Welcome to MOBCOM @ EURECOM
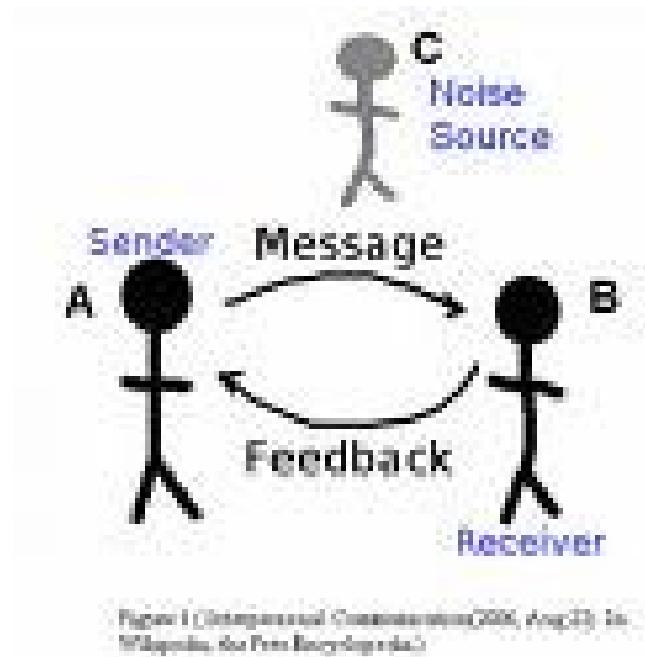
- Instructor: Petros Elia
    - http://www.eurecom.fr/people/elia.en.htm
    - elia@eurecom.fr
    - tel: 0493-00-8132
    - Office 329

- Class: Room 102, Thursday: 8:45am-12:00

- Office Hours: Thursday 12:00-1:00pm: Room 329 (zoom also)

Our focus: How to communicate information?

Figure I (Interpersonal Communication 2006, Aug 23). In Wikipedia, the Free Encyclopedia.

