

Design Based Teaching for Science and Engineering Students

**CANADIAN DESIGN ENGINEERING NETWORK
RÉSEAU CANADIEN DE LA CONCEPTION EN INGÉNIERIE**

July 27-29, 2008, Halifax, Nova Scotia

Mouhamed Abdulla – Yousef R. Shayan

Concordia University
Faculty of Engineering and Computer Science
Department of Electrical and Computer Engineering
Montréal , Québec

Contents

- The Big Picture
- Engineering Interdependencies
- Traditional Design Method
- Classroom Design Method
- Analysis of Design
- Questions

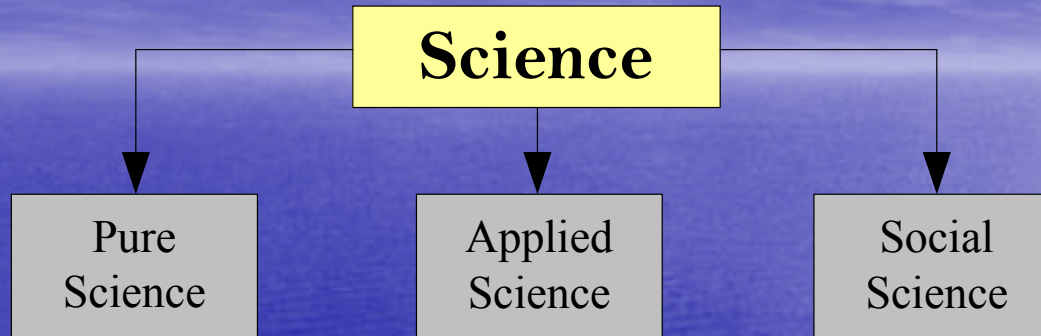
The BIG picture

Preliminary for Design

Science

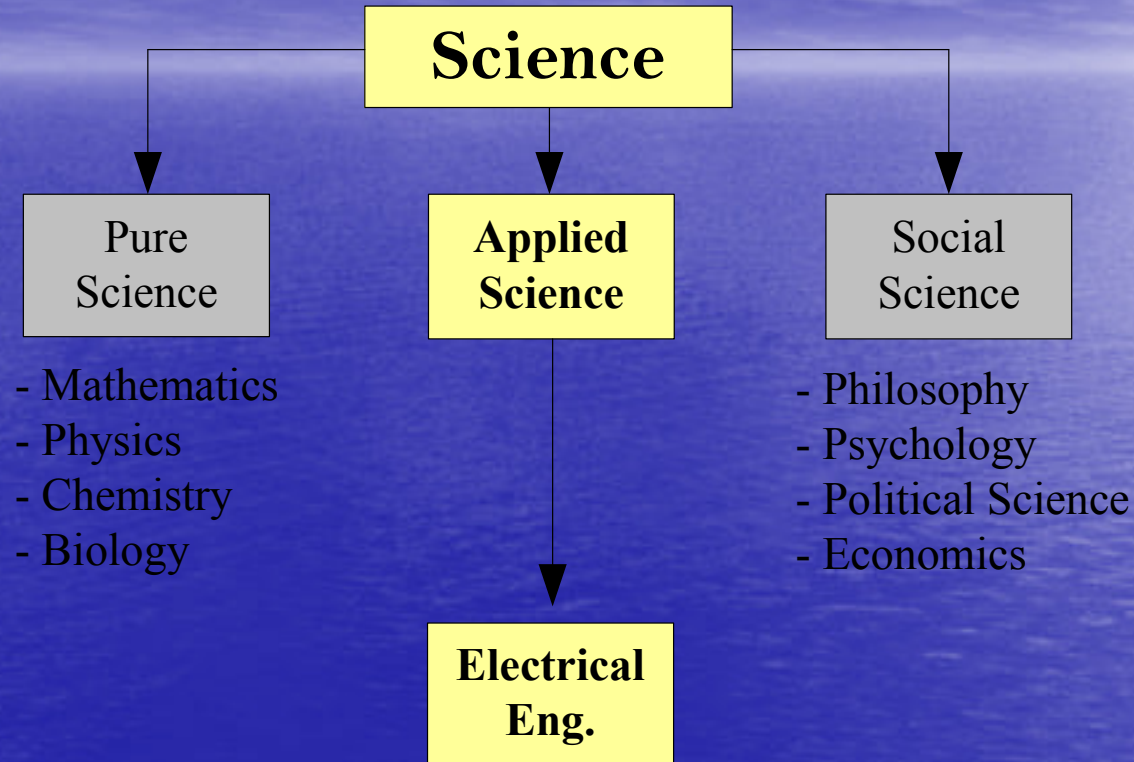
The BIG picture...

Preliminary for Design...



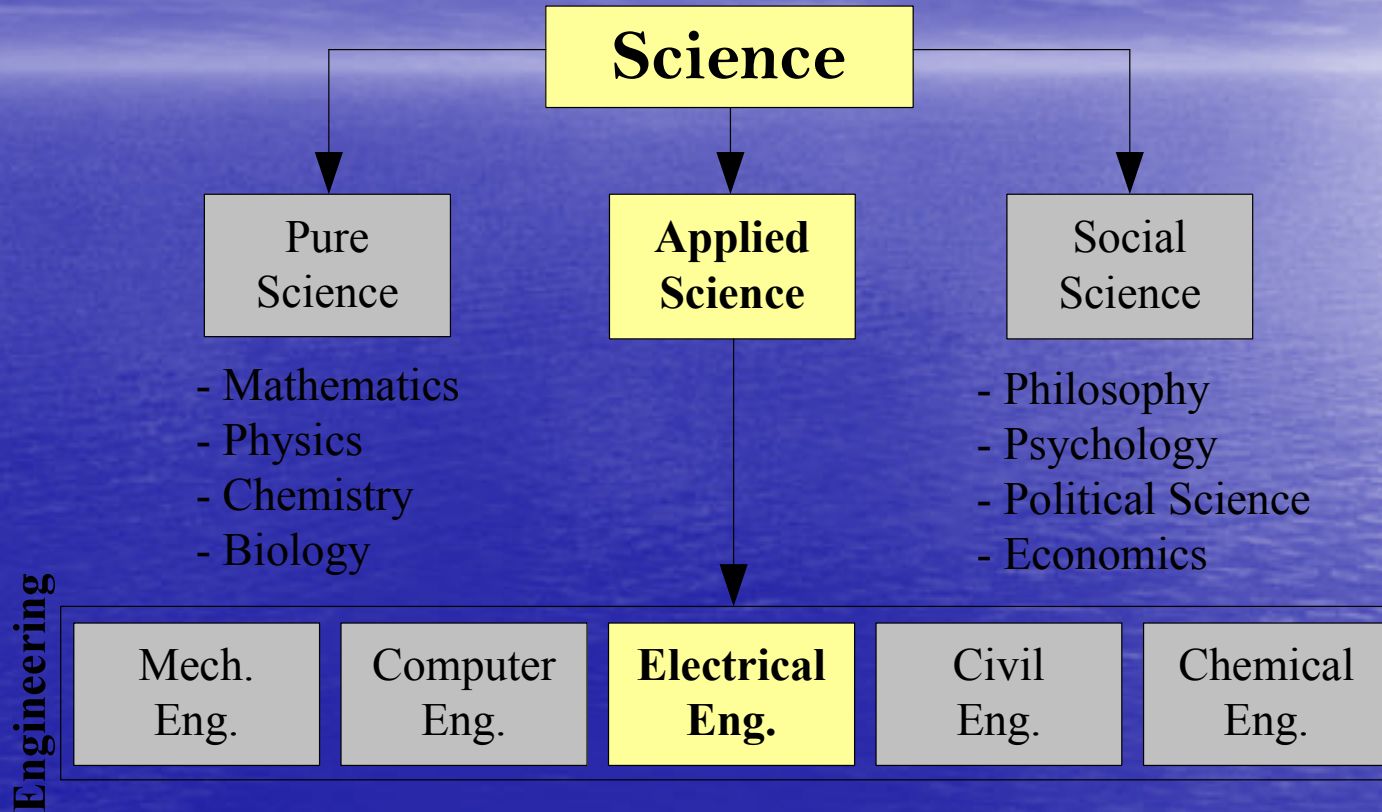
The BIG picture...

Preliminary for Design...



