AV312 and AV332 - Introduction

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A Mathematical Theory of Communication

By C. E. SHANNON

Introduction

THE recent development of various methods of modulation such as PCM and PPM which exchange bandwidth for signal-to-noise ratio has intensified the interest in a general theory of communication. A basis for such a theory is contained in the important papers of Nyquist[1] and Hartley[2] on this subject. In the present paper we will extend the theory to include a number of new factors, in particular the effect of noise in the channel, and the savings possible due to the statistical structure of the original message and due to the nature of the final destination of the information.

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one *selected from a set* of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of design.

If the number of messages in the set is finite then this number or any monotonic function of this number can be regarded as a measure of the information produced when one message is chosen from the set, all choices

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Analog or Digital

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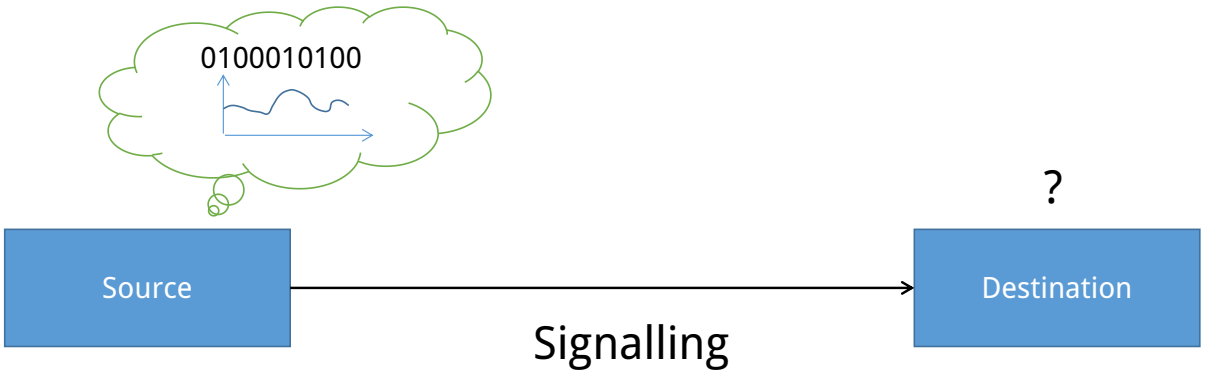

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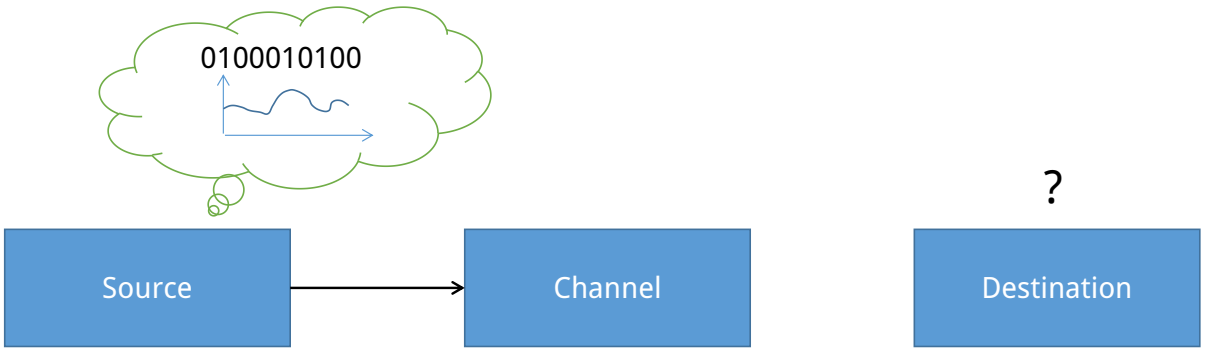

