Welcome to …

TDTS21 Advanced Networking

Niklas Carlsson, Associate Professor
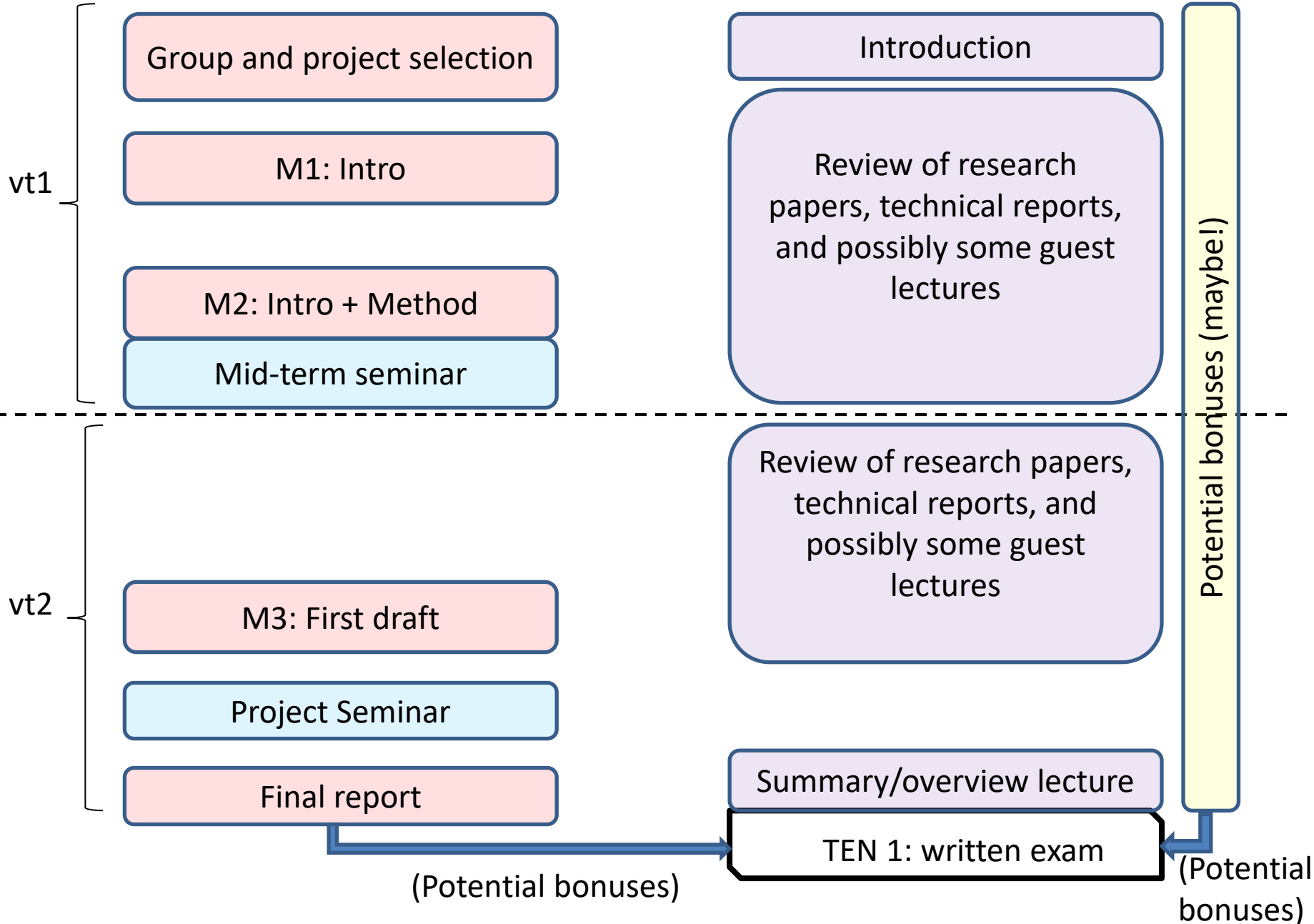http://www.ida.liu.se/~nikca89/

