BSE2206: Data Communications

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The world today--annoyances

- Internet is so slow, I have been struggling to upload all morning! Why?

- How do I move my data to China .

- My Huawei laptop cannot read from my Sumsang phone

- …….

Consequently…

- Nothing gets done!

- Working on less priority things first

- Bad decision making

- Wasted time and effort

- ……..

What we need to ensure

- Access to accurate information

- Interoperability between devices

- Enhance quick decision making

- Computer networks and internetworks are reliable
  - Know how networks operate
  - What types of technologies are available
  - Which design best fill which set of needs

This lecture

- Introduce the course
  - Clarify expectations
  - Assignments and grading
  - Answer any questions

- Introduce the idea of Data Communications

Course Aims

- Provide a good understanding of the electrical characteristics of digital signals and the basic methods of data transmission.

- Introduce the concept of communication protocols and give an overview of Data Communication Standards.

- Give an introduction to the area of computer networks, with emphasis on the range of communication protocols utilized.

- Explore the concept of Open Systems, giving an overview of Transport and Application Support Protocols

Course learning outcomes

- Understand basic functions on which modern communication systems are built

- Know how packets find their way through the Internet, and how congestion is avoided

- Know how wireless communication works

- Be able to develop programs that efficiently communicate over a network

- Have the required basis for working in this area

Course Content

1. Introduction to communication
2. Digital versus Analog transmission;
3. Modems
4. Transmission media: magnetic media, twisted pair, coaxial, fiber-optics;
5. Data encoding: straight, Manchester, differential Manchester, satellite;
6. Modulation and their standards, codes and pulse code modulation;
7. Integrated Services Digital Networks (ISDN)
8. Network Access Protocols; Passive versus dynamic allocation;
9. LAN standards:802.3 (Ethernet),802.4 (token bus), 802.5 (token ring)

Delivery

- Teaching pattern is blended learning including
  - Lectures (physical or online)
  - Group discussions and class presentations

Assessment

❑Mode of Assessment:

❑Coursework (40%) will comprise the following;

❑class presentations 10%

❑2 physical tests (TBD) 20%

❑class Attendance and class Quizzes 10%.

❑Final written Exam 60%

Reference List

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❑ David Stamper et al, *Business Data Communications, 6th Edition*, 2003, Prentice Hall.

❑ Fred Halsall, *Data Communications, Computer Networks, and Open Systems, 4th Edition*, 1998, Addison-Wesley.

Introduction to Data Communications

What is Data Communication

- **Exchange of digital data between two or more devices through a communication medium**
  - Purpose is to transmit information e.g text, numbers, images, audio and video from one location to another
  - Exchange can occur over short distances within a room or building (LANs) or over long distances (WANs)
  - In essence, information is exchanged in form of digital data

In simpler terms, data communications involves:

1. What is communicated:

- **Data:** the information presented in whatever form that is agreed upon by the parties creating and using (sending and receiving) it.
  - An entity that conveys meaning of information.

Data Communication….

How data is communicated:

- Channels: Physical mediums like cables or wireless signals carry the data.

- Protocols: Rules govern how devices understand and respond to each other.

- Transmission modes: Data can flow in one direction (simplex), both directions but not at the same time (half-duplex), or both directions simultaneously (full-duplex).

Why Data communications is important

- Connects devices: Enables computers, phones, and other devices to share information and resources.

- Powers the internet: Allows you to access websites, send emails, and use online services.

- Essential for modern life: Underpins everything from communication and entertainment to business and science.