Why is there a massive challenge?
Hint below

Generators of infinite information to properly treat and reliably communicate

Youtube   **GOOGLE**   **MICROSOFT**

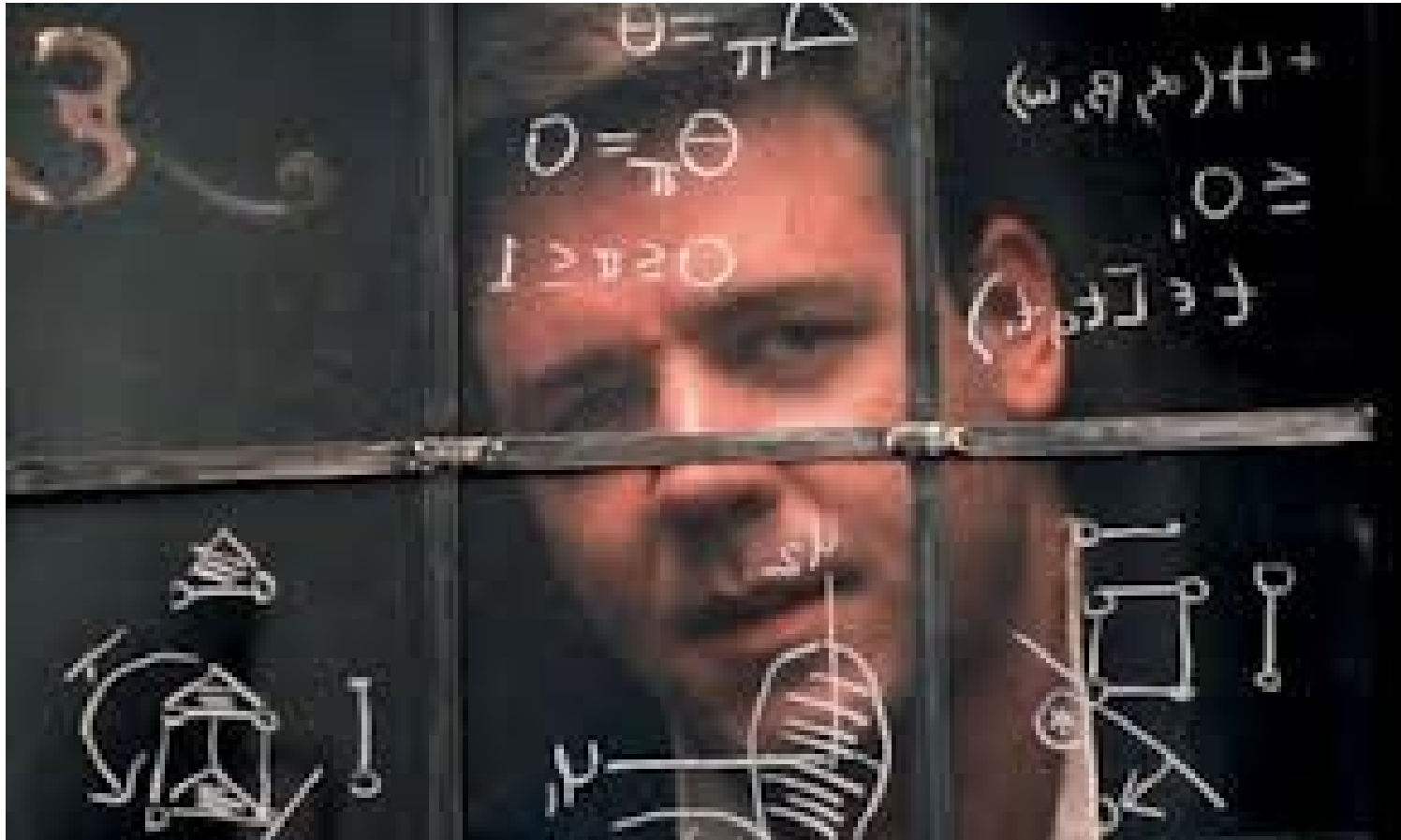# What are some of the tools?
Hint. Who is he?

