CPE348: Introduction to Computer Networks

Lecture #1: Introduction

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What is networking?

Scenario 1

- Xi'an, China, the ancient capital for a few dynasties in China

Terracotta Army Pit

Scenario 1

- An old Chinese Story in Zhou Dynasty (“烽烟戏诸侯，一笑失天下”)
- Zhou (1122 BC to 256 BC)

Scenario 1

Protocol: smoke-on indicates enemy attack, so allies would come to rescue

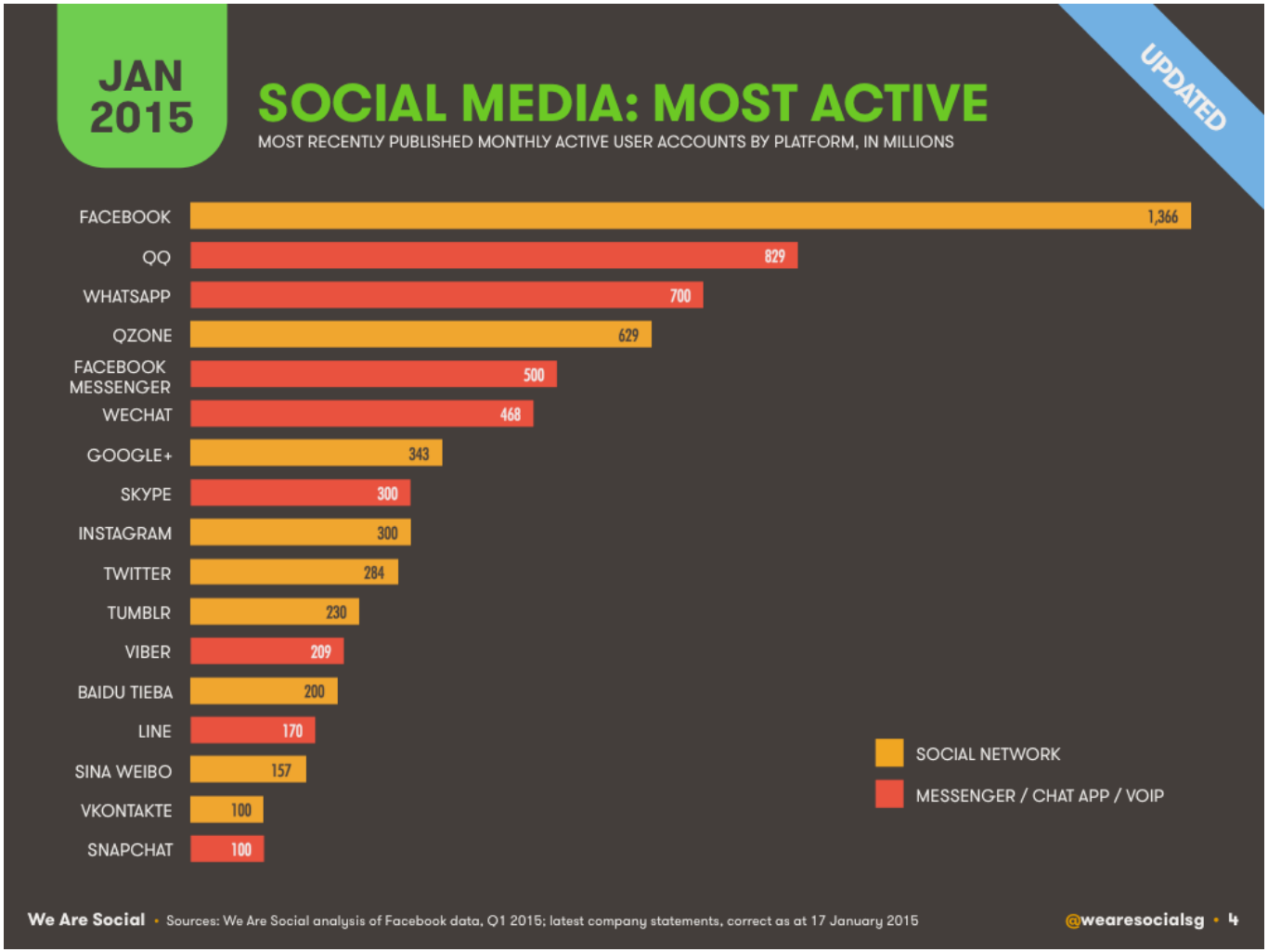
Emperor used this to please his concubine by lighting the smoke even if there is no attack

Protocol failure!