People

- Examiner and lecturer
  - Niklas Carlsson, Associate Professor
    Research area: Design, modeling, and performance evaluation of distributed systems and networks
- Course secretary
  - Helene Pers
- Director of studies
  - Patrick Lambrix

Structure of the Course

- Reading and analyzing research papers
  - Design and evaluation of protocols and applications
  - Summarize, critique, and compare papers
- Classroom time
  - Brief overview of background material
  - Discuss and debate research papers
- Research project
  - Milestones and deliverables

Projects

Theory

vt1

| Group and project selection | Introduction |

M1: Intro

Review of research papers, technical reports, and possibly some guest lectures

M2: Intro + Method

Mid-term seminar

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vt2

Review of research papers, technical reports, and possibly some guest lectures

M3: First draft

Project Seminar

Final report

Summary/overview lecture

TEN 1: written exam

Potential bonuses (maybe!)

(Potential bonuses)

(Potential bonuses)

Example: Research paper lectures

- Overview (some introduction to topic)
- Discussion of research papers
  - Expected to have read at different depths
  - Typically, roughly one "deep" read and one "lighter" read per week
- Lead the discussion for some paper(s)
  - Some papers picked by students, other by examiner
  - Deeper discussion: At least two students assigned
  - Brief overview: Possibly individual papers here (based on interest)

- Who you are
- What program
- Interest in topics? [allowed to change later ...]
- ===
- Janos, Joakim, Philip, Jakob S, Carl Magnus, Matteus, Robert, Tommy, David, Jacob W, Alexander, Arthur, Adam, Oceane, Lukas

Why Take This Course?

- How many of you have checked your e-mail, FB, text …
  - Today?
  - In the past hour?
  - Since I started talking?

Computer networks are ubiquitous

- Networks touch every part of our daily life
  - Web search
  - Social networking
  - Watching movies
  - Ordering merchandise
  - Wasting time
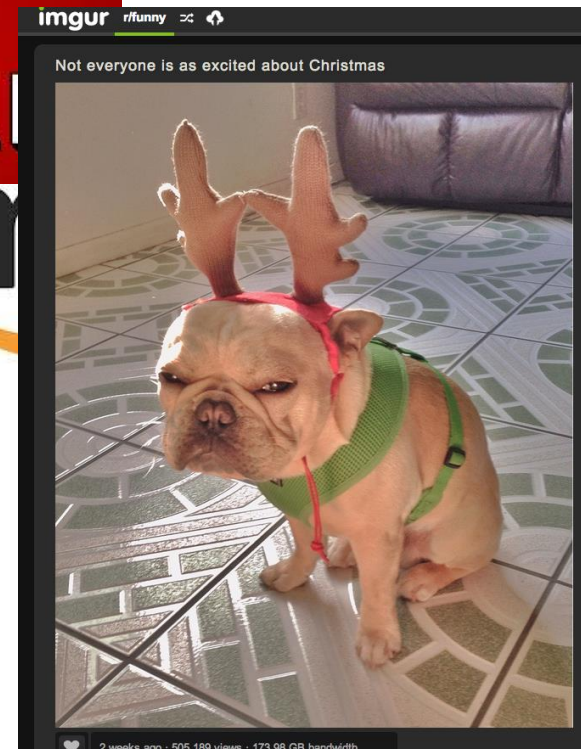
...but ...

Kick starting science ...

What do you have in the future?

What do you have in the future?

How does it keep going?

… well, cable into wall …

What happens there?

What happens there?

Or maybe more realistically …

- Work at company …

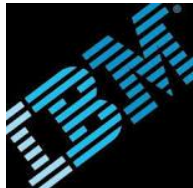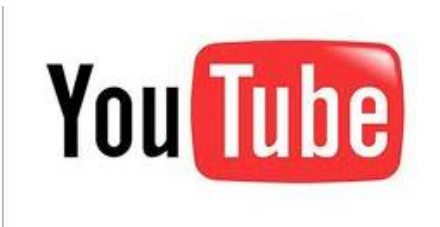# How do we build services that are …

Efficient   Secure   Reliable

Important problem faced every day by many companies, including …

… or …

… I mean almost every company!