Father of Information Theory
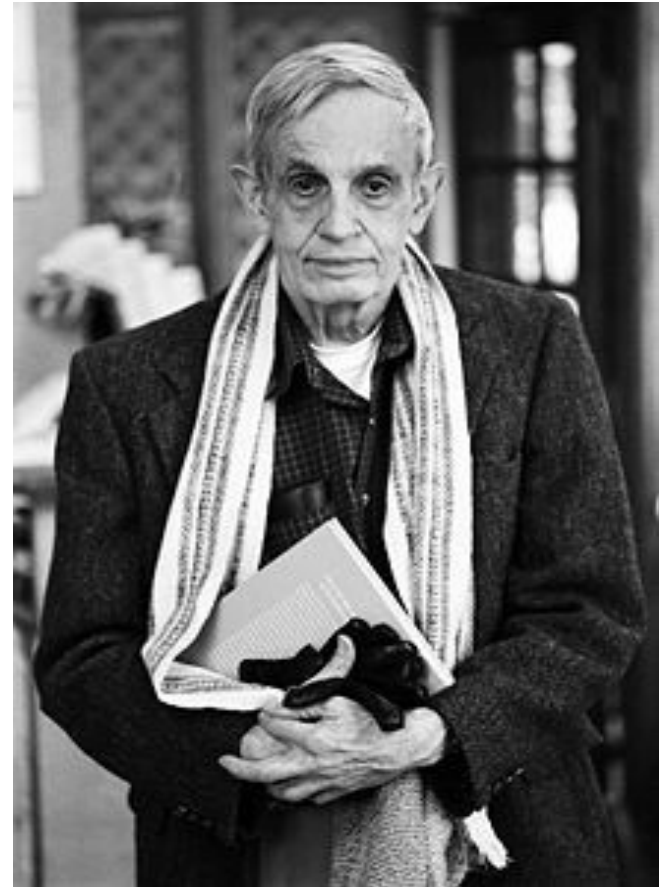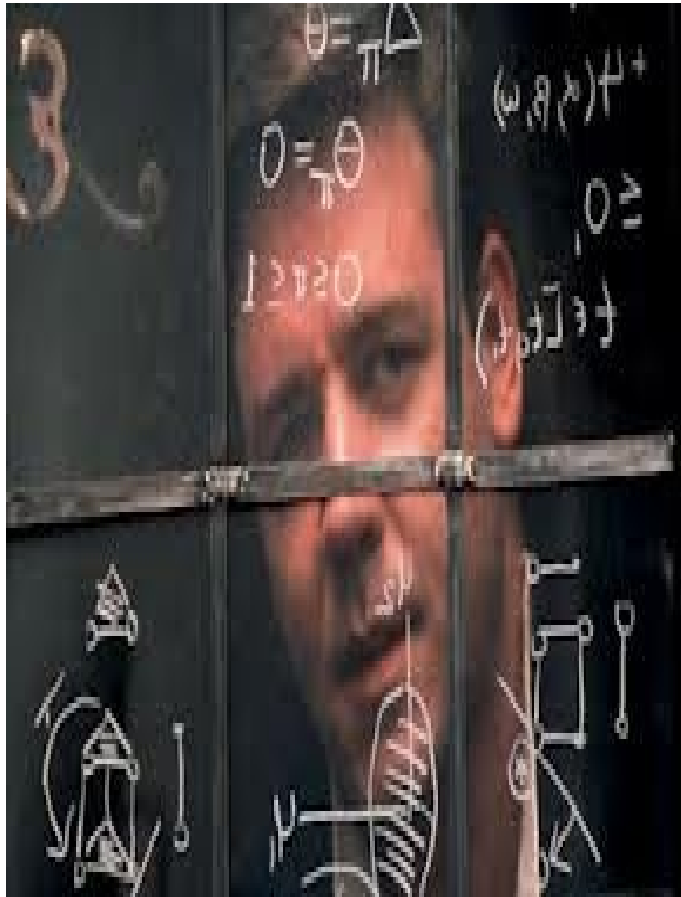## Helps find limits of information exchange?

Claude Elwood Shannon

What are some future tools?
Hint – think of Russell Crowe

John Nash: Game Theory
How to cooperate with other wireless users

What tool does coffee inspire?

Complexity of communications: Generate signals that behave like ... stirred coffee!