Scenario 2


Storify
Clixtr
beta
Chatroulette
skype
talk
facebook
jaiku
justin.tv
Podcast Alley
Blogger
LinkedIn
flickr
WIKIPEDIA
The Free Encyclopedia
digg
Qwiki
Yammer
Google
yelp
Picasa
MiGente.com
asianave
Quora
vimeo
classmates.com
delicious
Flipboard
BlackPlanet.com
THE WORLD IS YOURS
WordPress
Pinterest
Ning
tripadvisor
blog TV
blip.tv
Epinions.com
USTREAM.TV
FOTOLOG
bebo
myspace.com
a place for friends.
wikiHow
tumblr.
Gowalla
magnolia
ShoZu
foursquare
askeet!

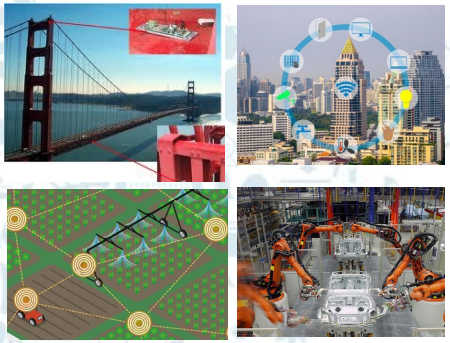
Social media popularity



A more connected world

Smart Health

Smart Transportation



Smart Industry

Smart Energy

Impact of Networking

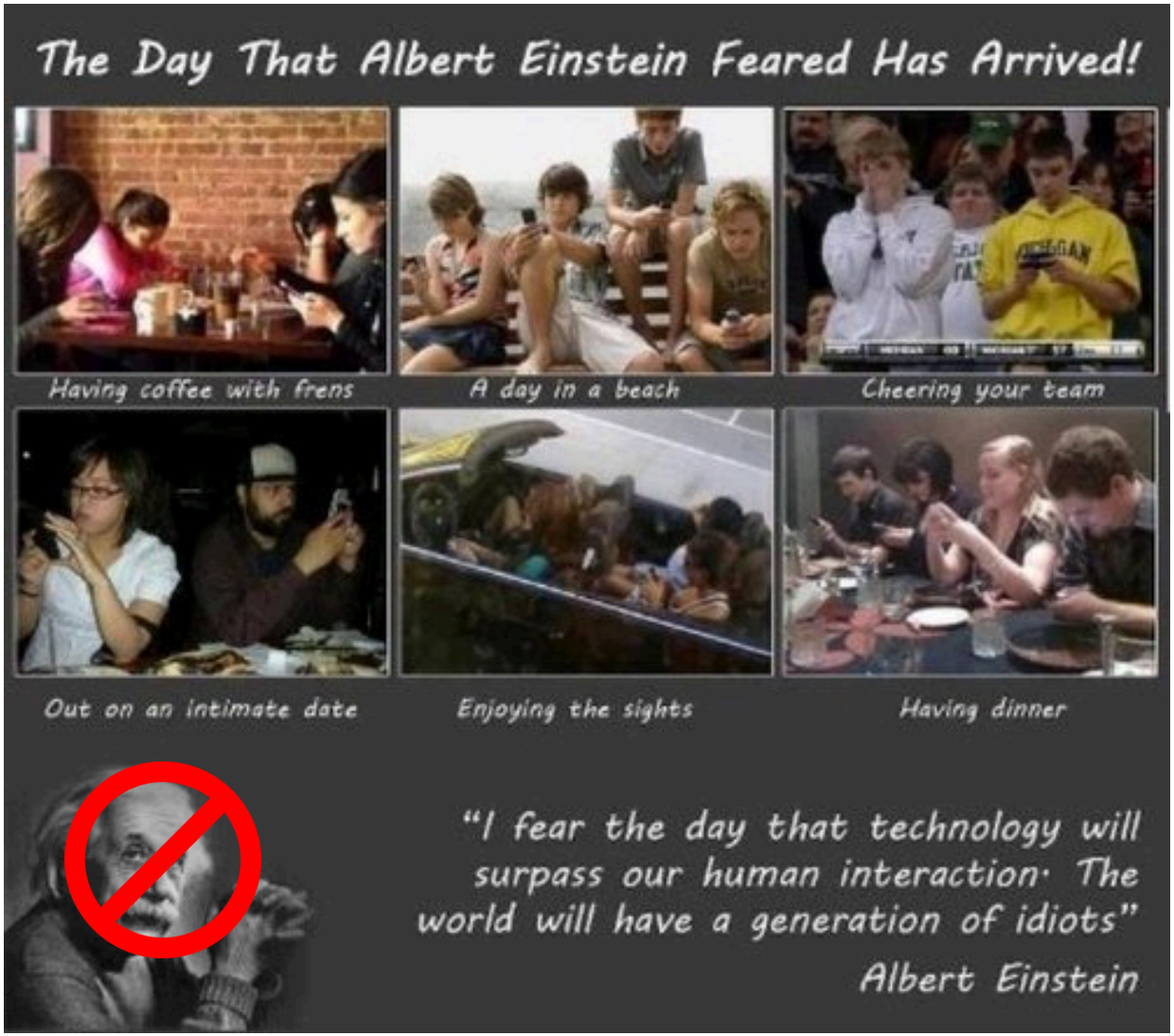
- Good
  - Improve working efficiency
  - Improve people's quality of life (QoL)
  - Improve society's connectivity
  - ...We cannot live without networks (Internet)
- Bad
  - Waste too much time (addiction to cyberspace)
  - Invade people's privacy (The Emperor's New Cloths)

The good (the innocent)…

St. Peter's Square

"How I met your mother"

More fun in cyberspace?



We are in the cyberspace age…

- We create it and we have to live with it…
- How did we get here?

Something we love to have, something we hate to have, something we cannot live without…

…we can only tell part of the story in this course, here it is…

What is about this course?

Overview

- What? computer network vs. communication network: --- an interconnected collection of autonomous computers to accomplish the task of information exchange among these computers
- Computers → communications devices
- Internet → NGI (Next Generation Internet), Internet2, vBNS, all-optical, wireless Internet, NSF GENI: clean slate design, OpenFlow, SDN...
- Globalization: Optical & Wireless

The essence of computer communications…

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point.

(Claude Shannon, *The Mathematical Theory of Communication*)

Overview (cont.)

- Why? An integral part of life
- the idea of teamwork: resource sharing (grid computing, cloud computing…)
- information exchange: be informed
- fast communications: be updated
- convenience: mobile (anywhere anytime connected…)
- money making: E-commerce/m-commerce
- health care: elderly care/smart aging, health monitoring, health social networks…
- infotainment (life killing or life enriching): entertainment (Internet gaming, blogging, social networking…)
- more…

Overview (cont.)

- History
  - smoke signals --- story of Zhou dynasty (scenario 1)
  - telephony: Alexander Graham Bell (the “decibel”)
  - telegraphy: Morse code
  - 1950s: connecting central computer to terminals
  - 1970s: Aloha systems for packet radios
  - DARPA projects: robust communication network design
  - ARPANET and TYMNET

Overview (cont.)