Basic Communication Model

Transfer of information from one point to another point located at a certain distance far away through transmission system or channel is called communication.
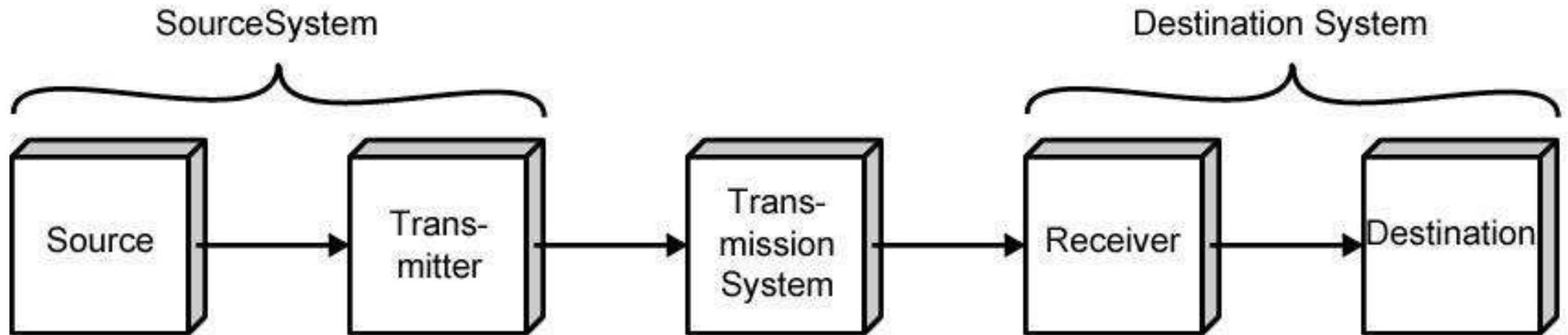
Basic communication model – Key elements

Source:
- Generates the data to be transmitted which could be analog or digital
- Devices used include computers, phones, etc

Transmitter
- Converts data into transmittable signals
- Encodes – for digital communication
- Converts into electrical form or electromagnetic signals

Transmission system
- Carries data from source to destination
- Could be transmission line or complex network
- Connects source and destination

Basic communication model – Key elements

Receiver
- ◦ Converts received signals into data
- ◦ Decodes and converts received signal into form suitable for destination to handle

Destination
- ◦ Takes incoming data from receiver and converts into desired form
- ◦ E.g., speaker, monitor, printer etc

Characteristics of effective data communication

Delivery :
- The system must deliver data to the correct destination
- Data must be received by the intended receiver only.

Accuracy:
- The System must deliver the data accurately.
- The data that have been altered in transmission and uncorrected at the receiver are useless.

Timeliness:
- The system must deliver data in time.
- The data which are delivered late are useless. This is more sensitive in case of real time transmission.

Jitter :
- Jitter is any deviation in, or displacement of, the signal pulses in a high-frequency digital signal.
- The deviation can be in terms of amplitude, phase timing or the width of the signal pulse.

Key tasks in a Data Communication System

o **Transmission system utilization** - need to make efficient use of transmission facilities typically shared among a number of communicating devices.

o A device must **interface** with the transmission system.

o Once an interface is established, **signal generation** is required for communication.

o There must be **synchronization** between transmitter and receiver, to determine when a signal begins to arrive and when it ends.

o There is a variety of requirements for communication between two parties that might be collected under the term **exchange management.**

o **Error detection and correction** are required in circumstances where errors cannot be tolerated

o **Flow control** is required to assure that the source does not overwhelm the destination by sending data faster than they can be processed and absorbed

Key tasks in a Data Communication System…

Addressing and **routing**, so a source system can indicate the identity of the intended destination, and can choose a specific route through this network

Recovery allows an interrupted transaction to resume activity at the point of interruption or to condition prior to the beginning of the exchange

Message formatting has to do with an agreement between two parties as to the form of the data to be exchanged or transmitted

Frequently need to provide some measure of **security** in a data communications system

Network management capabilities are needed to configure the system, monitor its status, react to failures and overloads, and plan intelligently for future growth

