Development of an Interactive Computer Networks Course

Prof. Dr. Torsten Braun

Rechnernetze und Verteilte Systeme

Institut für Informatik und angewandte Mathematik

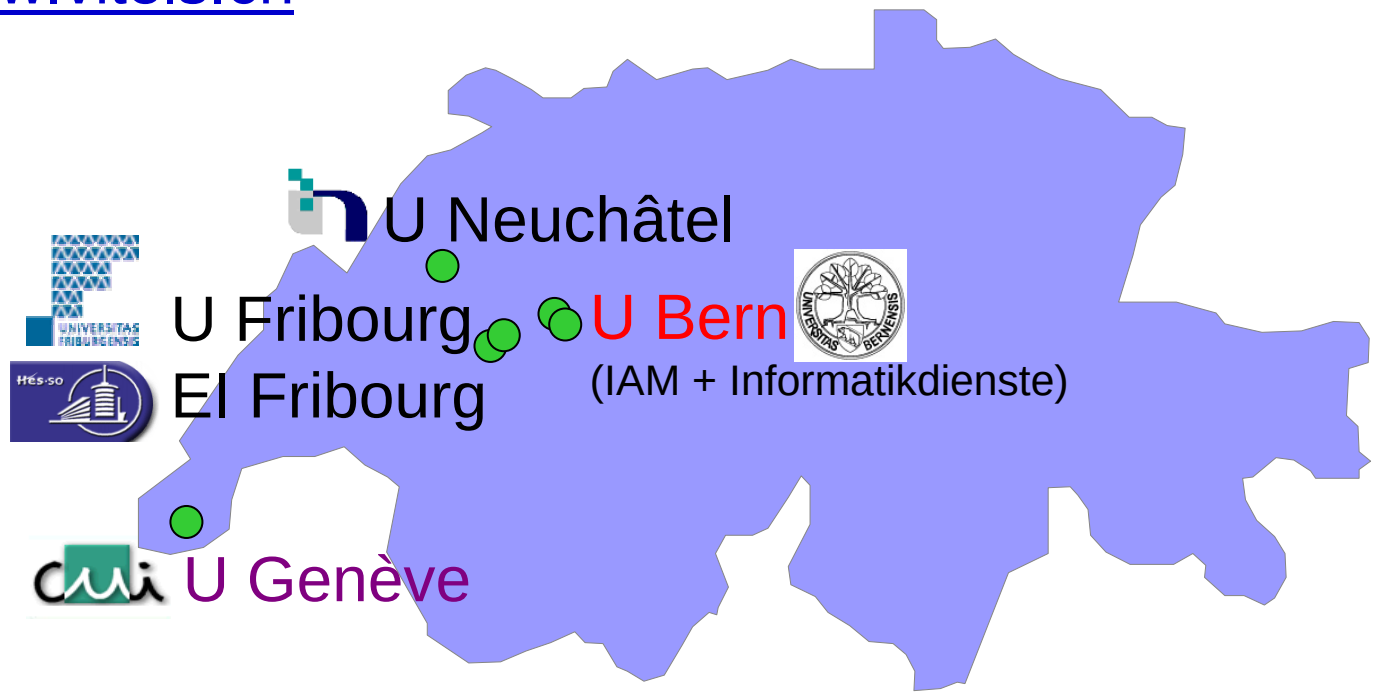
Universität Bern

Contents

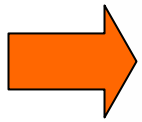
- VITELS Overview
- Goals
- Challenges
- Interactive Course Modules
- Course Module Structure
- Implementation Architecture
- Student Support
- Implementation Status
- Experiences
- Results
- Outlook