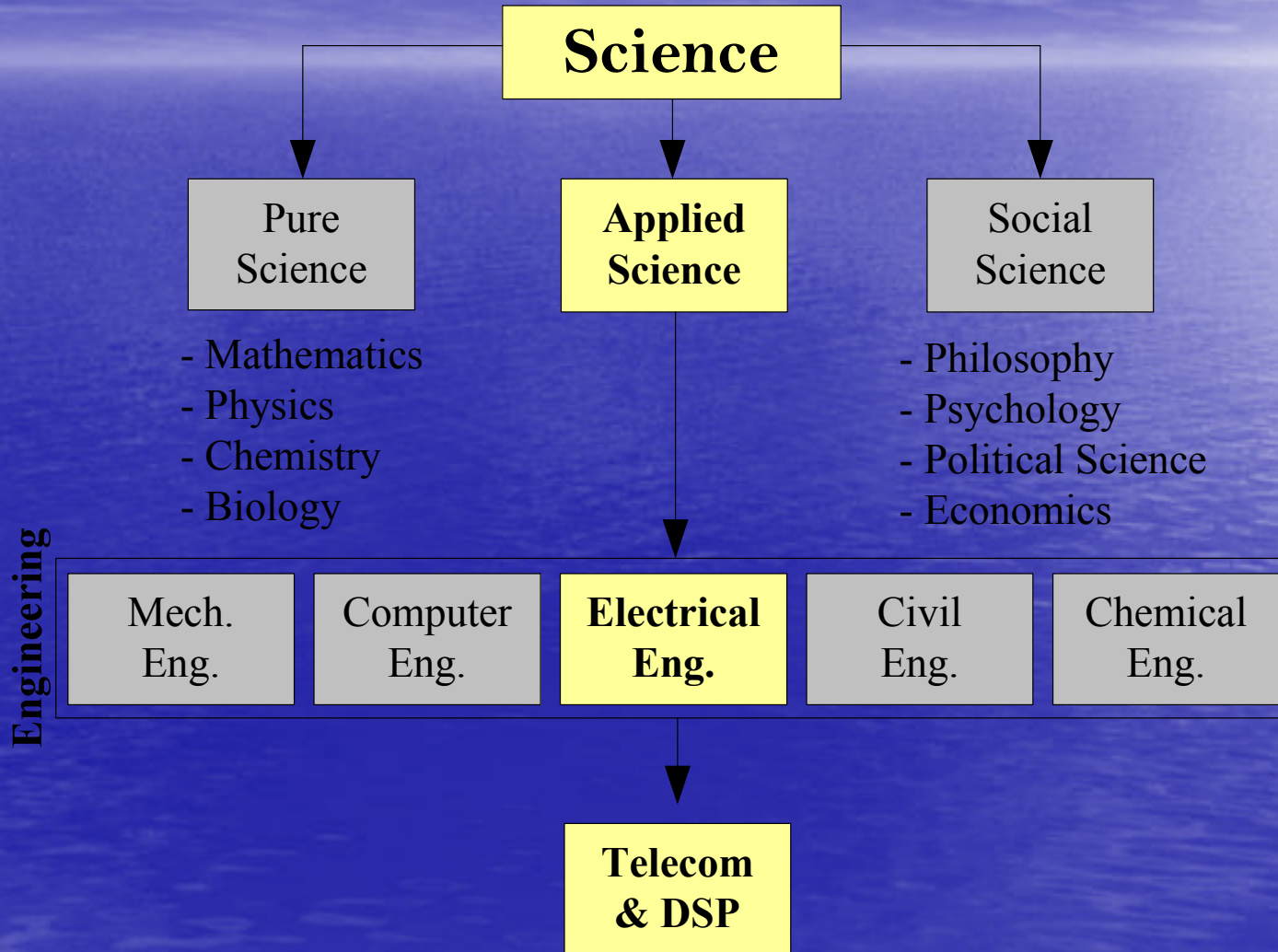
The BIG picture...

Preliminary for Design...



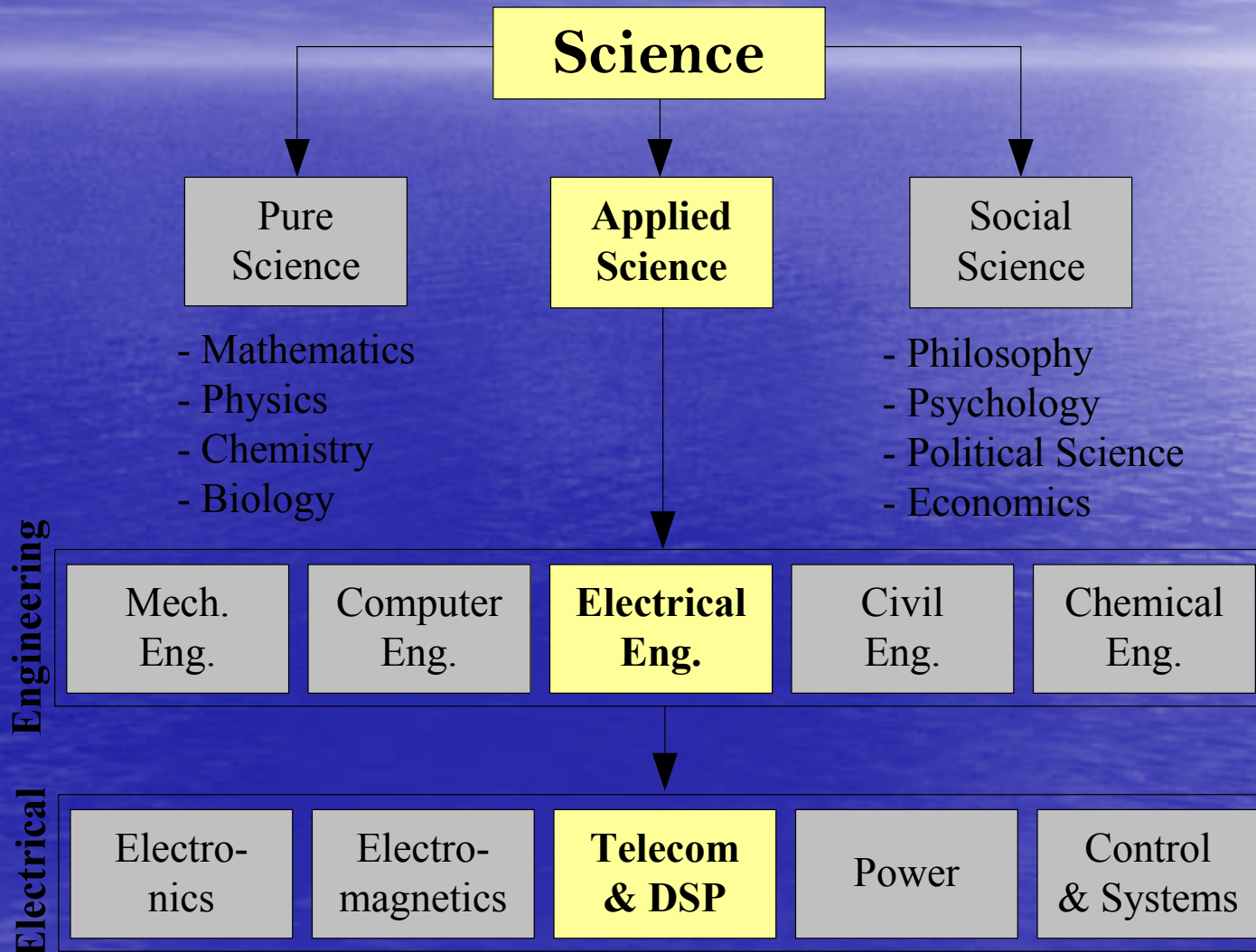
The BIG picture...

Preliminary for Design...



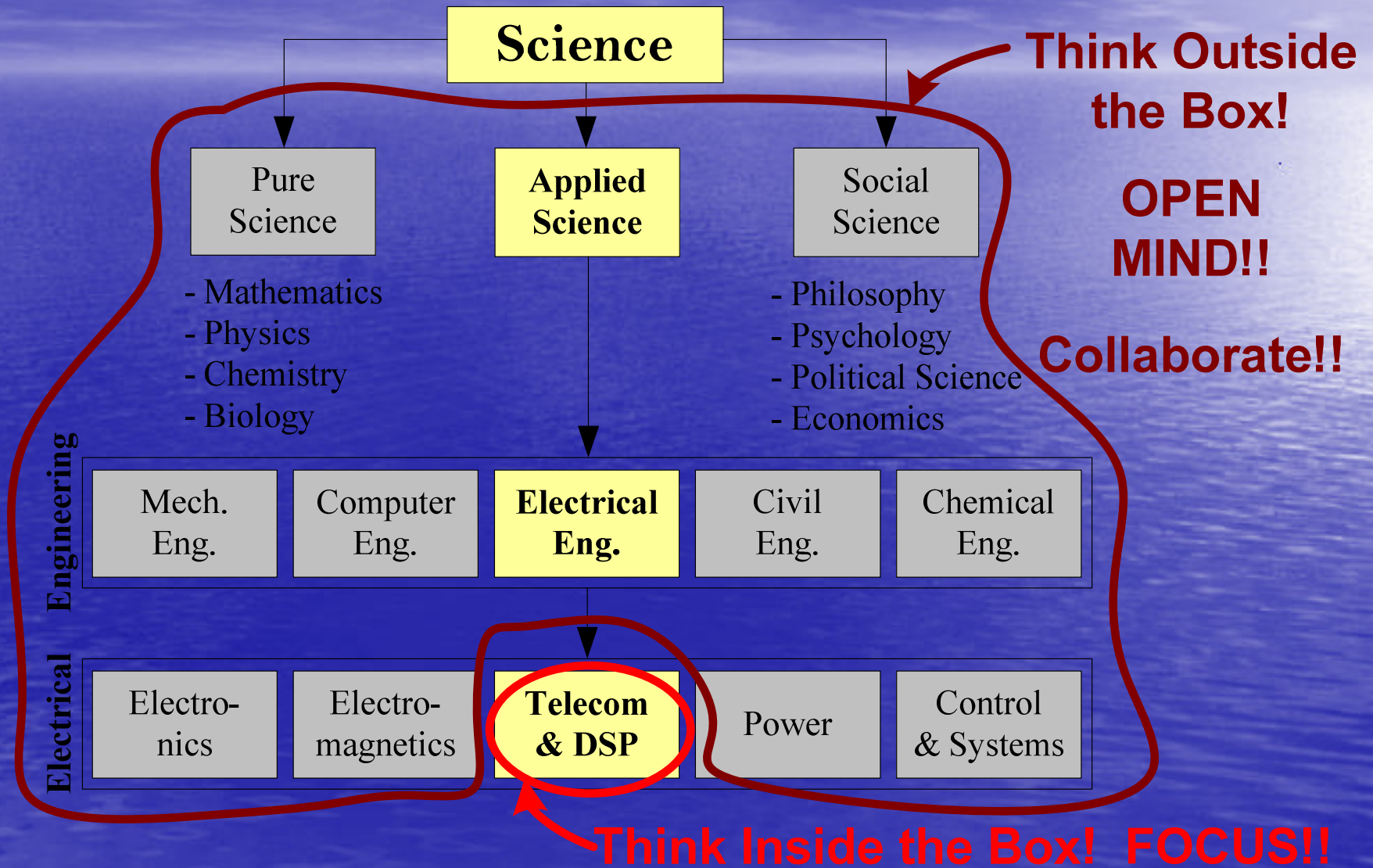
The BIG picture...

Preliminary for Design...



The BIG picture: WHY???

Preliminary for Design...



Contents



The Big Picture

- Engineering Interdependencies
- Traditional Design Method
- Classroom Design Method
- Analysis of Design
- Questions

Engineering Interdependencies

Motivation for Design

Engineering Interdependencies

Motivation for Design...