Data Communications Model
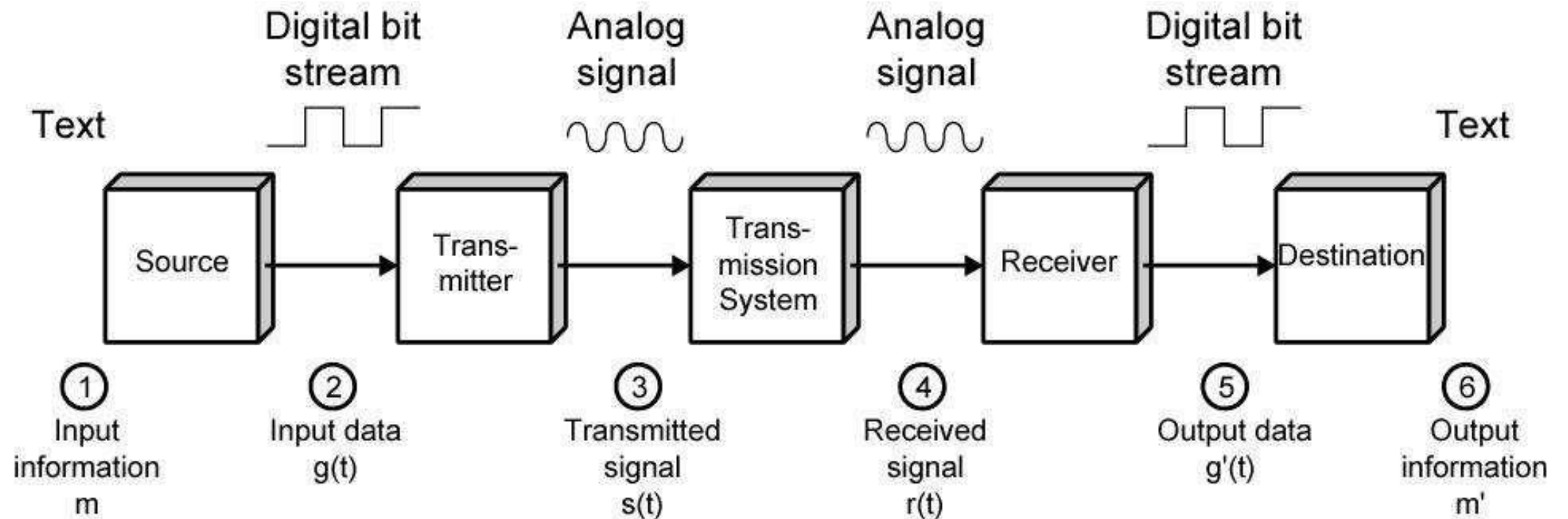
Data Communications Model

o user keys in message (m) comprising bits (g) buffered in source PC memory

o input data is transferred to I/O device (transmitter) as sequence of bits g(t) using voltage shifts

o transmitter converts these into a signal s(t) suitable for transmission media being used

o whilst transiting media signal may be impaired so received signal r(t) may differ from s(t)

o receiver decodes signal recovering g'(t) as estimate of original g(t)

o which is buffered in destination PC memory as bits (g') being the received message (m')

Data Communication Networking

Many computers worldwide

Need good ways to communicate between them

Connection between two or more computers for the purpose of sharing resources is called Networking

Communication networks categorised according to geographical coverage
- Local Area Networks (LAN)
- Metropolitan Area Networks (MAN)
- Wide Area Networks (WAN)

Enough!

Data Communication Model

- A set of coherent *activities* and *associated results* that lead to the production of a software product

- Activities include specifying, designing, implementing, testing and evolving software systems

- Results include architectural descriptions, source code, user documentation, and the roles of people involved in software engineering