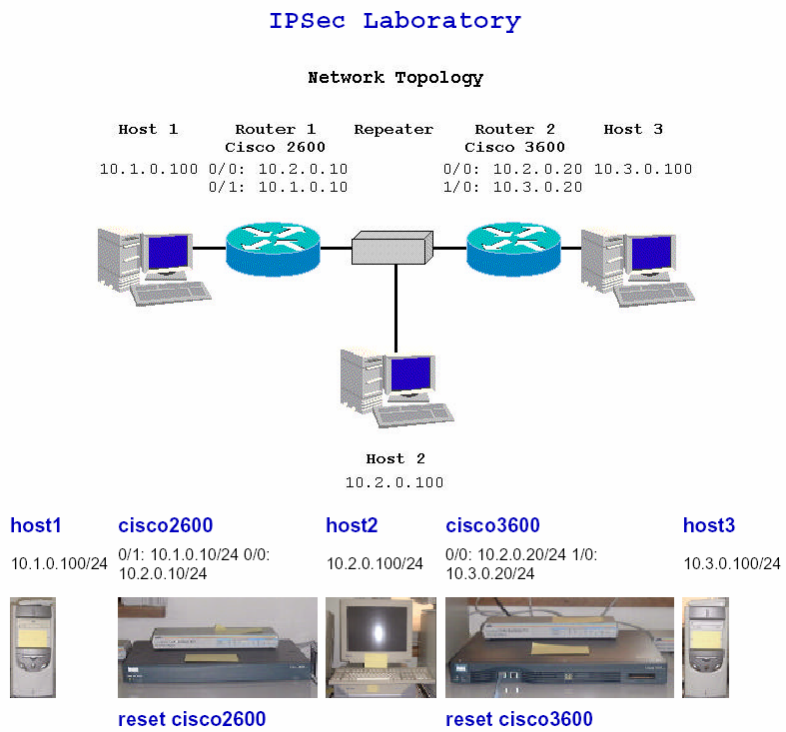
VITELS Overview

- Virtual Internet and Telecommunications Laboratory of Switzerland
- Swiss Virtual Campus Project No. 991043
- Runtime: October 2000 - July 2004
- Funding from BBW + BBT:
  600'000,- SFr. (<< 50 % of total project costs)
- www.vitels.ch



Goals





- Improve attractiveness and quality of education by practical exercises to complement lectures in telecommunications / computer networks
- Sharing of human and technical resources allowing partners to focus on main competence
- Highest degree of interactivity
- Ease of use (no special hardware / software requirements except web browser, single login)

Challenges

- Security Issues (Authentication & Authorization) due to distributed resources *and* users
  → Christoph Graf (SWITCH Zürich)
- Didactical and Pedagogical Issues
  → Prof. Jacques Viens (TECFA, U Genève)
- Uniform Module Structure & Graphical Design
  → Attila Weyland (U Bern)

- Course Module Implementation Demos
  → Attila Weyland (U Bern)
  → Marc-Alain Steinemann (U Bern)
  → Prof. Ulrich Ultes-Nitsche (U Freiburg)
  → Matthias Scheidegger (U Bern)
  → Thomas Bernoulli (U Bern)

Interactive Course Modules

- Keywords: Hands-on exercises, interactivity
- Series of course modules (course language: English)
- Types of course modules
  - Virtual exercises:
    experiments using emulation and simulation of network devices
    - Safe
    - No perfect image of the real world
  - Remote exercises:
    experiments with real, commercially available equipment
    - Not safe (→ challenge for software to be developed)
    - Mistakes like in the real world (→ valuable learning effects)
- Integration into curriculum
  - Replacement of traditional exercises with
    required presence of tutors and limited laboratory access times

Course Module Structure

Chapter 1: Introduction

- Welcome
- The Goals and How to Reach Them
- Module Vicinity
- My Goals
- Tips
- FAQ