Example: Mobile Phone



→ Time

Engineering Interdependencies

Motivation for Design...

Example: Mobile Phone...

Mobile Phone



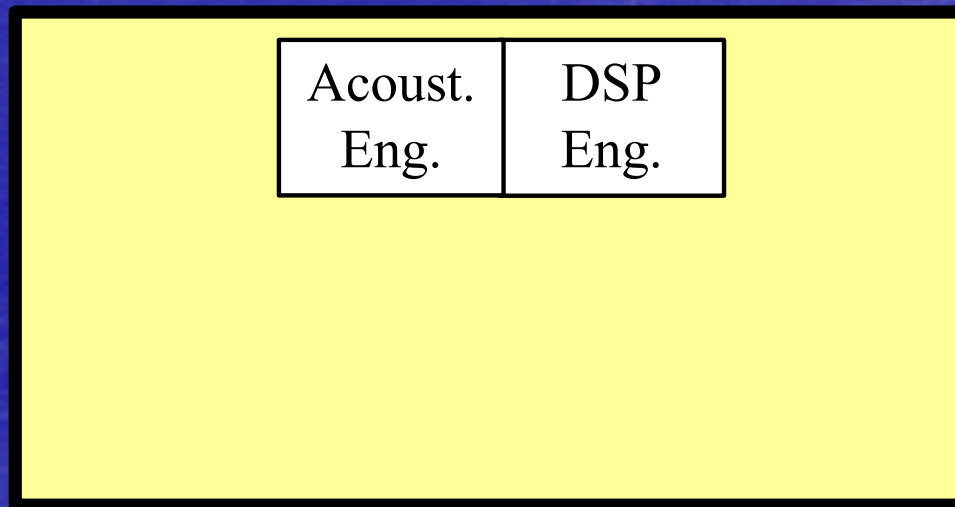
Acoust.
Eng.

Engineering Interdependencies

Motivation for Design...

Example: Mobile Phone...

Mobile Phone



Engineering Interdependencies

Motivation for Design...

Example: Mobile Phone...

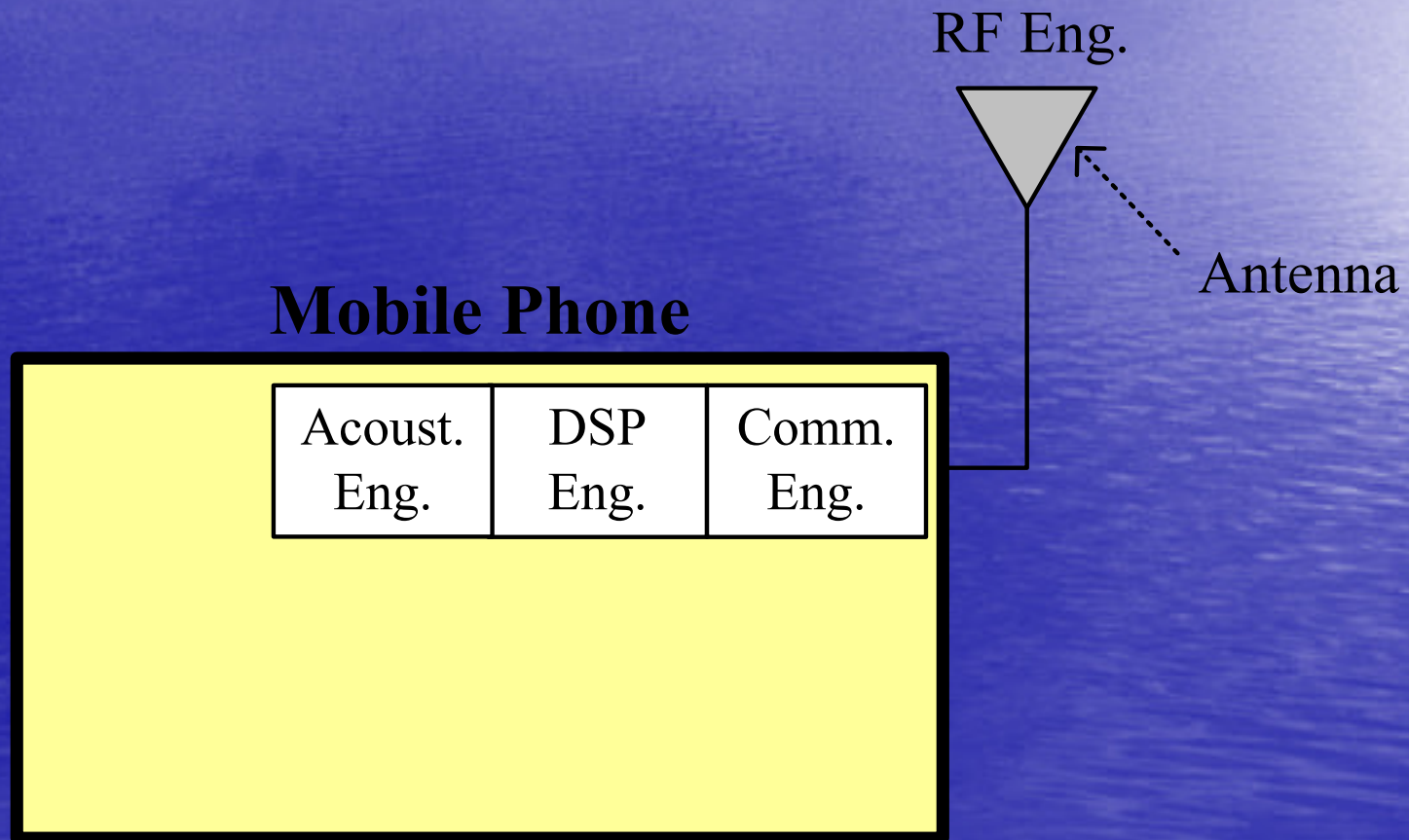
Mobile Phone

Acoust. Eng.	DSP Eng.	Comm. Eng.
-----------------	-------------	---------------

Engineering Interdependencies

Motivation for Design...

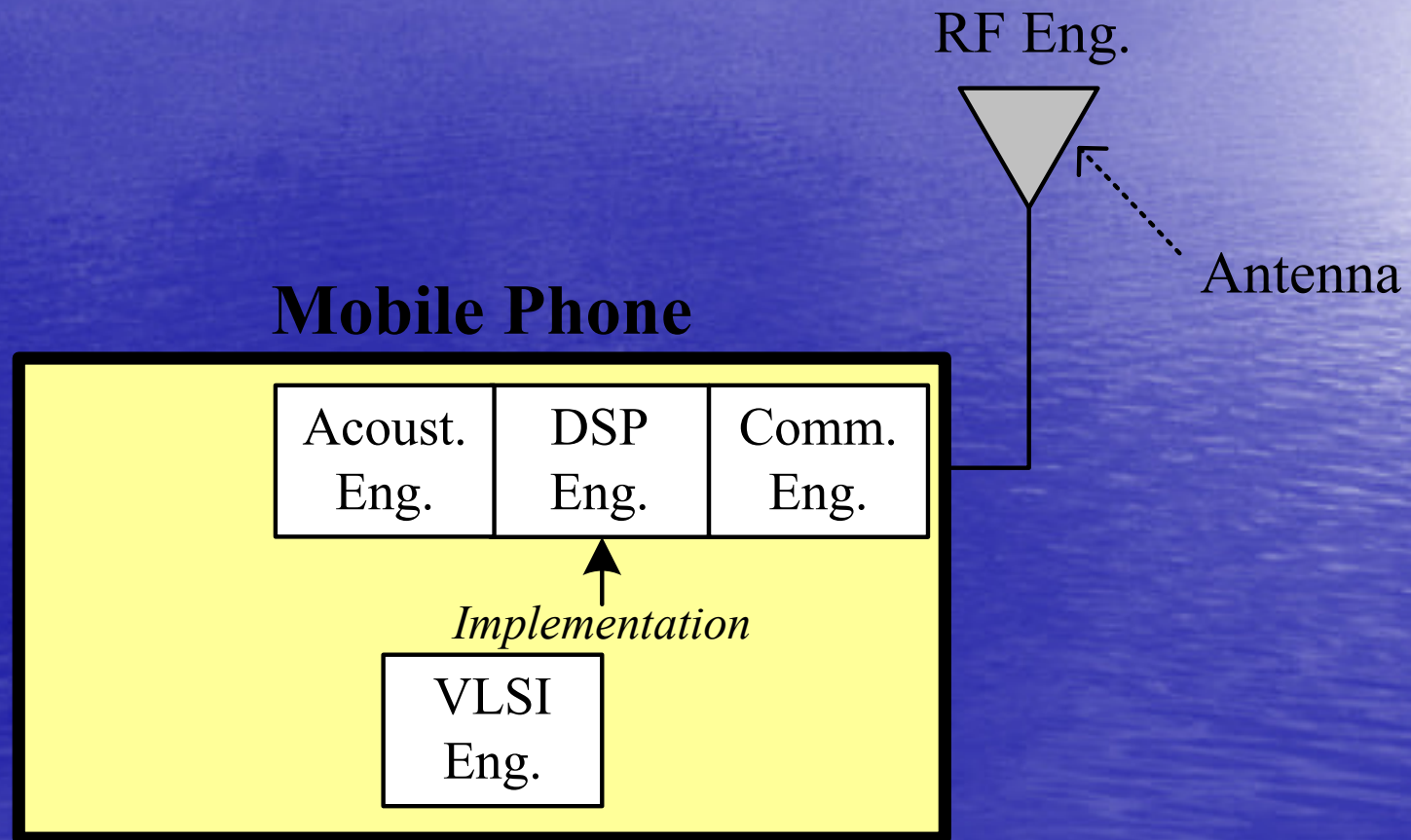
Example: Mobile Phone...



Engineering Interdependencies

Motivation for Design...

