T-110.5110 Computer Networks II

Introduction

17.9.2007

Adj. Prof. Sasu Tarkoma

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Course Outline

- 4 credit course
- During Autumn 2007, we will look at protocols and architectures related to mobility management, session management, authentication, authorization and accounting (AAA) services and quality of service (QoS).
- The course consists of the lectures and a final exam.
- The purpose is that the participants actively read the material beforehand and discuss problem areas during the lectures.
- Networks II lectures start on Monday 17.9. 14-16 in T2. Registration happens on this first lecture. Course material will be in English. Lectures will be in English if required.

Course Goals

- Understand advanced networking techniques
- Learn state of the art
- Get a glimpse to near-future technologies and long haul development

Time and Place

- Time and place: Mondays at 14:15 - 16:45 in T2 during the first period.
- Lectures will be held in T3 in the second period.
- Adj. Prof. Sasu Tarkoma gives the lecture unless otherwise indicated.

Carrying out the Course

- The course grade consists of partication to lectures and a final exam.
- Final exams will be held as follows:
  - 17.12.2007 16-19 at T1.
  - 12.3.2008 9-12 at T1.
- Required preliminary knowledge
  - T-110.300 Telecommunication Architectures
  - T-110.350 Computer Networks
  - T-110.402 Information Security Technology

Lectures

17.9. Introduction
24.9. Transport issues
Invited lecture given by Dr. Pasi Sarolahti / Nokia Research Center
1.10. Mobility I
Lectured by Prof. Jukka Manner
8.10. NAT (STUN, ICE, TURN)
15.10. QoS I
Lectured by Prof. Jukka Manner
22.10. Mobility II (MIP, HMIP, NEMO,..)
29.10. No lecture (exam period)
5.11. QoS continued and signalling (NSIS)
12.11. AAA
19.11. HIP I
26.11. HIP II
Invited lecture given by M.Sc. Miika Komu / HIIT
3.12. Privacy and identity management
10.12. Summary

Contact Points

- Send email
  - sasu.tarkoma@tml.hut.fi
- Follow course web-page
  - Results and updates will be posted to the Web
- Reception
  - After the lectures
  - Otherwise send email to arrange a meeting
  - Exam reception will be scheduled after results

Summary of Course

- As discussed the course focuses on several important features of current networking systems
  - Mobility, QoS, Security, Privacy
- We observe that these features were not important for the original Internet architecture
- They are important now
  - Mobility, QoS, Security are coming with IPv6
  - IPv6 deployment does not look promising
- Hence, many proposals to solve issues in the current Internet
- Also many solutions to solve expected problems in the Future Internet

Layered Architecture

- Internet has a layered architecture
- Four layers in TCP/IP
  - Application (L7)
  - Transport (L4)
  - Network (L3)
  - Link layer / physical (L2-L1)
- We will talk a lot about layering
  - Benefits, limitations, possibilities (cross-layer)
  - It is not always clear what is a good layering
- A lot of interesting networking developments are happening on application layer

The Internet has Changed

- A lot of the assumptions of the early Internet has changed
  - Trusted end-points
  - Stationary, publicly addressable addresses
  - End-to-End
- We will have a look at these in the light of recent developments
- End-to-end broken by NATs and firewalls

Network has Value

- A network is about delivering data between endpoints
- Data delivery creates value
- Data is the basis for decision making
- We have requirements to the network
  - Timeliness
  - Scalability
  - Security
  - ...

Looking at the Layers

- Link Layer / Physical
- Network
  - We will look at mobility, security, and QoS on L3
  - Mobile IP, network mobility, HIP, NAT Traversal
- Transport
  - Basic properties of transport layer protocols
    - TCP variants, DCCP, TLS, dTLS
  - Mobility and security on L4
- Application
  - Security, identity management

- Goal: have an understanding of the solutions and tradeoffs on each layer and discussion on the role of layering

Role of Standards

- On this course, we will talk a lot about standards
  - IETF is the main standards body for Internet technologies
  - Instruments: RFCs, Internet drafts
  - Working groups
  - IRTF
- Other relevant standards bodies
  - W3C, OMA, 3GPP, OMG

Transport Issues

- Network layer (IP) provides basic unreliable packet delivery between end-points
- Transport layer needs to provide reliability, congestion control, flow control, etc. for applications
- TCP variants
- SCTP
- DCCP
- TLS
- dTLS

Mobility

- What happens when network endpoints start to move?
- What happens when networks move?
- Problem for on-going conversations
  - X no longer associated with address
  - Solution: X informs new address
- Problem for future conversations
  - Where is X? what is the address?
  - Solution: X makes contact address available
- In practice not so easy. Security is needed!

NAT Traversal

- As mentioned, end-to-end is broken
- Firewalls block and drop traffic
- NATs do address and port translation
  - Hide subnetwork and private IPs
- How to work with NATs
  - Tricky: two NATs between communications
  - NAT and NAPT
  - One part is to detect NATs
  - Another is to get ports open
- IETF efforts
  - STUN
  - ICE
  - TURN
  - NSIS

QoS

- By default, there is no QoS support on the Internet
- IP is unreliable, packet types are handled differently (TCP/UDP/ICMP)
- No guarantees on TCP flow priority (OS and NW stack issue)
- IETF work
  - DiffServ, IntServ, NSIS

Security Features

- IPSec provides basic security (tunnel,transport) with IKE
- Solution for autentication, authorization, accounting is needed (AAA)
  - Radius, Diameter
- Case: WLAN access network

HIP

- HIP is a proposal to unify mobility, multi-homing, and security features that are needed by applications
- Identity-based addressing realizing locator-identity split
- Change in the networking stack that is not very visible to applications (no IP addresses though!)
- HIP architecture, HIP implementation for Linux

Privacy and Identity Management

- Privacy and trust matters a lot
- Services on the Web
- Single sign-on
  - Liberty, OpenID, GAA, ..
- Recent developments

Questions and Discussion