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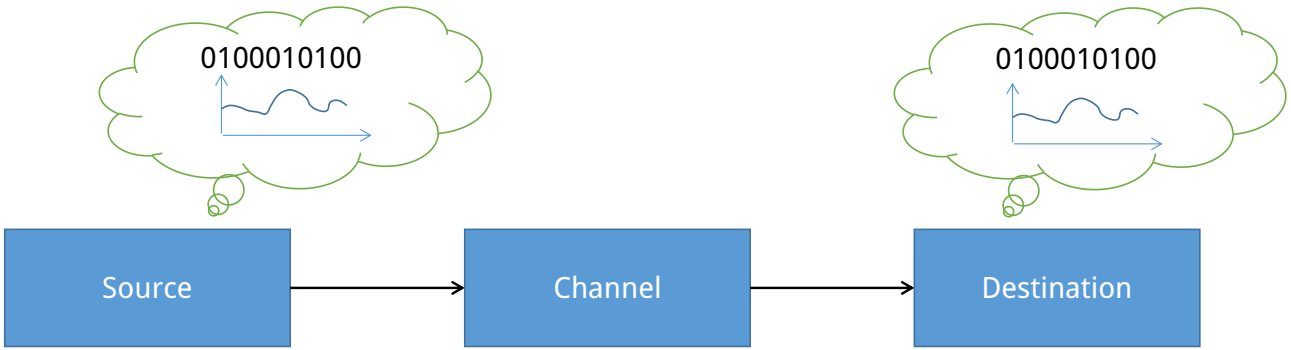