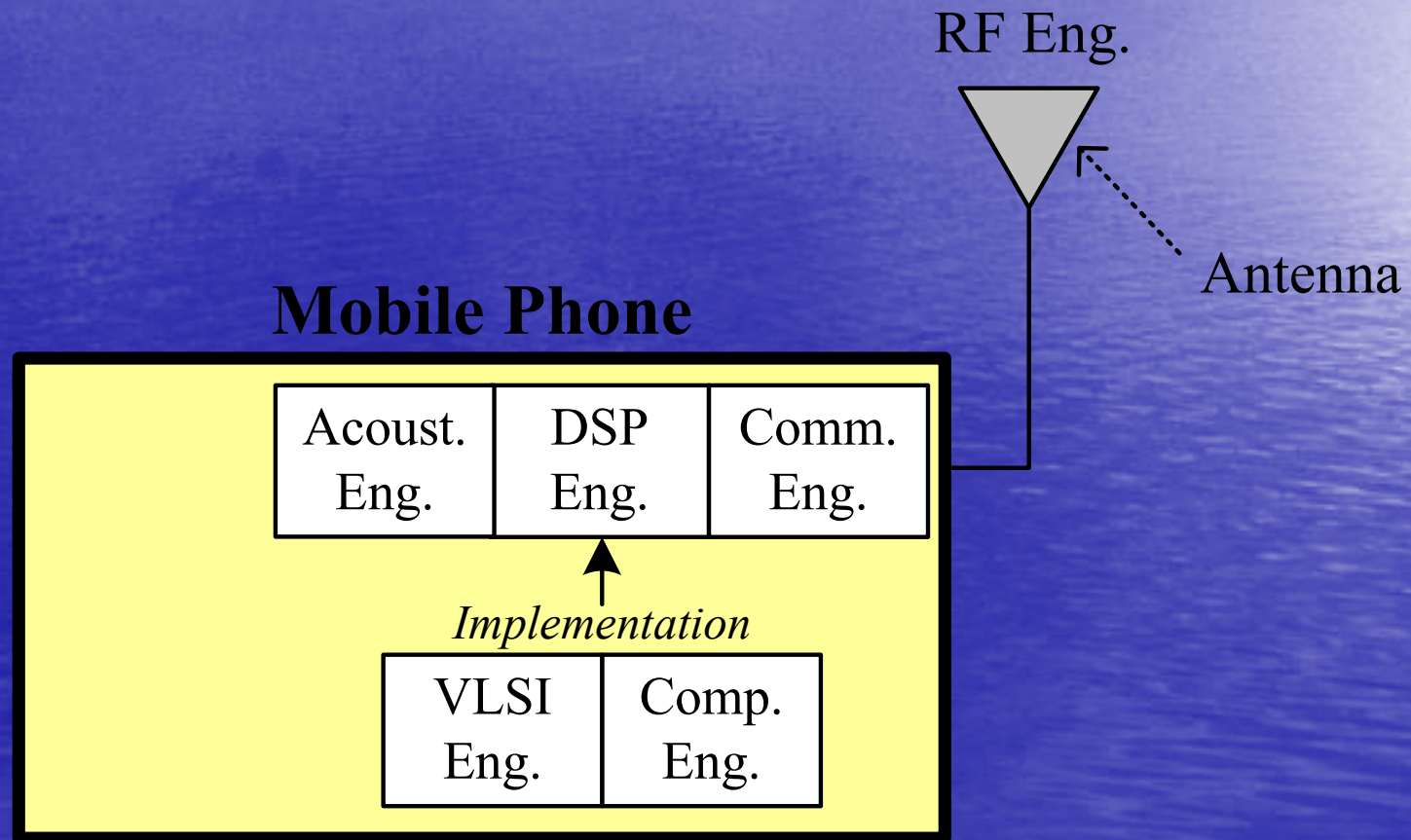
Example: Mobile Phone...



Engineering Interdependencies

Motivation for Design...

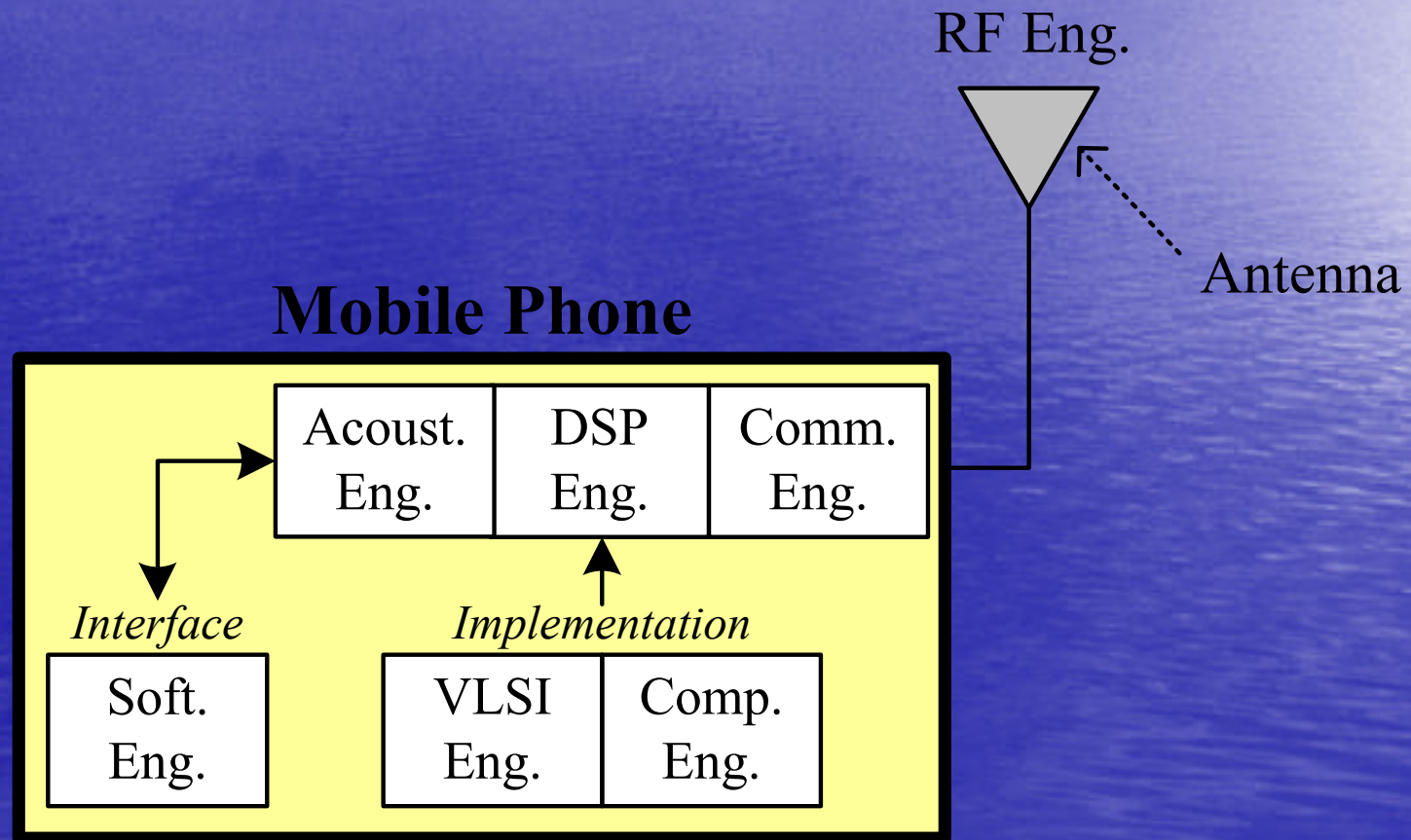
Example: Mobile Phone...



Engineering Interdependencies

Motivation for Design...

Example: Mobile Phone...

