Problem Space

Multimedia Content Sources

Heterogeneous Networks

Dis-similar Client Devices

Realtime Interactive Multimedia Service Delivery
Project 1.1

Multimedia Content Sources

IPv6 Networking

Network handover performance

Heterogeneous Networks

QoS Routing

GPRS, 3G, etc.

802.11

Dis-similar Client Devices

Next Generation Internet
Copyright protection through encryption

Multimedia Content Sources

“Real-world” multimedia traffic generators

Copyright protection through encryption

Heterogeneous Networks

Dis-similar Client Devices

Advanced Video Retrieval Services
Project 1.3

Multimedia Content Sources → Heterogeneous Networks

Dis-similar Client Devices

Interaction with wireless networks – 802.11, Bluetooth, 3G, etc.

Wireless multimedia applications

Multimedia over Wireless Networks
Advanced Computing and Simulation Laboratory (AXL)

Research Overview

Malin Premaratne
Researchers in AXL

- Dr Malin Premaratne (Research Director)
- Dr Ahmet Sekercioglu
- Professor Greg Egan
- Dr Khee Pang
- Dr Mani Nallasamy
- Dr Andrew Price
AXL Research Outline

- Parallel and Distributed Simulation of Optical Communications Systems
- Constrained Design and Optimization Techniques for Optical Communications Systems
- Device Modeling, Simulation and Optimization
- Modeling and Simulation of Bio-Photonics Processes
- Theoretical Study on Quantum and Optical Computing
Parallel and Distributed Simulation of Networks

- Parallel/distributed implementation of pulse propagation in optical fiber and other devices
- Approximate black-box models for devices and networks
- Non-uniform sampling techniques for speeding up simulations
- Efficient data representation techniques
Problem Statement: Given a set of available equipments and a connection topology, find a subset of equipments that meets required performance while minimizing the cost.

- NP – Hard problem (i.e. solutions can only be found using clever heuristics!!)
- Very much interest in industry
Device Optimization

- Transient analysis of Raman and EDFA amplifiers
- Distributed characterization of optical fiber
- Analysis of quantum well/wire/dots based lasing structures

Gain Clamped EDFA

Modified Quantum Wire Structure
Modeling and Simulation of Bio-Photonic Processors

- Photo-acoustic methods - Noninvasive detection of glucose in blood
- Optical coherence tomography techniques for noninvasive detection of substances in humans
- Scattering and absorption dynamics in tissue
- Monte Carlo inversion techniques
Theoretical Study on Quantum and Optical Computing

- Algorithm Development for NP-hard problems such as device placement problems in optical networks
- Simulation algorithms for optical devices and networks in quantum and optical computers
- Study of photon flux through optical devices as birth-death-immigration processes
Integration of services: data-voice-video.
Complete mobility of the end nodes.
Widespread coverage without requiring expensive network management.
“always-on” connections for mobile devices at the edge of a fixed core network.
Protocol Research and Standardisation Activity
- Fast Handovers for time sensitive traffic.
- Duplicate Address Detection (DAD) for IPv6 devices.
- Link Triggers for smooth handovers.
- HMIPv6
- Detecting Network Attachment (DNA).
- Multicast Mobility Requirements, etc.

Network Performance Analysis by Simulation
- Developed full IPv6 Suite
- MIPv6 / HMIPv6 Models
- 802.11 Wireless LAN Models
Simulation Activities

- **IPv6 Networks**: Mobility, Seamless Handovers, Routing, Multicasting, Wireless QoS
- **Beyond 3G Networks**
- **New Router Architectures & Routing Table Search Algorithms for IPv6**
- **Fuzzy Logic for Network Control & QoS**

**Aticrc Activities**

**Protocol Models**: IPv6, MIPv6, Transport, DLC
**Device Models**: Routers, Switches
**Link Models**: Wireless, PPP, Ethernet
**Traffic Models**: Video Client/Server

**OMNeT++ Simulation Framework**

**AIM**: Performance analysis of IPv6 networks (protocols, topologies, algorithms)

**AIM**: An advanced framework for simulation of large-scale networks

**Topology Generation for Large-Scale Wired/Wireless/Mobile Nets**
- Synthetic topologies (Brite)
- Extracted from real networks

**Parallel Simulation**
- Topology partitioning and load balancing
- Synchronization algorithms

**Mixed-Mode Simulation**
- Hardware-in-the-loop
- Emulation (User-Mode Linux)
Research & Industry Partners

- **Australian Telecommunication Cooperative Research Centre (ATcrc)**
  - Program 1 : Applications

- **Samsung Advanced Institute of Technology**
  - Fast Handover and Configuration for IPv6

- **Toshiba**
  - Detecting Network Attachment issues.

- **Clarinox**
  - Integration of Bluetooth to wireless LAN handover protocols.

- **Louis Pasteur University (LSIIT), Strasbourg**

- **WIDE at Keio University, Jun Murai Labs.**
Some Recent Publications

Unmanned Air Vehicles

Terry Cornall
Who, what, why

- Research: Greg Egan, Andrew Price, Terry Cornall
- Associates: John Bird, Brian Taylor
- Technical: Ray Cooper, Paul Jenkins, Ian Reynolds
- Telemetry, sensors, computer vision, power systems, autonomous control for unmanned aircraft
- Rapidly increasing military and civilian interest in UAV applications and capabilities
Platform development

Payload capacity
Power system
Stability
Duration
Maintainability
Controllability
Cost
Manufacturability
Portability
Low speed
High speed
Altitude
Distance
Materials

Altitude Gain

Graph showing altitude gain over time.

23
Telemetry

Transmitter, power, band
Receiver ground, satellite
Channel coding
Video, raw, compressed
Still image, high resolution
Altitude and airspeed
Battery condition
Motor condition
Performance
Attitude, position
Telemetry range
Bandwidth
Ground station antennas
Tracking
Security
**Payload**

Vision processing
Barometric sensors
Airspeed, altitude
Motor monitoring
Temperature
Battery monitoring
Voltage, current
GPS receiver
Telemetry transmitter
Still camera
Video camera
Inertial measurements-
Non inertial alternatives
Computer Vision

Horizon angle measurement
Horizon detection
Pitch angle measurement
Feature detection and tracking
Speed from image flow
Time to impact from image flow
Altitude from feature size
Vision capture
Vision processing
Algorithms
System integration

GPS, airspeed, Barometric altitude

Autopilot, aircraft control system
Control

- The control of a UAV involves the use and integration of the onboard and ground sensors, mission definition, control systems, power systems, emergency systems, launch and recovery, telemetry, remote and autonomous control.
- Energy management, mission duration, robust control, computational power, failsafe operation, safety, platform flight characteristics, stability, mission strategy, autonomous landing, autonomous flight, autonomous navigation, telemetry and remote control range.
Other research topics

- Cooperative missions - swarming, sensor fusion, reliability
- Antennas, ad hoc networks
- Navigation - GPS denial, dead reckoning, cooperative, feature based
- Electric propulsion - motor and propeller materials
- Energy storage - new battery technologies, solar augmentation, fuel-cells
- Energy management - low energy flight stabilisation, mission planning,