Entropy increases.
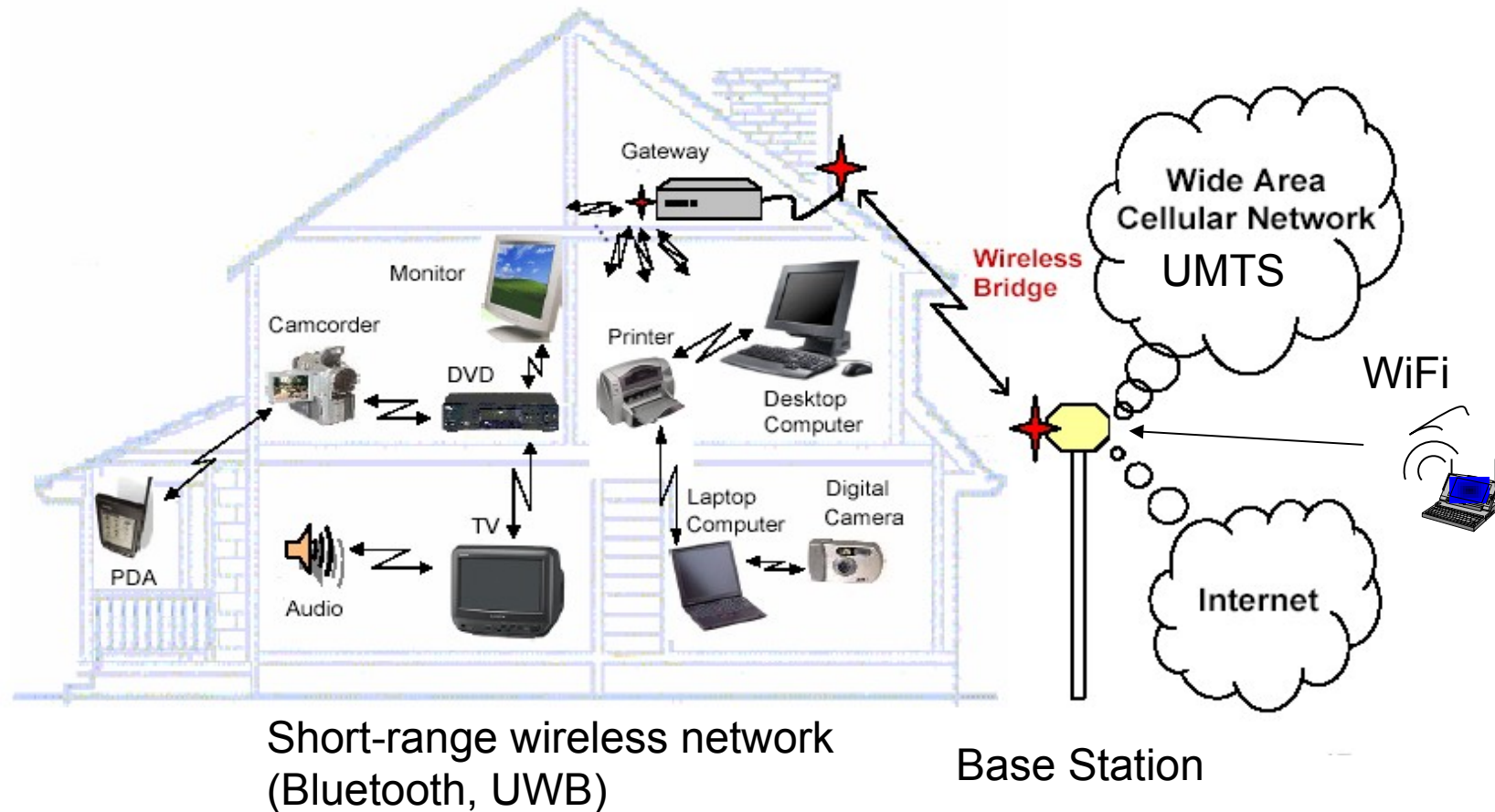Complexity first increases, then decreases.

low entropy
low complexity

medium entropy
high complexity

high entropy
low complexity

All these come together in the palm of your hand

...of many hands

Short-range wireless network
(Bluetooth, UWB)

Base Station

Why Telecommunications

- Fascinating area
  - A trillion dollar industry
  - challenging research drawing from a plethora of areas
  - big picture can pay off in a lot of ways (consulting, research)

- Class will lay foundations for mobile communications
  - see the big picture
  - apply the proper mathematical and physical tools
  - gain insight and offer solutions

Telecommunication-related careers

AUTOMOTIVE

INFOCOM

TRANSPORT, ENVIRONMENT & POWER ENGINEERING

AERONAUTICS

SPACE

DEFENCE & SECURITY

Why study MOBCOM??

- **Telecommunications area GROWING FAST**:
  - Among most active industries

- **FINANCIALLY REWARDING – INDUSTRY IS WAITING FOR YOU:**
  - Wireless network architect: FT, Bouygues, SFR,..
  - Creating devices: Nokia, Ericsson, Alcatel, Motorola, Siemens…
  - Creating new wireless service software (games, positioning, interactive)
  - Advancing the theory of information: Research labs
  - Management and even … finance

  NO LACK OF JOBS IN THIS AREA!!!
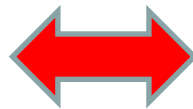
- **IT IS EXTREMELY INTERESTING**

Spirit of MOBCOM

- Class meant to offer a broad exposition of the general area of mobile communications