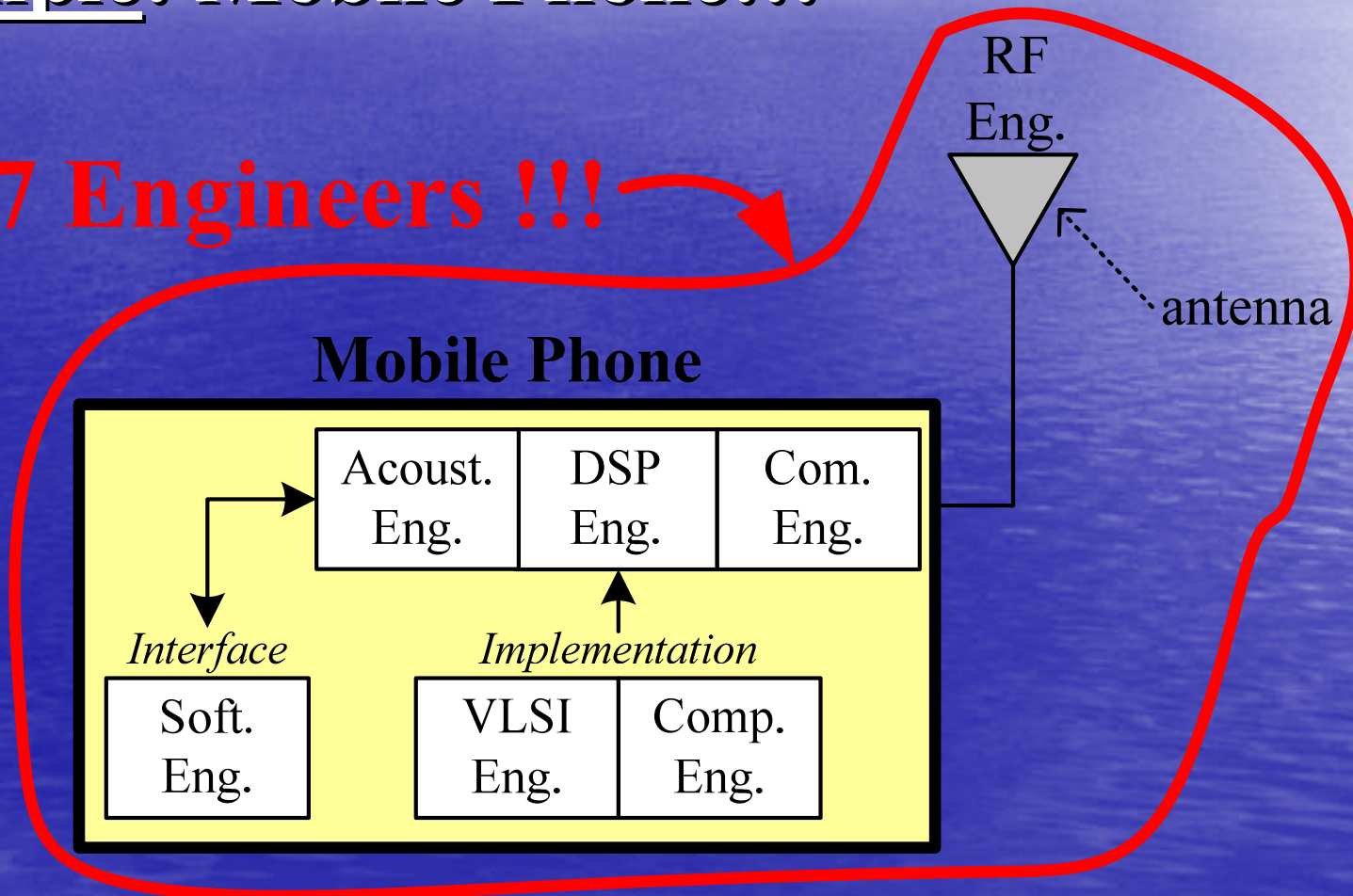


Engineering Interdependencies

Motivation for Design...

Example: Mobile Phone...

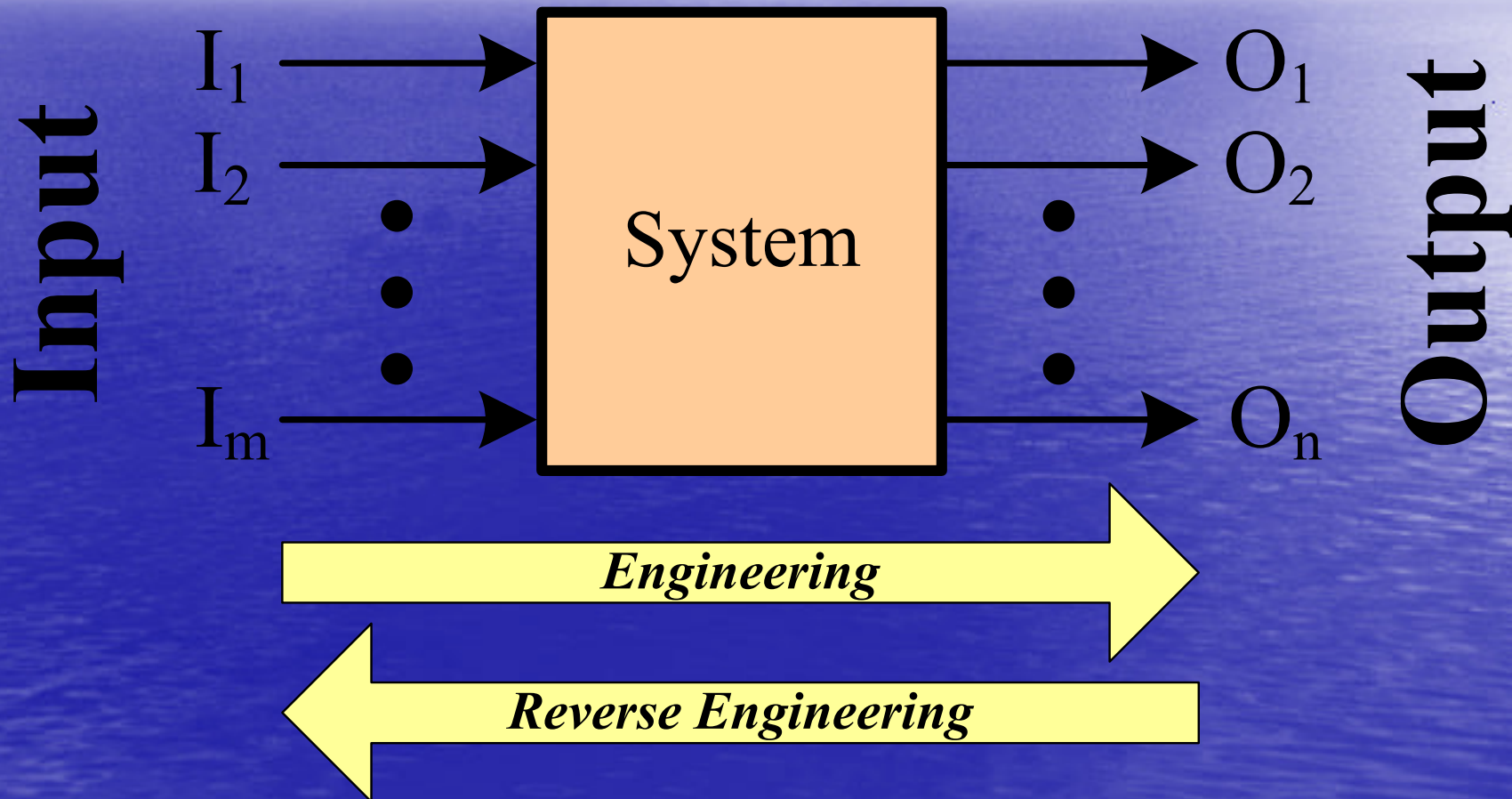
≈ 7 Engineers !!!



Contents

- ☑ The Big Picture
- ☑ Engineering Interdependencies
 - Traditional Design Method
 - Classroom Design Method
 - Analysis of Design
 - Questions

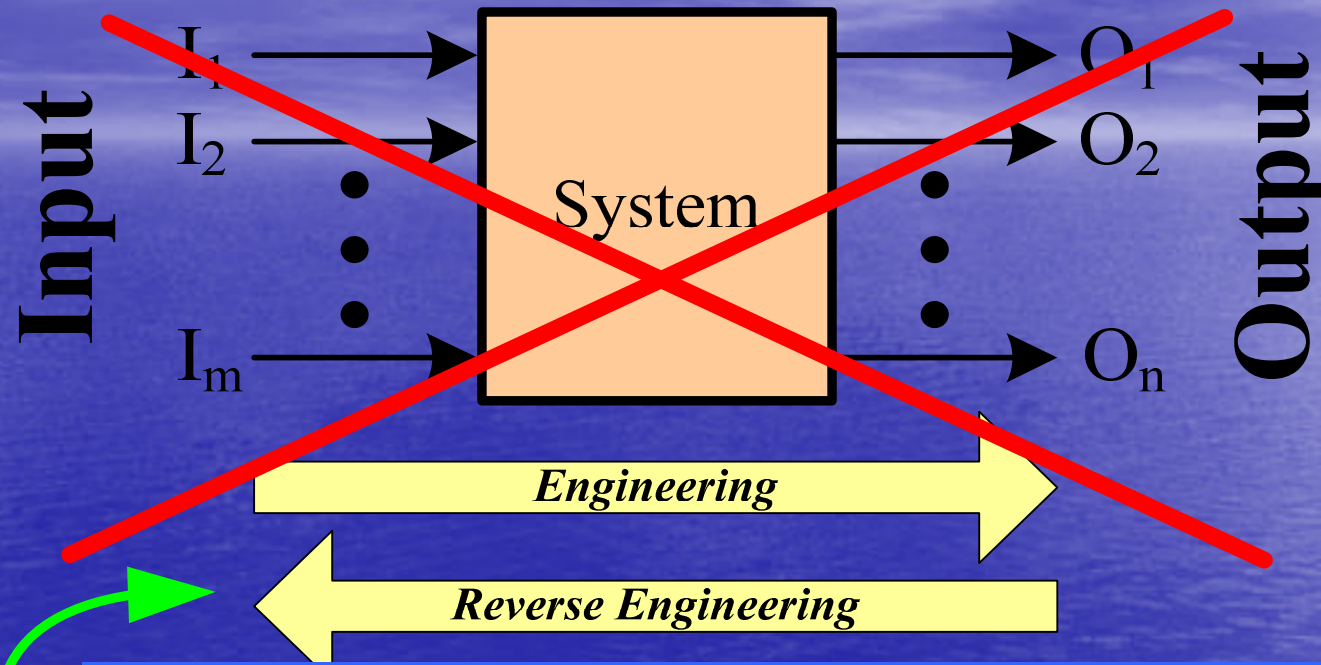
Traditional Design Method



Contents

- ☑ The Big Picture
- ☑ Engineering Interdependencies
- ☑ Traditional Design Method
 - Classroom Design Method
 - Analysis of Design
 - Questions

Classroom Design Method



Assignments or Projects → OK
Teaching → NO!!!

This method TELLS you what to do
and does not make you THINK!!

Classroom Design Method...

Traditional Design Teaching – THEORY

Tell, Show
System Design

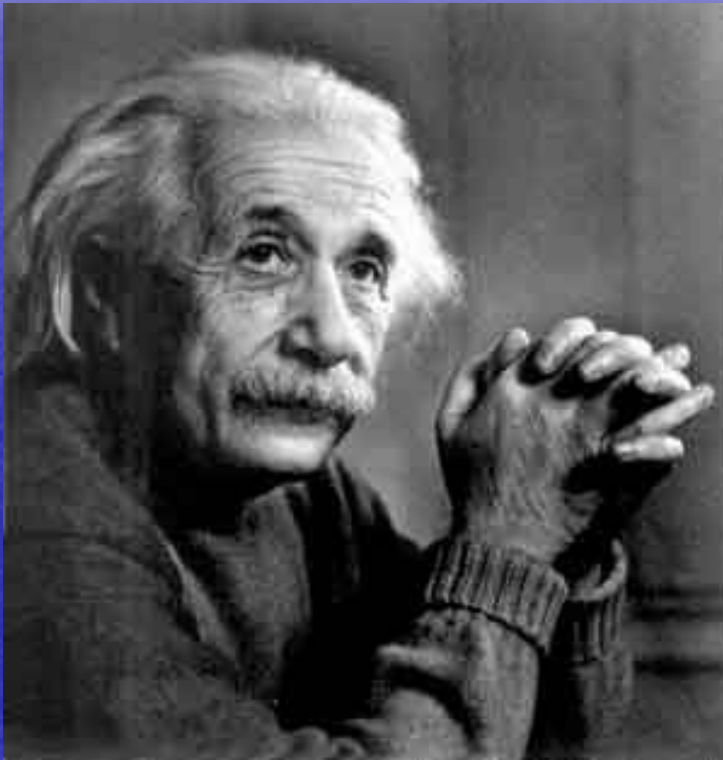
v.s.