- History (cont.)
  - Internet (1980s)
  - World Wide Web (1990s)
  - Internet telephony
  - digital age: paradigm shifts
  - wireless Internet / Ubinet: Ubiquitous Networking
  - any one, anywhere, anytime, any form, with flexible data rate--future generation telecommunication networks!
  - xG networks (2000s)…
- Telecomm bust! (2000s)…Telecomm will come back! … It starts to come back! … It's coming back!…It is booming again…

Nutshell "Network" Design

- "Wire them together" to form a network
  - Need to hook TWO devices first (direct link): transmission media between two (physical layer)
  - Two should understand each other (protocols)
  - Two should communicate efficiently (efficiency)
  - Multiple users sharing the same "wire" should coordinate (MAC)
  - Two "far away" should be able to communicate (routing and transport)
  - Access any information we desire (applications)
  - Protect it and what is on it (security)

General design tasks

- Need to address the point-to-point (P2P) data transfer (PHY layer)
- Guarantee the reliable transfer P2P (data link layer)
- Coordinate the efficient use of a link if shared (MAC)
- Design more efficient routing schemes (efficiency in terms of overheads, power saving or other resource) if two points are not directly connected (routing)
- Need to assure the reliability end-to-end (e2e) (transport)
- Guarantee the efficient data transfer across a network (flow & congestion control)
- Protect the network infrastructure and information content

Network scalability

- Hierarchical network topology
  - Clustering ideas: a group of nodes form a network, multiple groups form another high layer network, and so on, lab-dept-university-city-state-national-international-universe
  - Backbone: high-speed links connect multiple networks
    - optical fiber
    - cable
    - satellite
  - Last mile: reaching the customers (first mile…)

Network classification

- Network classification
  - Based on geography
    - LAN: Local Area Networks
    - MAN: Metropolitan Area Networks
    - WAN: Wide Area Networks
  - Based on transmission media
    - wired networks
    - wireless networks