- Try to distill a complicated problem, and provide insightful and concise answers
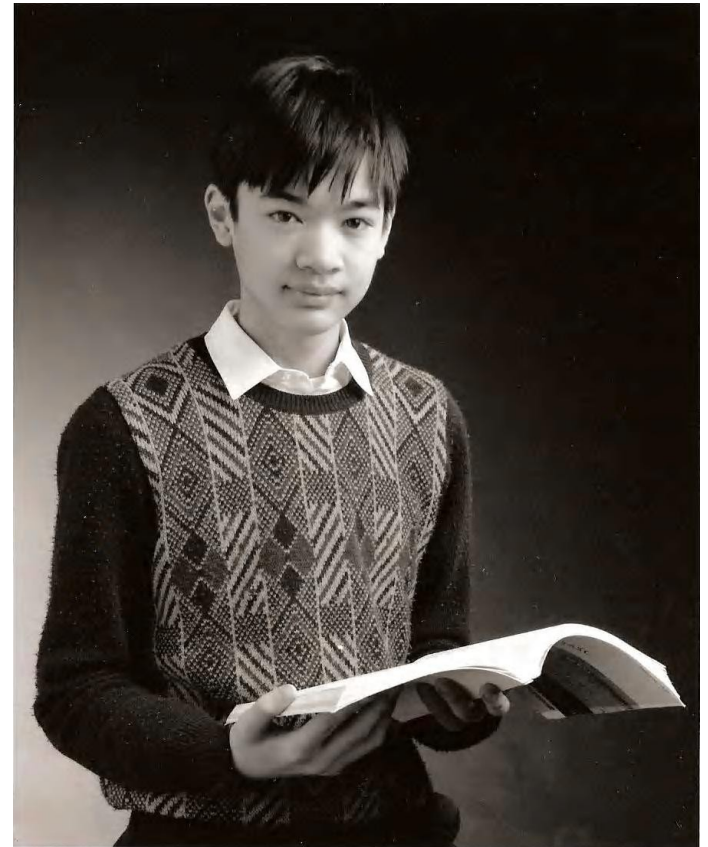

$$C = W \log \frac{P+N}{N}$$

Spirit of MOBCOM

- Try to balance theory and practice

From practical/engineering

To Fields Medalist breakthroughs

Now lets focus a bit on the details

- Course Soft Pre-requisites:
  - probability theory
  - random processes
  - transform theory
  - digital communications

- Class Text Book:
  - Fundamentals of Wireless Communication, by D. Tse and P. Viswanath, Cambridge University Press, May 2005.
  - A leading textbook: unified view of wireless communications process

Details: Grading (tentative – special semester)

- Homeworks   10%

- MATLAB+Research sessions   25%

- Midterm exam (November)   25%

- Final exam (February)   40%

Details: Exam

- Final Exam
  - Two hours long
  - Comprehensive
  - Class notes allowed

- Midterm exam
  - (~1 hour)

Details: Course Outline

- Physical channel modeling
- Detection of signals in fading channels
- Single User Communications
    - Basic Communication Techniques
    - Fundamental Limits
- Multiuser Communications
    - Basic Communication Techniques
    - Fundamental Limits
- Coding for achieving Fundamental limits
    - Classical Coding + Linear codes
    - Convolutional codes
    - Polar Codes
    - Advanced techniques