Creative Design Teaching – INTUITION

Build, Think, Re-discover
System Design



Classroom Design Method...



“Everything should be made as **simple** as possible, but **not simpler**”

– *Albert Einstein*

Classroom Design Method...

Steps used in Design Based Teaching

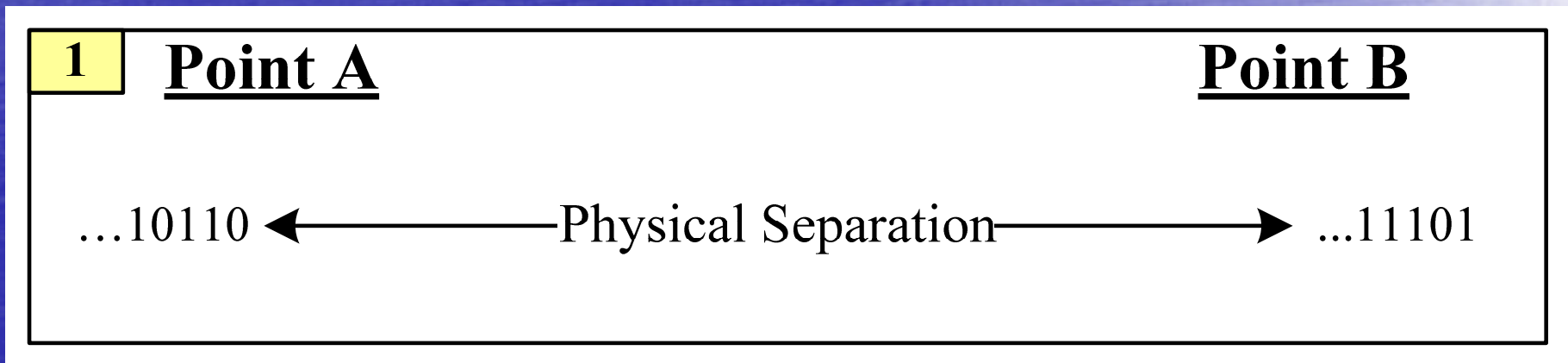
Step #1	Explain a design question in its simplest possible form ever.
Step #2	Engage students for feedback and show open mindedness to all suggestions no matter how far-fetched it seems.
Step #3	Build gradually the system and the theoretical knowledge required to comprehend it.
Step #4	Add natural and manmade limitations to the system gradually one after the other [not all in one shot]. And explain ways to modify the system to cope with these changes.
Step #5	Show parallel systems and compare them to identify advantages and disadvantages of each.

Classroom Design Method...

Example: Telecommunications

Classroom Design Method...

Example: Telecommunications...



I want bits to go from “A” to “B”.

Classroom Design Method...

Example: Telecommunications...

2

Point A

Point B

...10110

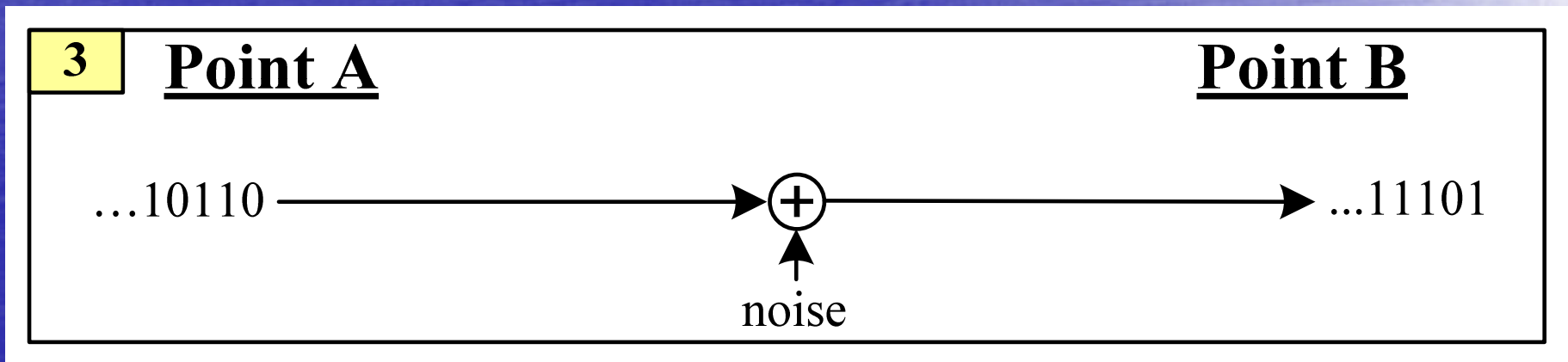


...11101

Say we use a wire!

Classroom Design Method...

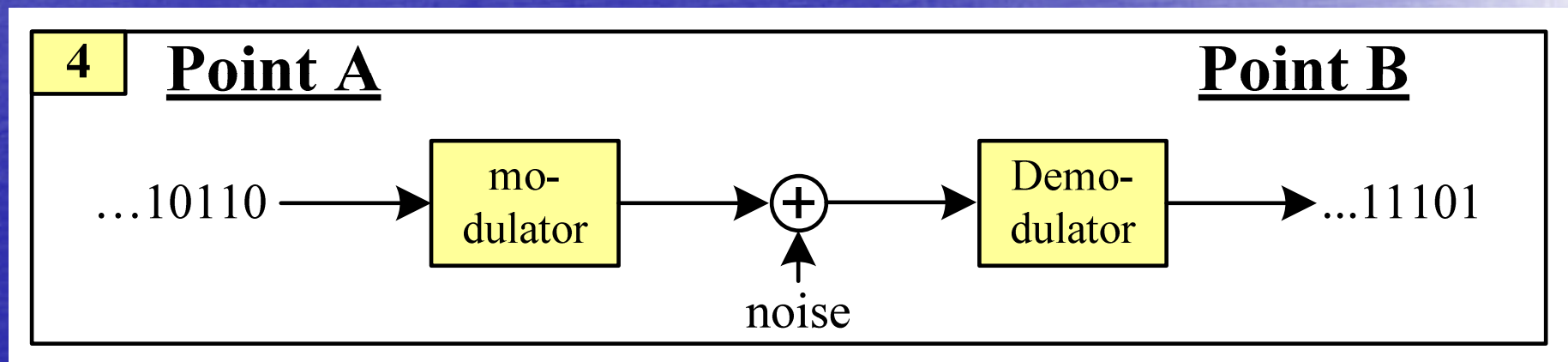
Example: Telecommunications...



Wire or channel is not perfect!

Classroom Design Method...

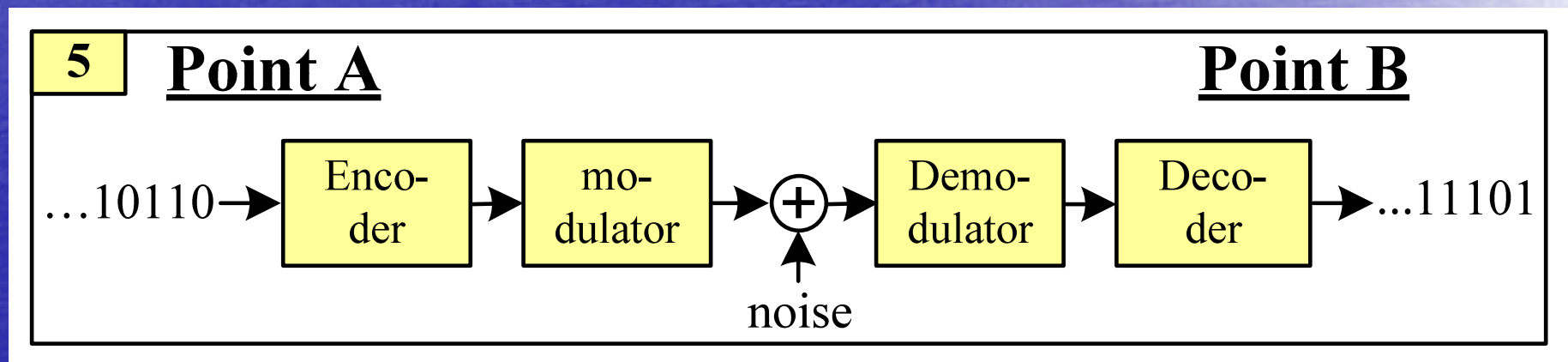
Example: Telecommunications...



Signal power is small w.r.t. noise!

Classroom Design Method...