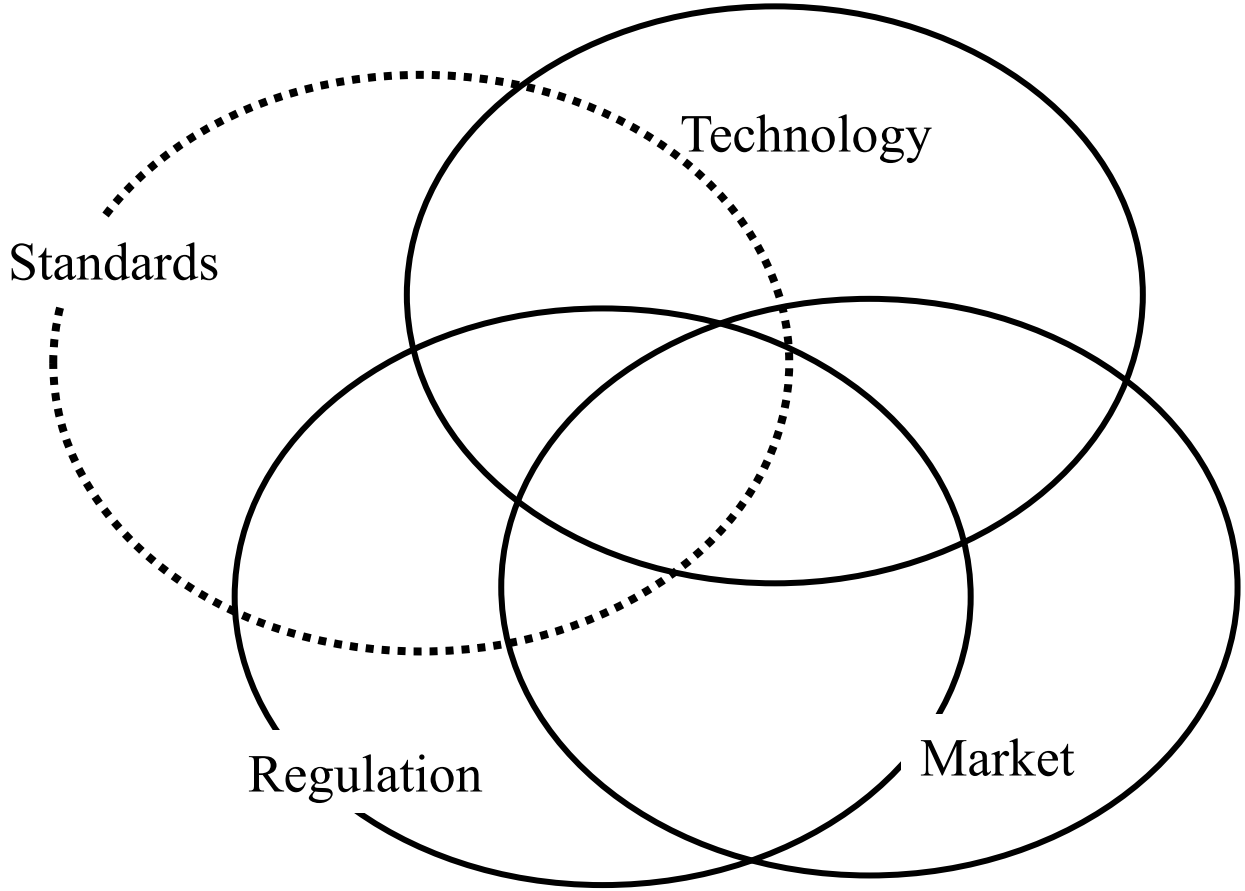
Network classification

- Network classification (cont.)
  - Based on information content
    - telephony
    - data networks
    - multimedia networks
  - Based on communication technology
    - analog networks
    - digital networks

Network design

- Design methodology
  - Top-down: breaking down design task into different design subtasks
  - Bottom-up: finishing all subtasks and assembling all into one

Key factors to network success…



Further reading…

- Exercises: web search
  - Find who invents WWW
  - Find who wrote the TCP/IP
  - Determine who is the real founding father of Internet
  - Find what mobile social networks are
  - What are mobile Healthcare or wireless healthcare systems?
  - Check out this: http://gma.yahoo.com/video/news-alan-dershowitz-young-people-080000867.html

More about this course…

Goals

Introduction to the basic computer network concepts and underlying technologies including

1. Local Area Networks (LANs), Ethernet, Internet;
2. MAC, TCP/IP and Application Layer Protocols;
3. Socket Programming and Network Security.

It's a big field, so we have
to focus on just a few topics.

Basics

- Students are expected to attend all lectures;
- Course videos will be recorded on Panapto;
- No late homework, Canvas submission, hardcopy;
- No makeup exams without a written excuse, and no makeup exams for the Final;

So…. don’t miss exams or homework

Grade

Homework 10%

- 5 homework assignments: 2% each

Project 20%

- PA #1: 8% backoff protocol simulation
- PA #2: 4% CRC & IP Checksum calculation
- PA #3: 8% Wireshark TCP packet analysis

Midterm exam 40%

- 2 midterm exam: 20% each (online, close books/notes)

Final exam 30%

- Comprehensive, close books/notes, April 28th

Grade

Letter grade scale

- >90%: A
- 80-90%: B
- 70-80%: C
- 60-70%: D
- <60%: F

Academic Honesty

Students enrolled in this course are expected to conform to the UAH policies concerning academic misconduct as outlined in the UAH Student Handbook at http://www.uah.edu/student-support/student-conduct/handbook

- Collaboration on exams or laboratory assignments will not be permitted and will be considered cheating. All work submitted for a grade must be entirely your own, including the laboratory programming assignments.

- **Students who cheat will be reported to the University Judicial Officer and** will receive **no credit (0)** for that exam or assignment**.**

Logistics

TA

- Siddharth Sankar Das
- Email: sd0064@uah.edu

Instructor's Office hour

- MW 4:30-6:00PM
- ZOOM: 596-759-0587

Thanks

Be safe and have a great semester!!!