The Internet: An Exciting Time

- One of the most influential inventions
  - A research experiment that escaped from the lab
  - … to be a global communications infrastructure
- Ever wider reach
  - Today: 3-4 billion users
  - Tomorrow: more users, computers, things, …
- Near-constant innovation
  - Apps: Web, P2P, social networks, virtual worlds
 - Links: optics, WiFi, cellular, WiMax, …

Transforming Everything

- The ways we do business
  - E-commerce, advertising, cloud computing, …
- The way we have relationships
  - E-mail, IM, Facebook, virtual worlds, online dating
- How we think about law
  - Interstate commerce? National boundaries?
- The way we govern
  - E-voting and e-government
  - Censorship and wiretapping
- The way we fight
  - Cyber-attacks, including nation-state attacks

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Taking us from "yesterday" …

- World Wide Web (WWW)
- Remote login (telnet, rlogin, ssh)
- File transfer
- Peer-to-peer file sharing
- Cloud computing/services
- Instant messaging (chat, text messaging, etc.)
- Live and video-on-demand streaming
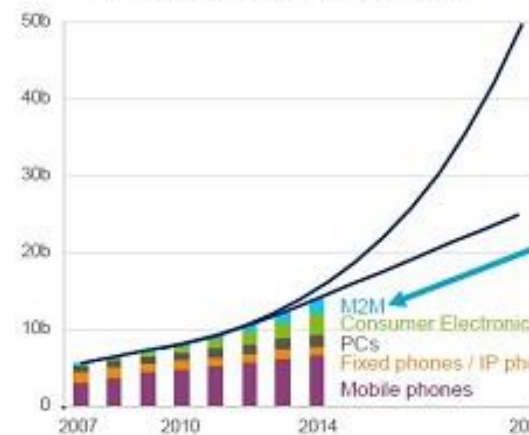- Internet phone (Voice-Over-IP)
- Distributed games

… to today …
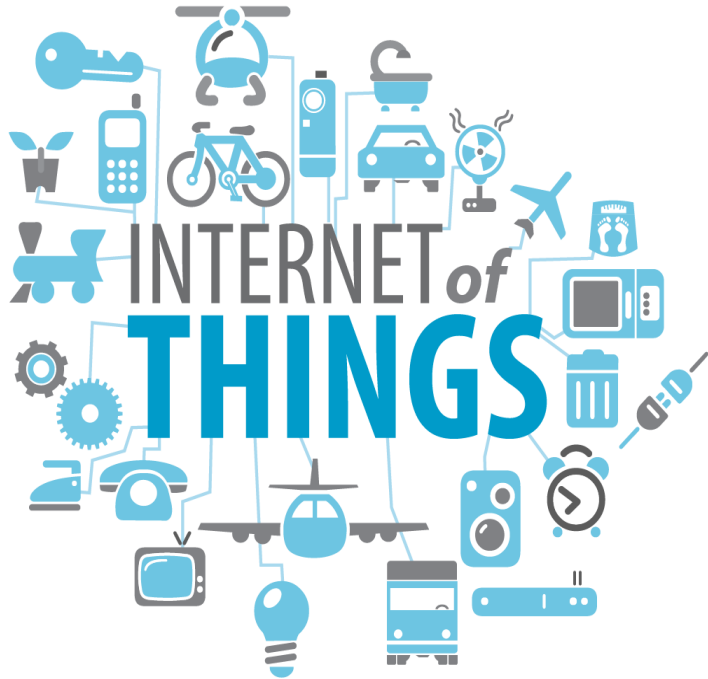
NEW DEVICES AND NEW INDUSTRIES
BRING NEW BUSINESS OPPORTUNITIES

Connected Devices Worldwide

Addressing Industries
Traffic systems, Automotive
Transport and logistics
Utilities – smart grid
Security – connected buildings
Home appliances
Medical automation, Remote healthcare
ATM, Point of sale, Vending
Critical infrastructures
Monitoring and control

M2M
Consumer Electronics
PCs
Fixed phones / IP phones
Mobile phones

More devices per person
eBook readers, Music players, DVD players, Gaming devices, Cameras, Home appliances, In-vehicle entertainment etc.