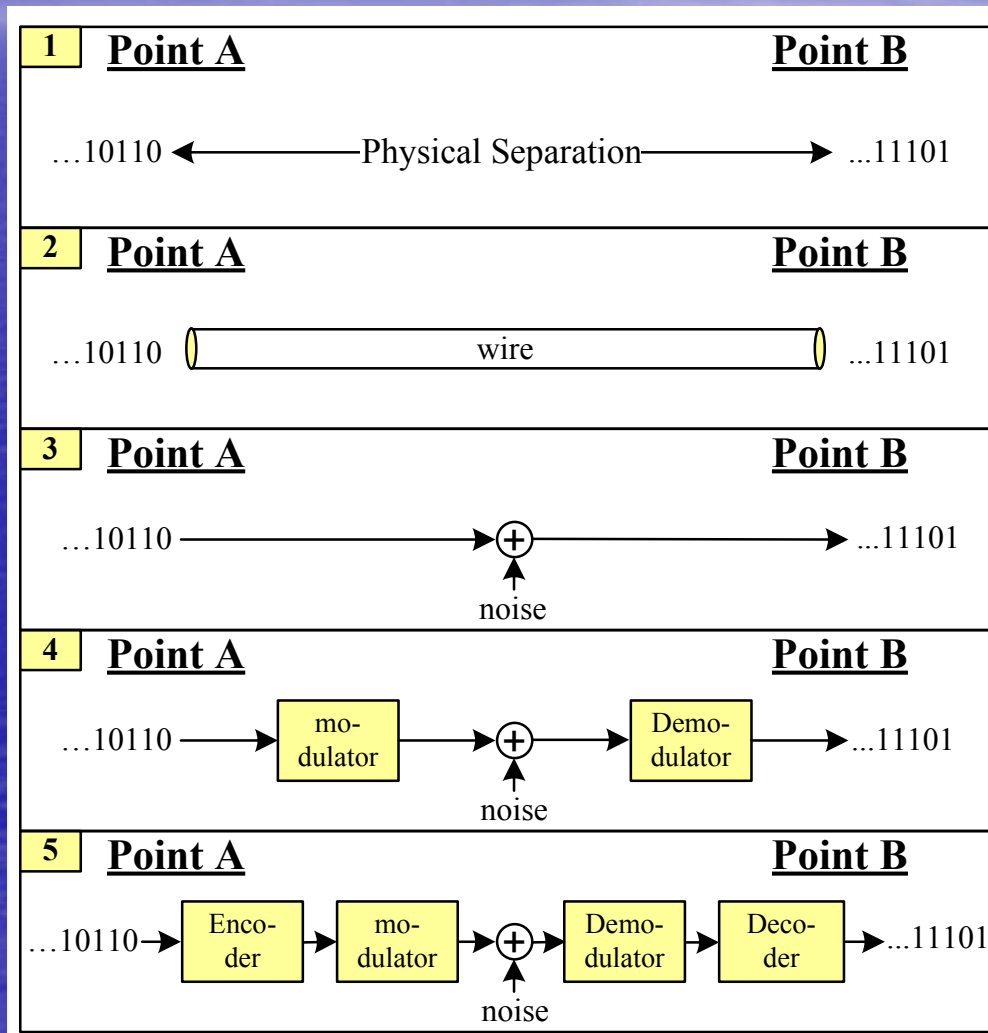
Example: Telecommunications...



I still have bits detected in error!

Classroom Design Method...

Example: Telecommunications...



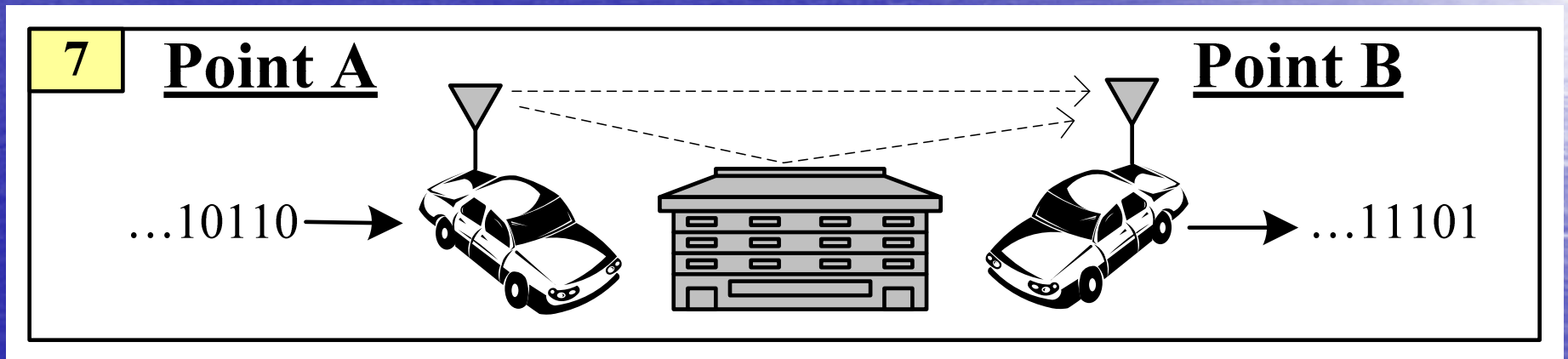
Semester #1

**i.e. 4 months
of Design
Teaching**

**Digital Communications
4 Credit Course**

Classroom Design Method...

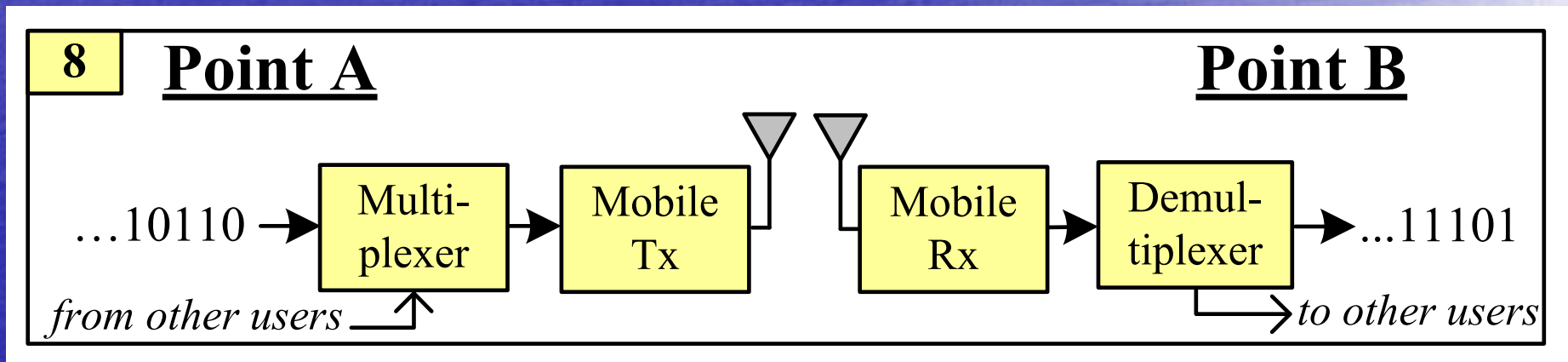
Example: Telecommunications...



I want the device to be mobile!

Classroom Design Method...

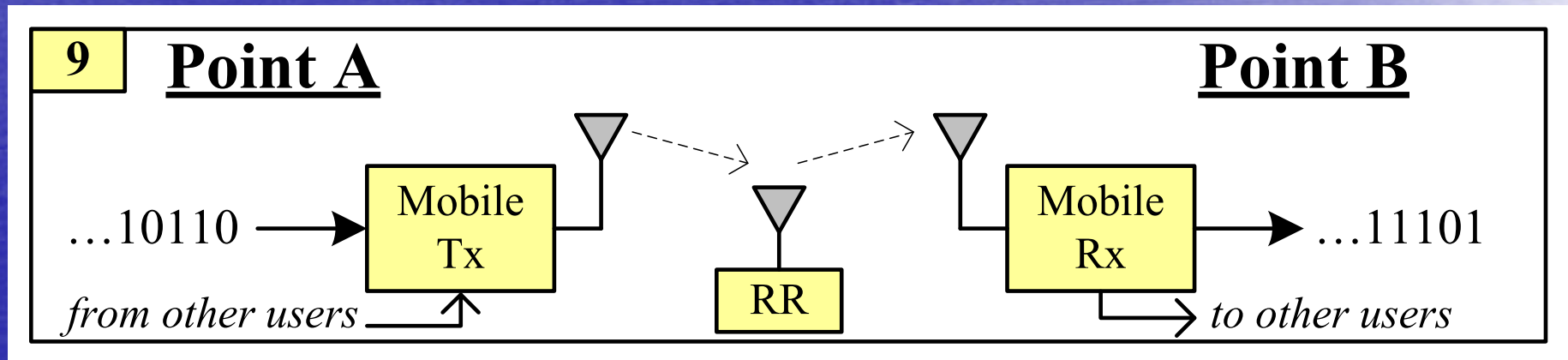
Example: Telecommunications...



Merge the bits from others!

Classroom Design Method...

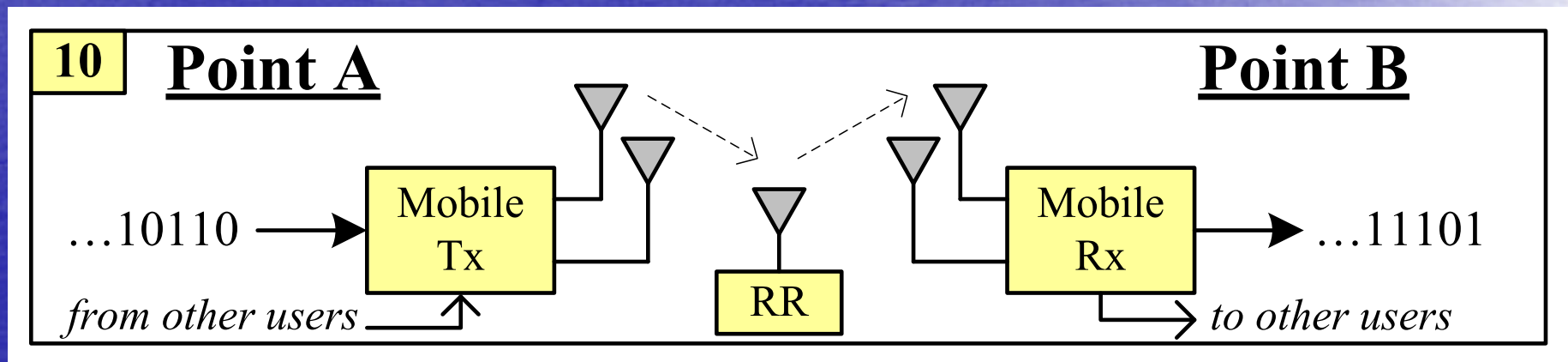
Example: Telecommunications...



I want to increase the range!

Classroom Design Method...

