple possible receivers
- Control
 - Active
 - Passive

Medium

- Lowest level
 - Dedicated
 - » Point-to-point
 - Shared
 - » Multicast/Broadcast
 - » Control Mechanisms
 - Who
 - When
- Higher level
 - Additional capabilities
 - » Buffering
 - » Error handling
 - » Format Conversion
 - » Segmentation/ Packetizing
 - » ...

Timing

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- **Passive Medium**
 - There must be agreement about timing
 - » Predefined
 - » R Listening all the time
 - Interrupt is a form of listening all the time
 - Polling can be in hardware or in software
 - Sender and receiver must synchronize to interpret the signals properly
 - Buffers act as universal sender/receiver
- **Similar issues arise at higher levels**

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Information Coding

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- **S and R must know the common coding for the information**
- **Interpretation of the information must be consistent**

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Naming

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- **S must know the identity of R**
 - Explicitly
 - Implicitly
- **ID must contain enough information for the medium to locate R**
- **Name / Address mapping issues**
- **Routing issues**
- **Is mapping static or dynamic**
 - Mobile computing

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Confirmation

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- **How does S know that R has received the information correctly?**
 - True by design
 - Handshake
 - Explicit acknowledgement
- **Error Detection and Handling**
 - Who detects
 - What steps are taken
 - » Ignore error
 - » Inform sender
 - » ..

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Building Block

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- **Simple Medium**
- **Media as agent**
 - Active
 - » Capable of acting as
 - sender
 - receiver
 - processor
 - State information
 - Storage Capabilities

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Organizing a network

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- **Hierarchical structure**
 - Levels of abstraction
- **Defined in terms of units of information**
 - bit
 - byte
 - frame
 - packet
 - message
 - cell
- **At one level**
 - Sender
 - Receiver
 - Medium

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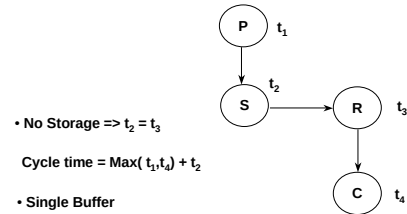
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Transfer Cycle

- Move one unit of information from S to R and sustain a delay
- Unacknowledged
- Sequencing of information
 - Explicit - sequence numbering
 - Implicit - Medium guarantees in order delivery

Producer Consumer Relationship



- No Storage $\Rightarrow t_2 = t_3$

$$\text{Cycle time} = \text{Max}(t_1, t_4) + t_2$$

- Single Buffer

$$\text{Cycle Time} = \text{Max}(t_1 + t_2, t_2 + t_3, t_3 + t_4)$$

- Multiple Buffers ?

Resource Implications

- All actions require the use of resources
- Have to consider them in Resource/Time space
- Independent resources may be capable of autonomous actions
- Interdependencies/ sequencing of actions has to be explicitly identified