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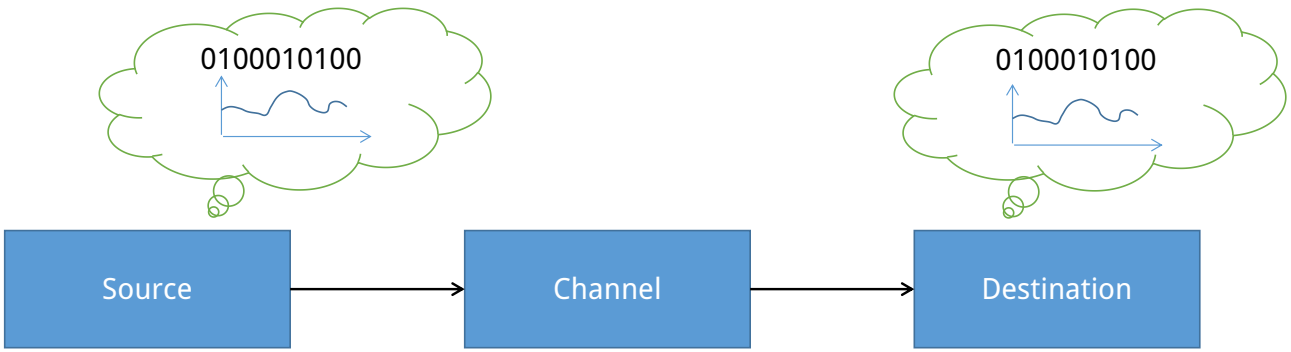
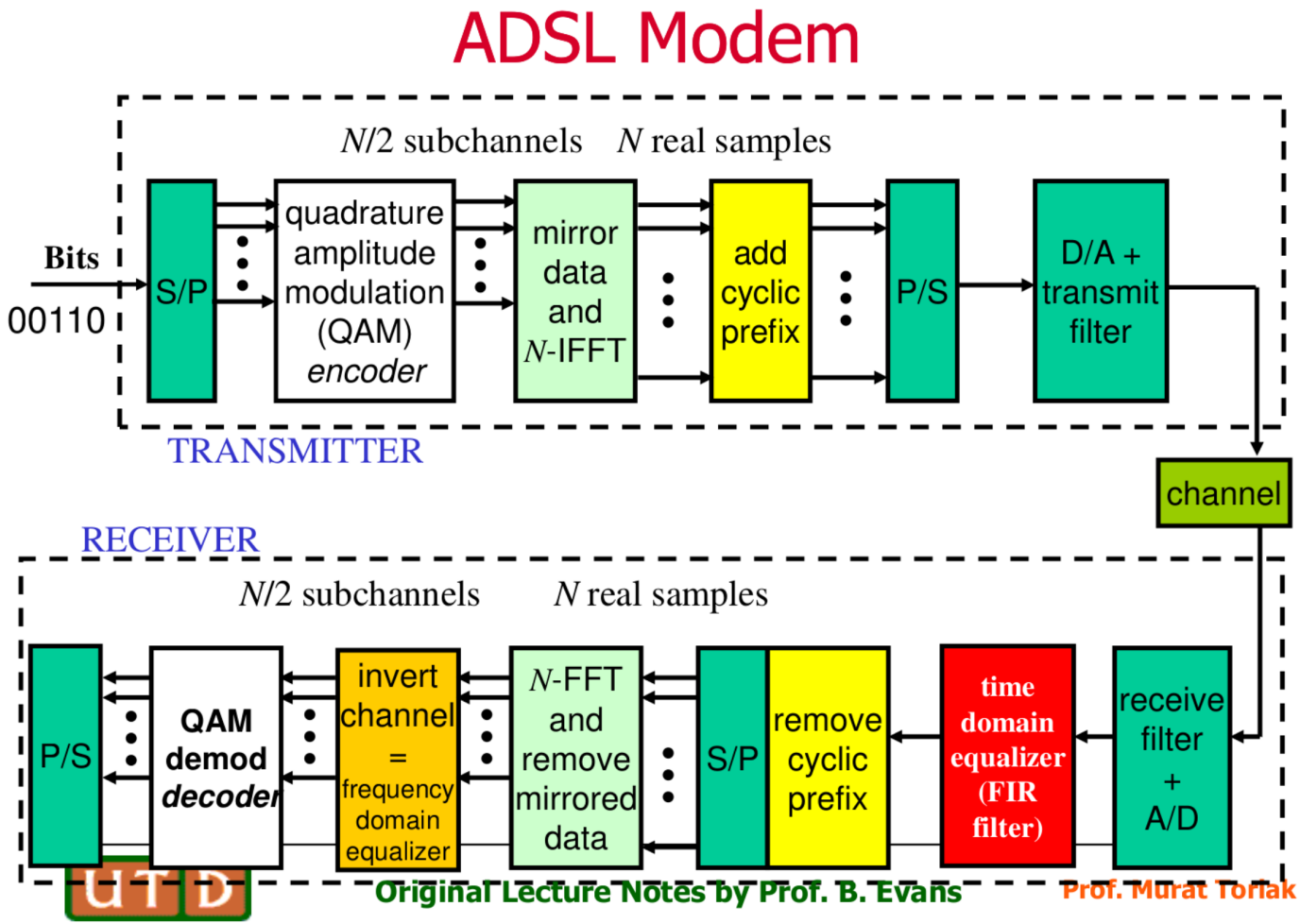


- Channel characteristics
  - Distortion
  - Noise
  - Interference
  - Regulation/Standards
- Synchronism between source and destination