New telecom cycle: 10x devices, 10x industries

The 2020 vision (extended)

- ❒ Everything that can be connected will be connected
- ❒ IoT and smart cities
  - ○ Machine-to-machine
- ❒ High-definition 3D streaming to heterogeneous clients (holograms may also be on the way …)

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… and into the future …

The Study of Networking is Cool

- Tangible, relates to reality
  - Can measure/build things
  - Can truly effect far-reaching change in the real world
- Inherently interdisciplinary
  - Well-motivated problems + rigorous solution techniques
  - Interplay with policy, economics, and social science
- Widely-read papers
  - Many of the most cited papers in CS are in networking
  - Congestion control, distributed hash tables, resource reservation, self-similar traffic, multimedia protocols,…

The Study of Networking is Cool

- Young, relatively immature field
  - Great if you like to make order out of chaos
  - Tremendous intellectual progress is still needed
  - *You* can help decide what networking really is
- Defining the problem is a big part of the challenge
  - Recognizing a need, formulating a well-defined problem
  - … is at least as important as solving the problem…
- Lots of platforms for building your ideas
  - Programmability: Click, OpenFlow, NetFPGA
  - Routing software: Quagga, XORP, and Bird
  - Testbeds: Emulab, PlanetLab, Orbit, GENI, …
  - Measurements: RouteViews, traceroute, Internet2, …

How to Read

You May Think You Already Know
How To Read, But…

This subset of slides are
Based on slides by Jennifer Rexford

You Spend a Lot of Time Reading

- Reading for grad classes
- Reviewing conference submissions
- Giving colleagues feedback
- Keeping up with your field
- Staying broadly educated
- Transitioning into new areas
- Learning how to write better papers ☺

It is worthwhile to learn to read *effectively*

Keshav's Three-Pass Approach: Step 1

- A ten-minute scan to get the general idea
  - Title, abstract, and introduction
  - Section and subsection titles
  - Conclusion
  - Bibliography
- What to learn: the five C's
  - Category: What type of paper is it?
  - Context: What body of work does it relate to?
  - Correctness: Do the assumptions seem valid?
  - Contributions: What are the main research contributions?
  - Clarity: Is the paper well-written?
- Decide whether to read further…

Keshav's Three-Pass Approach: Step 2

- A more careful, one-hour reading
  - Read with greater care, but ignore details like proofs
  - Figures, diagrams, and illustrations
  - Mark relevant references for later reading
- Grasp the content of the paper
  - Be able to summarize the main idea
  - Identify whether you can (or should) fully understand
- Decide whether to
  - Abandon reading in greater depth
  - Read background material before proceeding further
  - Persevere and continue for a third pass

Keshav's Three-Pass Approach: Step 3

- Several-hour virtual re-implementation of the work
  - Making the same assumptions, recreate the work
  - Identify the paper's innovations and its failings
  - Identify and challenge every assumption
  - Think how you would present the ideas yourself
  - Jot down ideas for future work
- When should you read this carefully?
  - Reviewing for a conference or journal
  - Giving colleagues feedback on a paper
  - Understanding a paper closely related to your research
  - Deeply understanding a classic paper in the field

http://ccr.sigcomm.org/online/?q=node/234

Other Tips for Reading Papers

- Read at the right level for what you need
  - "Work smarter, not harder"
- Read at the right time of day
  - When you are fresh, not sleepy
- Read in the right place
  - Where you are not distracted, and have enough time
- Read actively
  - With a purpose (what is your goal?)
  - With a pen or computer to take notes
- Read critically
  - Think, question, challenge, critique, …

Again, research paper lectures

- Overview (some introduction to topic)
- Discussion of research papers
  - Primary: At least "three-pass read"
  - Secondary: At least "two-pass read"
  - Optional: At least "one-pass read"
- Lead the discussion for some paper(s)
  - Deeper discussion: At least two students assigned, expected to have done at least "three-pass read"
  - Brief overview: Possibly individual papers here (based on interest), "two-pass read" expected (but to feel prepared it may be good to do some steps from the "three-pass read")