- Can be about developing from scratch or modifying an existing system
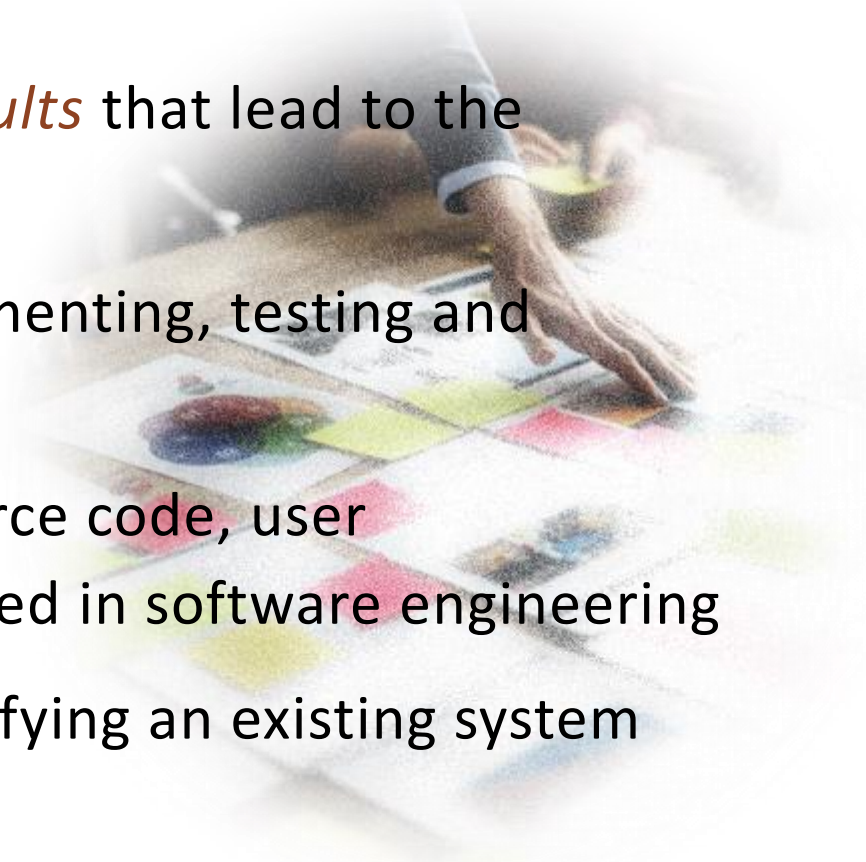
Software Process and process models

- There is no ideal process and most organisations have developed their own software development processes.

- Whereas a software process is a set of activities, a process model is a simplified representation of a Software process from a specific perspective

- Process to use depends on context e.g market, customer, final product.

Process models include:

1. Waterfall model

2. Iterative development

3. Incremental development

4. Spiral model

5. Agile development
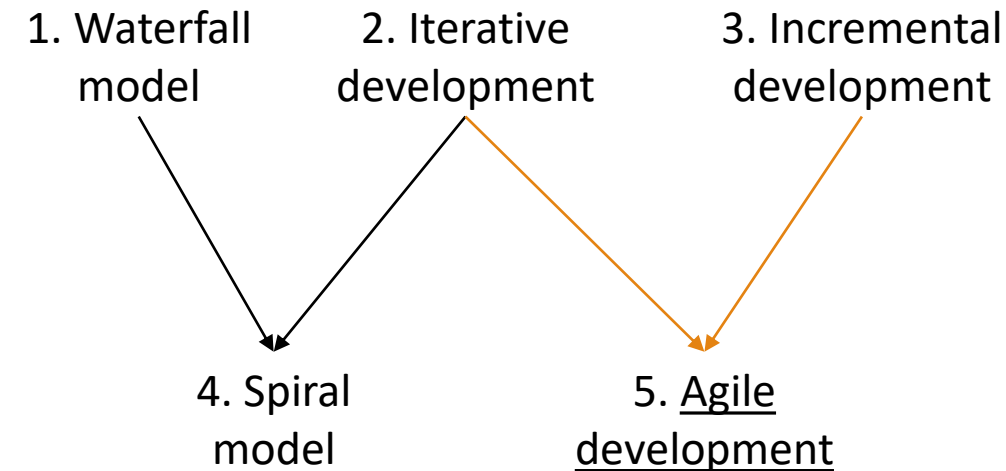
What would be ideal process for an organisation working on critical systems and why?