Outline: Physical Channel Modeling

- Physical channel modeling
  - Input/output channel models
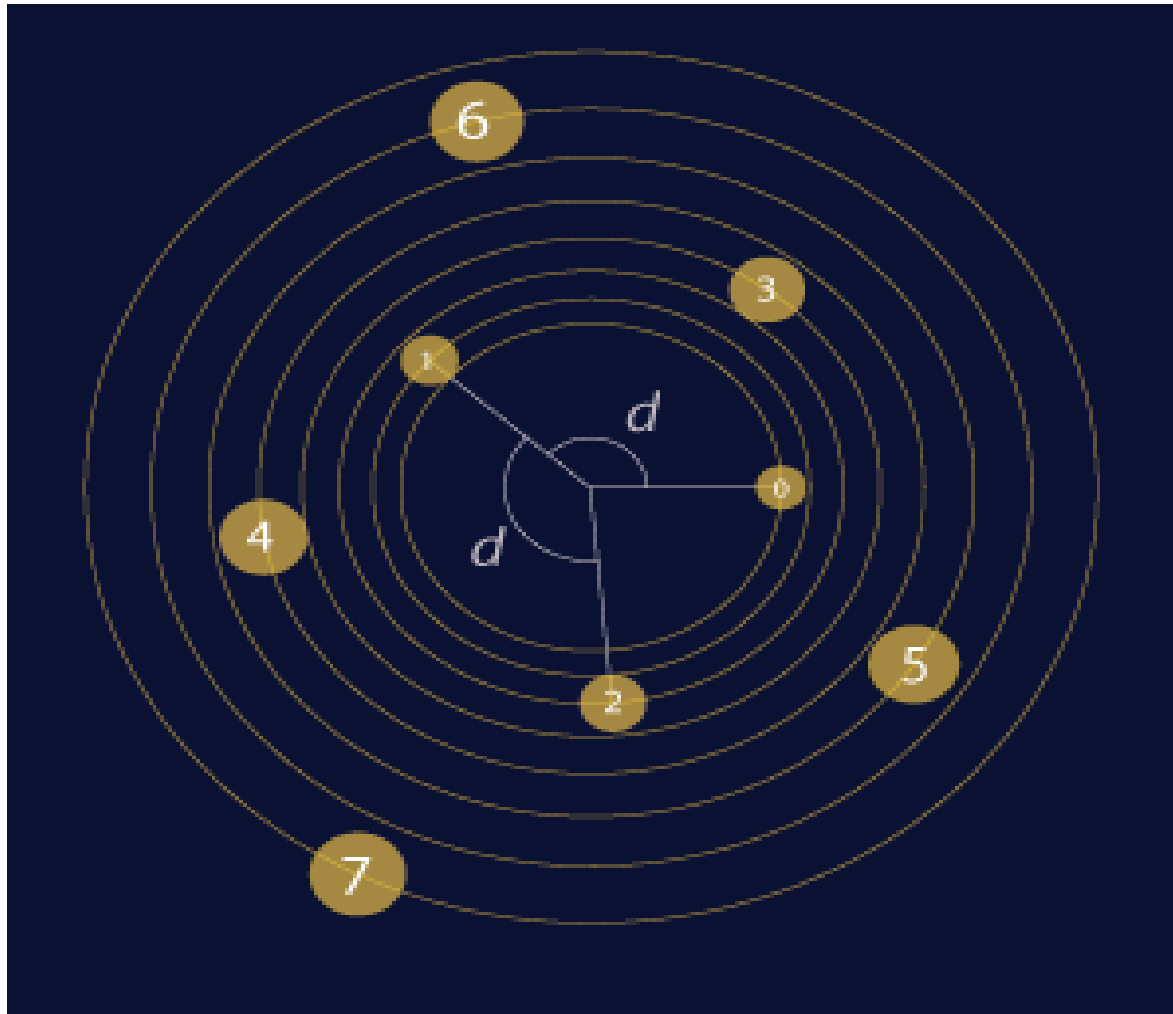 - Channel behavior in time, space, and frequency

- From:

- To: $y[m] = \sum_{l=0}^{L-1} h_l \, x[m-l]$

Outline: Detection of signals in fading channels

- How to detect what was communicated

Outline: Communication techniques

- How to communicate in the presence of randomness?