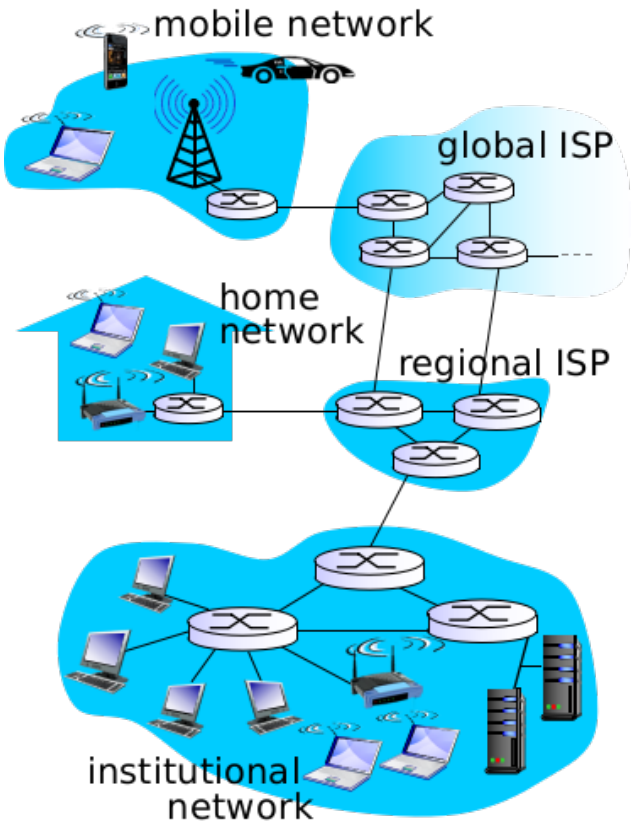
Addressing the challenges



What do we do in this course ?

- Channels - what are the characteristics and how to model these characteristics
- How to signal over a channel given channel characteristics to meet our fundamental requirement?
- Understand the existence of engineering tradeoffs
- How to analyze signalling schemes?
  - Experiments
  - Simulations
  - Mathematical analysis
- Understand how to do tradeoff analysis
- System design of communication systems to meet requirements

The scope of this course



Courtesy: Kurose and Ross. Computer Networking

Course plan

- Course will be based on "Communication Systems (4 ed.) - Simon Haykin"
- Will cover topics in two passes
- First pass will require Signals and Systems background
- Chapter 0, Chapter 2, Chapter 3, Chapter 4, Chapter 6
- Second pass will require Probability and Random processes background
- Chapter 2, Chapter 4, Chapter 5, Chapter 6
- Solution manual is available at "http://dsp-book.narod.ru/SolManComm.htm"

Other material

- Presentations and supplemental notes would be put up on webpage
- Textbooks
  - Introduction to analog and digital communications - Haykin and Moher
  - Modern digital and analog communication - B.P. Lathi
  - ...
- Online courses
  - NPTEL - Communication engineering, Prof. Surendra Prasad
  - NPTEL - Digital communication, Prof. Bikash Kumar Dey
  - NPTEL - Principles of communication, Prof. Venkata Rao
  - ...

AV312 and AV332: Logistics

- Webpage: http://vineethbs.github.io/
- Credits: $3 + 1$
- Number of hours you should put in: 10-12 hours per week
- Office hours: Fridays, 1600 - 1730 hrs at R111, D4
- TA: TBA

AV312: Logistics

- Attendance: Institute rules
- Assessment
  - Bi-weekly class tests: schedule and tested portions put up on webpage
  - Scribing: schedule on webpage
  - Assigments
    - Graded assignments
    - Ungraded homeworks
    - Group assignment
  - Midterms and Final

Mark distribution

	Marks
Graded assigments	7.5
Scribing	5
Group assignment	7.5
	20
Average of class tests before Midterm I	5
Midterm I	10
Average of class tests $\in$ (Midterm I, Midterm II]	5
Midterm II	10
	30
Average of class tests $\in$ (Midterm II, Final]	5
Finals	45
	50

Graded assignments

- Do the assigments on your own!
- Assignments will be announced in class and put up on webpage
- Deadlines (usually) 1 week from date of class
- No credit for late submissions

Scribing

- Write notes in each class
- Prepare notes in LaTeX and submit
- Template (in LaTeX) on webpage
- Diagrams - use inkscape, Dia etc.
- Schedule on webpage
- Submission deadline - 1 week from date of class
- No credit for late submissions

Group assignment

- Groups of maximum size 4
- You can decide on the group membership
- Submit a written report (4 pages) on a topic
- Topic suggestions on the webpage
- Submission deadline will be announced
- No credit for late submissions
- Report template (in LaTeX) on webpage
- Top 3 groups (might) get to present at Shannon Centennial Event (IEEE)