Chapter 2: Theory

- Theoretical Basics
- Readings
- Personal Synthesis
- Self-test
- Quiz

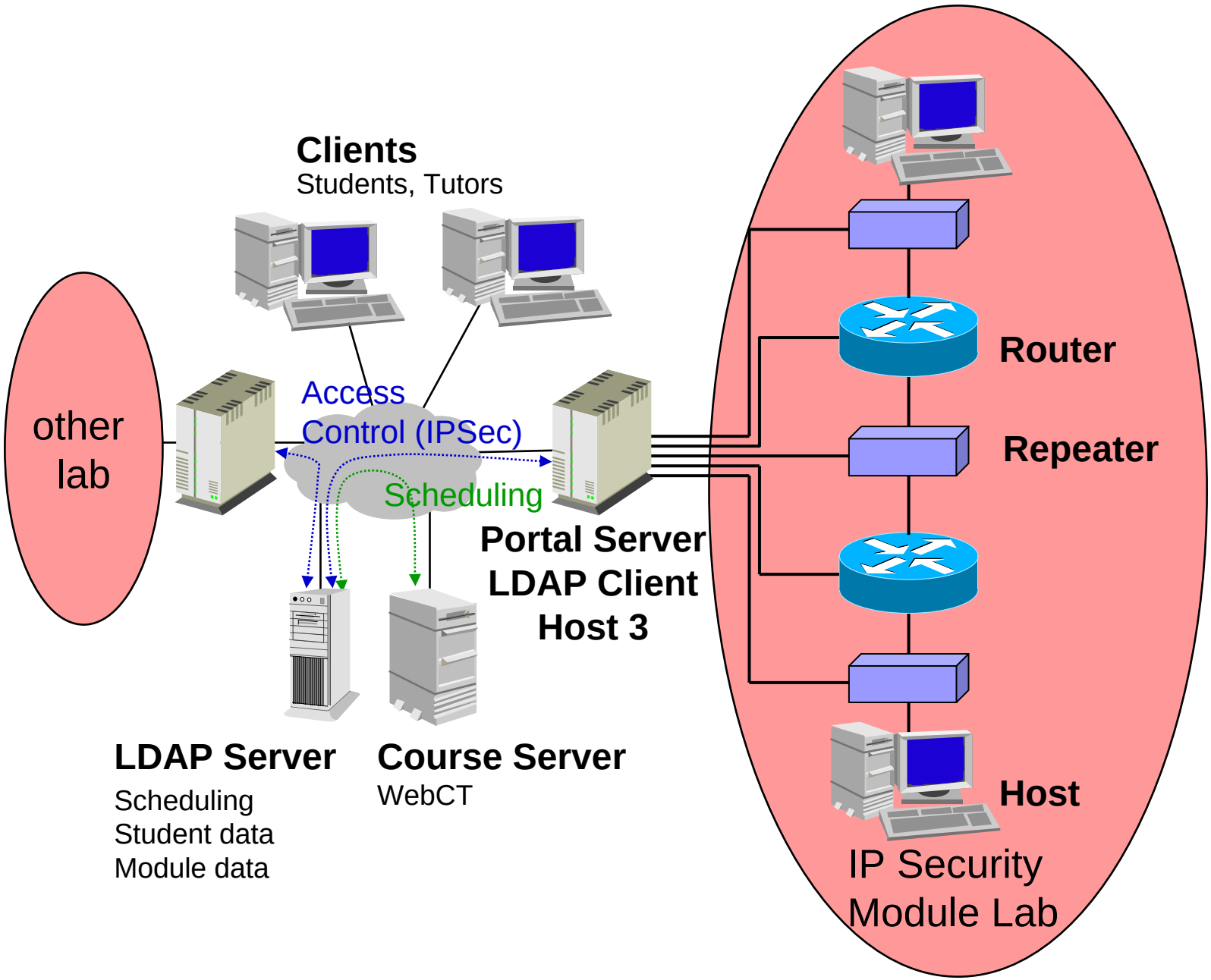
Chapter 3: Knowledge Application / Exploration