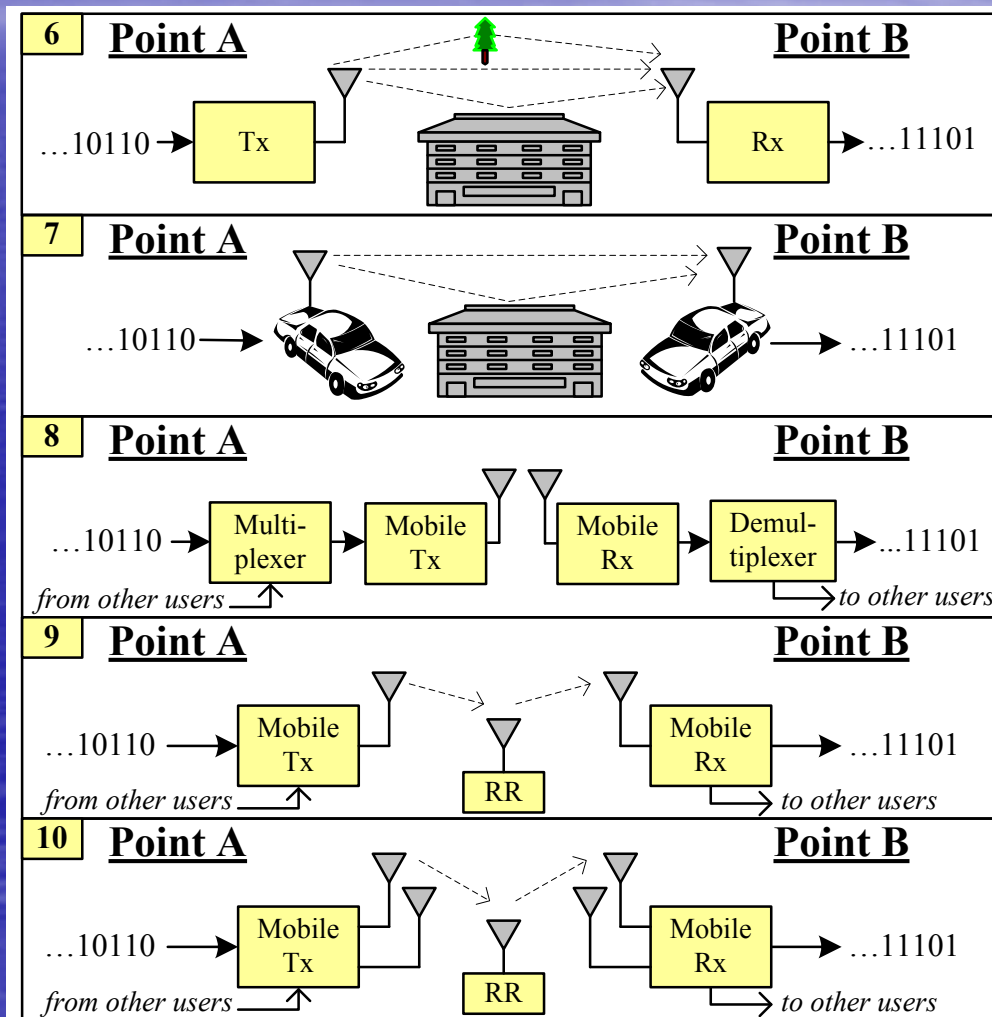
Example: Telecommunications...



I want to increase “Speed”.

Classroom Design Method...

Example: Telecommunications...



Semester #2

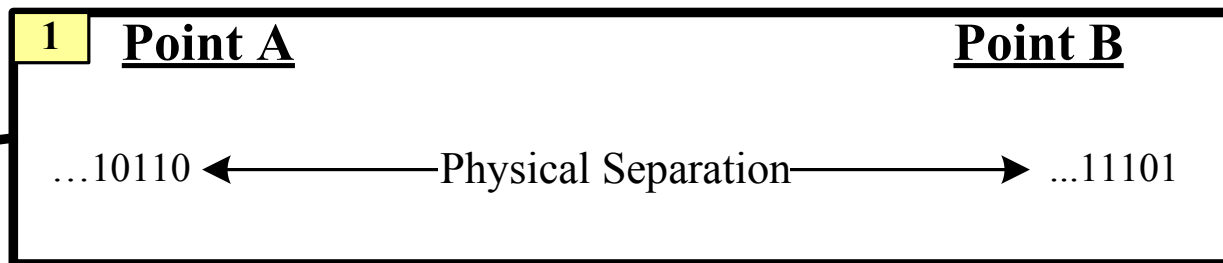
**i.e. 4 months
of Design
Teaching**

**Wireless Communication
4 Credit Course**

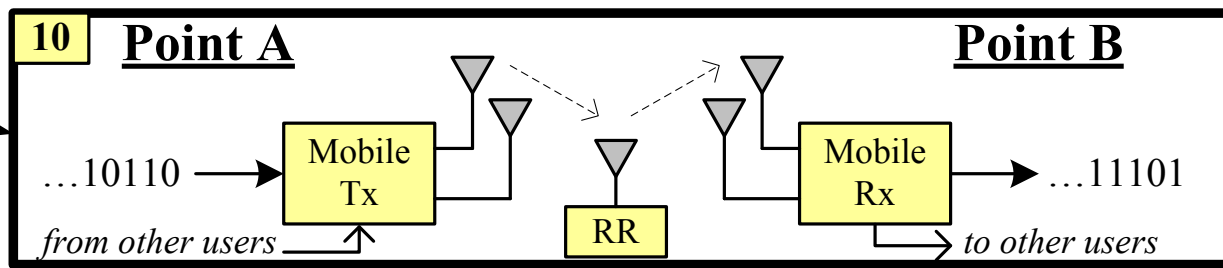
Classroom Design Method...

MORAL OF THE STORY

Ask a Simple Design Question



Design a Very Complex System



CREATIVE Design Teaching

*Intuition
NOT MATH!*

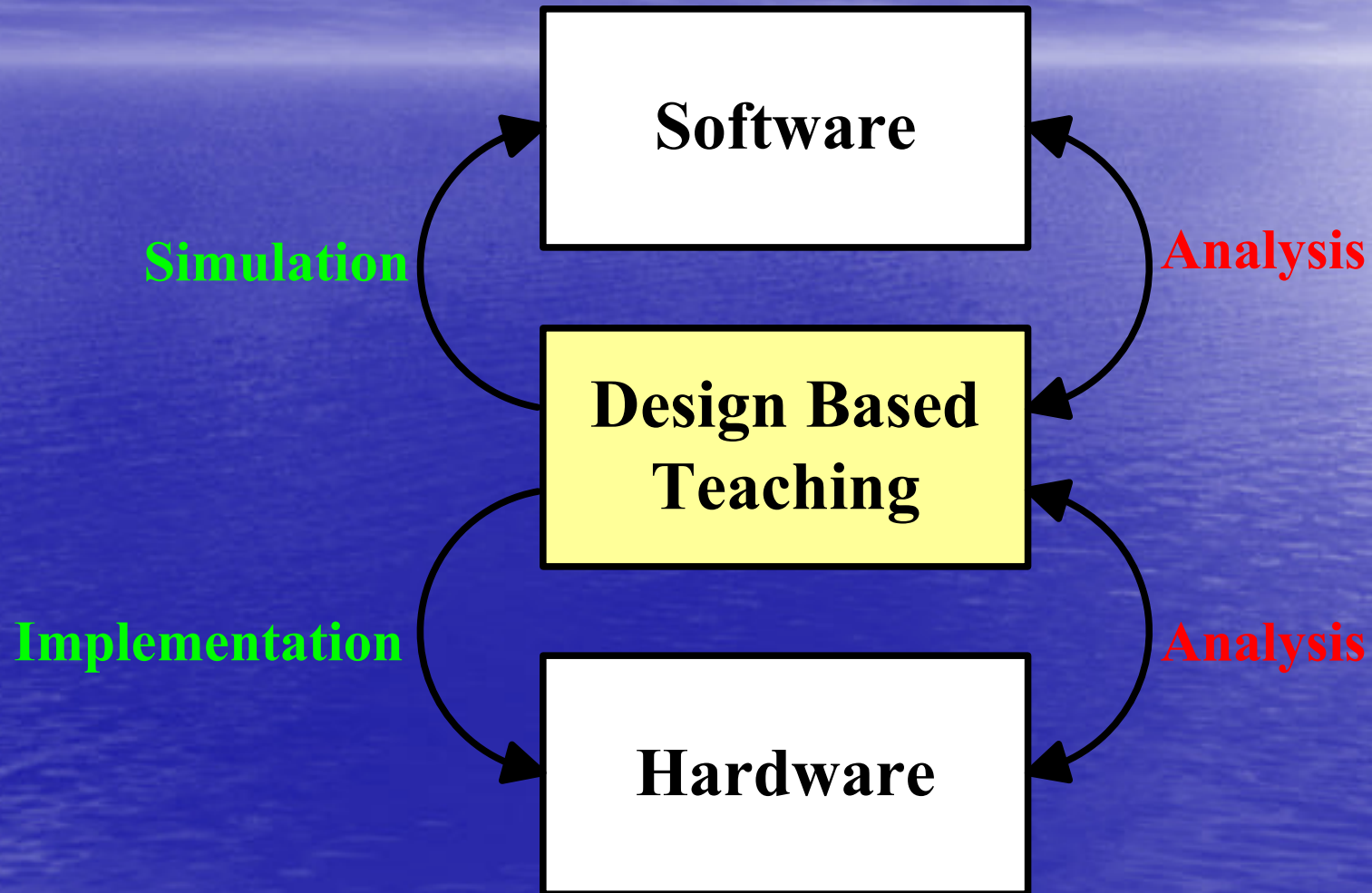
8 Months

move **SLOWLY**

Contents

- ✓ The Big Picture
- ✓ Engineering Interdependencies
- ✓ Traditional Design Method
- ✓ Classroom Design Method
 - Analysis of Design
 - Questions

Analysis of Design...



Questions 😊

To be on a quest is nothing more or less than to become an asker of questions.

— Sam Keen