Outline: Communication techniques

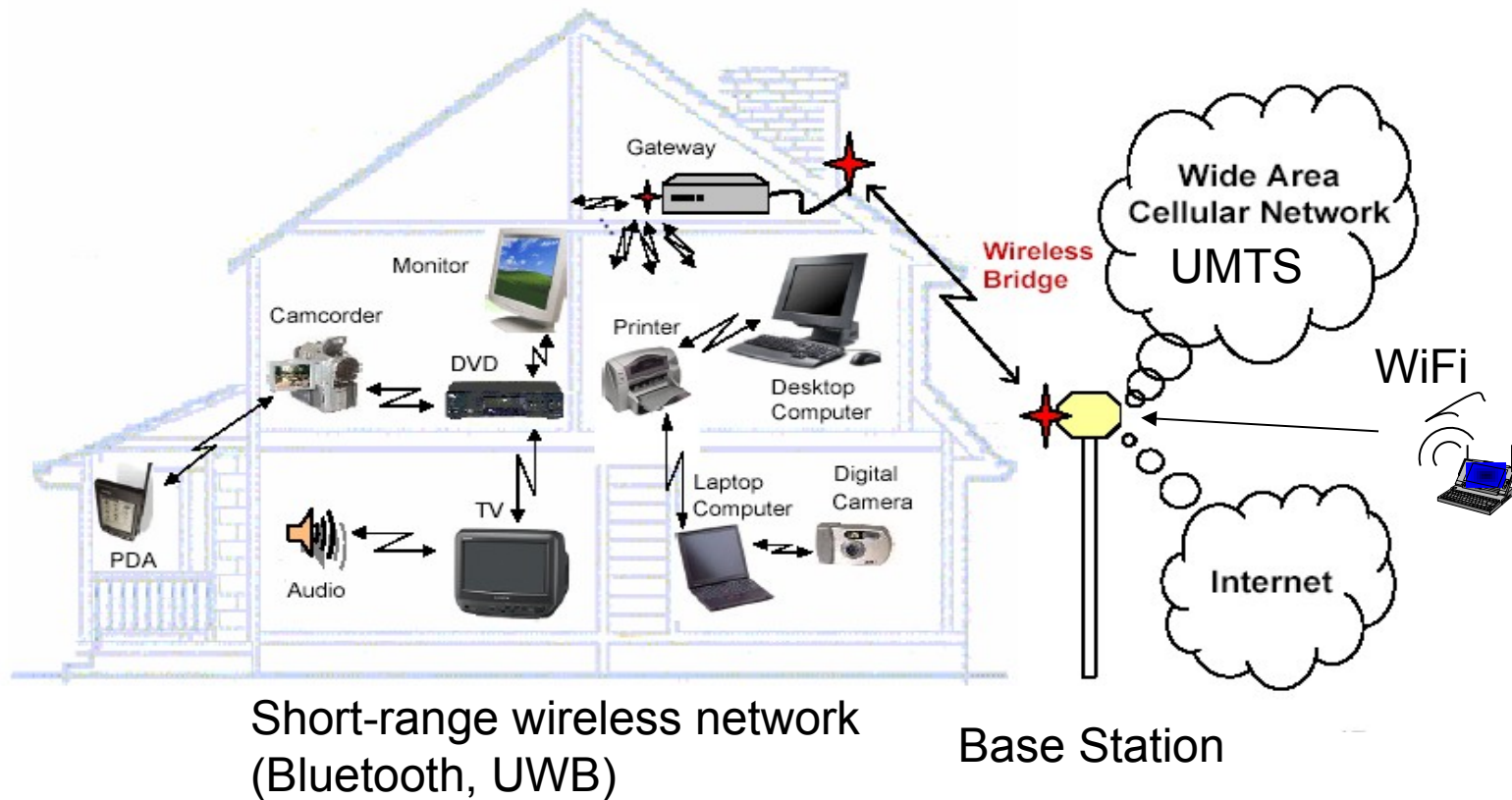- Will learn how to invest our signals in space/time/frequency

Outline: Communication techniques

- Will learn how to invest our signals in space/time/frequency

Outline: Multiuser (Interfering) Communications

- Will learn how to accommodate many (interfering) users

Short-range wireless network
(Bluetooth, UWB)

Base Station

Let us start from the beginning

- Point-to-Point Physical Channel Communication

- From:

- To: $y[m] = \sum_{l=0}^{L-1} h_l \, x[m-l]$

- Naturally important parameter:
  RECEIVED SIGNAL STRENGH !!!!