- Hands-on Session

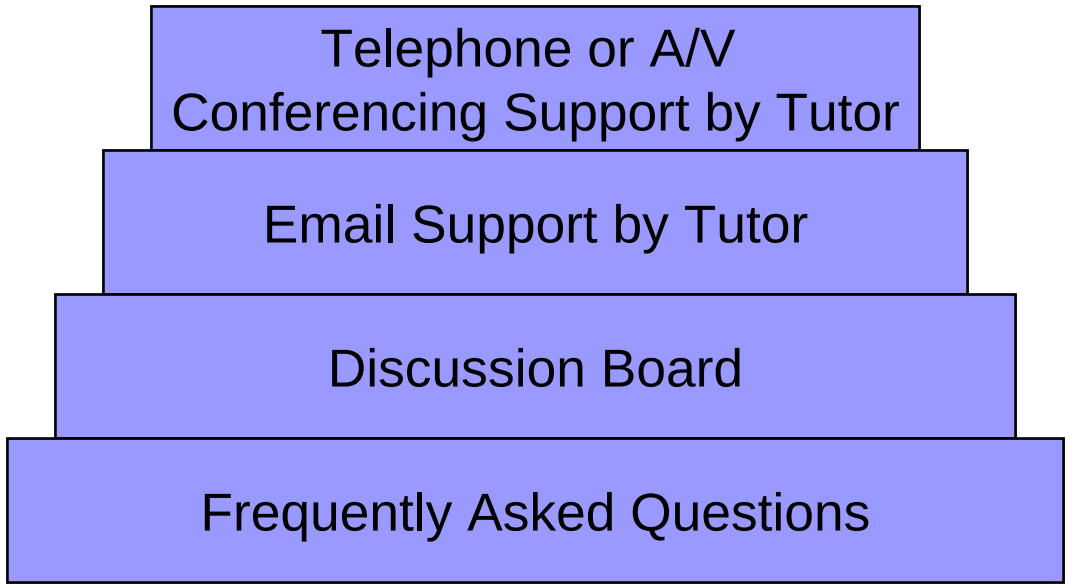
Chapter 4: Prove Your Knowledge and Skills

- Personal Synthesis
- Final Quiz

Implementation Architecture



Student Support



Implementation Status

- Running supporting infrastructure:
  course server and scheduling system (U Bern)
- Finished Modules
  - Simulation of IP Network Configuration (U Bern)
  - IP Security (U Bern)
  - Firewall Management (U Freiburg)
  - Sockets and Remote Procedure Call (U Bern)
  - Remote Method Invocation (U Bern)
- Modules under development
  - Linux Systems Installation and Configuration (U Genève)
  - Performance Evaluation of a Real IP Network (U Genève)
  - Client/Server Communications and HTTP (U Neuchâtel)
  - Protocol Analysis (HTA Freiburg)
- Several modules have been used and tested by students in regular university courses.

Experiences

- Students like
  - to get in touch with real networking equipment.
  - practical courses and exercises due to high learning effects
  - robust software
  - spatial and temporal flexibility provided by on-line course
  - printed preparation material (more convenient and flexible)
  - to ask teachers in case of problems,
    but those might not always be present in a virtual lab.
  - to work in groups.
- Students do not like
  - too much theoretical preparation / evaluation
  - reading material on computers

Results

- Innovative developments and valuable scientific results
  - Successful demonstrations at fairs, e.g. SVC days and Learntec 2003
  - Invited talks and seminars
  - Numerous scientific publications at international workshops, conferences, and renowned journals, e.g. ACM Computer Communications Review
- Stimulating collaboration among partners
  - Great experience with regular video conferences as pilot users of SWITCH video conferencing service
- Encouraging student feedback
  - Students are open to new platforms such as exercises and on-line discussions

Outlook

- Further improvements based on student feedback
- New modules
- Authentication and Authorization Infrastructure (AAI) portal in collaboration with SWITCH and SVC project Nano-World (SVC mandates)
- Migration to central course server at SWITCH
- Support of mobile students
- Follow-On Projects
  - SVC consolidation programme
  - CTI/KTI projects (looking for partners)
  - International collaborations
- Commercialisation ?