What is agile development?

Agile development

- Agile is the ability to create and respond to change

Agile software development is an umbrella term for a set of frameworks and practices based on the values and principles behind it. - Agile Alliance

- The four main values are:
  - Individuals and interactions over processes and tools
  - Working software over comprehensive documentation
  - Customer collaboration over contract negotiation
  - Responding to change by following a plan

- Agile development focuses on creating working software quickly, collaborating with customers frequently, and being able to adapt to changes easily.

- This methodology is especially beneficial for projects that are complex or have uncertain requirements.

Sample Agile Methodologies

Most popular:

- Scrum

- Extreme programming (XP)

The Agile Scrum Framework at a glance
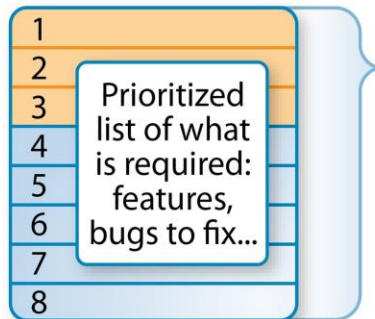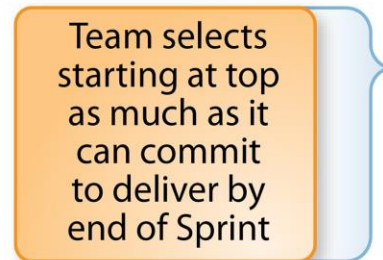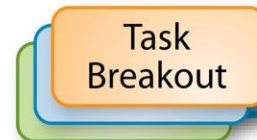
Extreme Programming

XP phases that iterate continuously

Planning	Design	Coding	Testing

Planning
- Requirements as User stories
- Estimate stories
- Create release plan

Design
- Part of planning
- Emphasise simplicity

Coding
- Code standard
- Pair programming
- Continuous integration
- Collective code ownership

Testing
- Unit testing (automated)
- Acceptance testing

Customer collaboration and feedback are emphasised

Customers, developers, coaches, managers?

Scrum vs XP

- Scrum focuses on value delivery and adaptability
- XP focusses on creating set of best practices that team can follow
- Both emphasise customer satisfaction, feedback, continuous improvement and empowered teams
- Can be used together

Which one would you choose for your project and why?

Aspect / Practice	Scrum	XP
Cycle (iteration):	2 – 4-week 'Sprints'	1 – 2-week iterations
Priority determined by:	The Team (loose)	The customer (strict)
Changes to Backlog:	Not allowed	Flexible
Validation:	End of the Sprint (Review)	Before any code is written
Prescribed Engineering Practices:	None	Many
Ultimate responsibility:	The Scrum Master	Any developer (collective)

Many other frameworks and methods

- Kanban

- Feature Driven development

- Crystal methodology

  …..?

Beyond agile:

How has agile evolved?

Agile development

Advantages	Disadvantages
Change is embraced	Hard to establish solid delivery date
Faster, high-quality delivery	Teams must be highly skilled in many areas
Strong team interaction	Documentation usually neglected
Continuous improvement	Final product can be very different
Customers satisfaction	Time commitment from developers draining

How has agile evolved?

1

Scaling of agile for large project – SaFE and LeSS

2

DevOPs integration – bridging thr gap between development and operations

3

Agile data science: iterative approach to data analytics

Key takeaways

What are software processes?

- ◦ Software processes organise development from start to end

Discuss the basics of agile development

- ◦ Agile development aims for faster development with changing requirements and enforces customer involvement

Beyond agile development

- ◦ We see agile and DevOps, agile data science and its use in non-it fields.

Lets get more innovative!!

Quiz

https://www.menti.com/albh9xq2hc2e

voting code **4561 6470**

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