PLANETE
Protocols and Applications for the Internet

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http://planete.inria.fr
Today we have the Internet

Estimated to 2,095,006,005
7 billion persons
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Internet Evolution

- Increasing heterogeneity
Internet Evolution

- Mobility and episodic connectivity
Internet Evolution

- Unusual but legitimate traffic load
- Delivery of real-time high-bandwidth video services
Internet Evolution

- “Stakeholders” with no mutual trust
Incremental or Disruptive

- Incremental patches
- Clean Slate approach

- "Network Innovations" may follow either of these two approaches
- Validation
  - Overlays
  - Large scale experimental platforms
The team

INRIA researchers

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Thierry Turletti (S), Vincent Roca (G),
Chadi Barakat (S), Arnaud Legout (S),
Mohamed Ali Kaafar (G).

Permanent Engineers

Thierry Parmentelat (S).

9 Research Engineers

15 PhD students
Planète Research Directions

1. Efficient Data Dissemination
   • Content centric Networking
2. Network security
3. Network monitoring
4. Evaluation platforms and methodology

• With an experimental approach
1. Efficient Data Dissemination

- Design of efficient, robust and secure broadcasting systems
- Peer-to-peer architectures
- Cope with episodic connectivity
- Content sharing in ad-hoc networks
Data Broadcast

- Application-Level FEC Codes and their applications to broadcast/multicast systems
- A new File delivery application for content distribution
- Enhanced MAC level Encoding scheme for Mobile Satellite TV Broadcasting
research opportunities

- numerous interesting future R&D directions:
  - low rate codes, “Gaussian elimination friendly” LDPC codes, low working memory decoding, UEP, interactions with source video coding, redundancy optimal location in a TCP/IP stack
- many opportunities to disseminate (IETF, open-source codecs, publications)

Dissemination

- Our LDPC-Staircase codes have been included this year as the primary AL-FEC (Application Layer Forward Erasure Correction code) solution for ISDB-Tmm (Integrated Services Digital Broadcasting, Terrestrial Mobile Multimedia), a Japanese standard for digital television (DTV) and digital radio.
Building blocks for content distribution

- research activities
  - new file-casting application (we have a much better FLUTE replacement, FCAST)
  - contributions to and evaluation of FECFRAME streaming architecture, and more generally FEC based robust streaming systems

- on-going projects
  - now: PhD with ALU-BL on “robust, self adaptive, video streaming in wireless systems”

Mid-way between AL-FEC and content distribution systems in fact!
Peer-to-peer protocols

- Focus on BitTorrent
  - Large scale experiments
  - Large scale measurements
- Properties of the core algorithms of BitTorrent
  - We show there are close to optimality
- Properties of the overlay construction strategies
  - We show some pathological behaviors
Peer-to-peer protocols

- **BitTorrent Locality**
  - We show that we can push BitTorrent locality much further than previously known and that it saves 40% of inter-ISP traffic at the scale of the Internet

- **BitTorrent Piracy**
  - We characterize the impact of piracy

- **Skype Privacy Issues**
Episodic Connectivity

- **Goal:** Manage transparently the mobility of users in a heterogeneous network with episodic connectivity.

- **Points to resolve:**
  - Service continuity between infrastructure, ad hoc and DTN networks
  - Reliable and secure communications
  - Design adequate congestion control mechanisms
Episodic Connectivity

- **First results:**
  - Protocole MeDeHa: Support of service discontinuity between infrastructure WiFi and ad-hoc networks
  - Heuristics to enhance routing in DTN

- **Objective:**
  - Adaptive routing mechanism for infrastructure, MANET and DTN networks
  - Tested in INRIA and UCSC testbeds

- **Collaborations:**
  - Associated team COMMUNITY avec UCSC
  - ETH Zurich
Content sharing in wireless ad-hoc networks

- A fully distributed network of wireless devices
- No infrastructure
  - Devices connected by wifi in ad hoc mode
- Sharing content:
  - Looking for content in the devices of others
  - Once found, share the content with others
  - Can be seen as BitTorrent in the Internet but adapted to wireless
    - Share with close devices to reduce resource consumption
    - Seeds take in charge the dissemination of the content in the network
BitHoc: Our solution for content sharing

- Available for download at http://planete.inria.fr/bithoc/
- Available for windows mobile

Main window

Real time control
BitHoc: Our solution for content sharing

- Publishing a content and searching for it
2. Network Security

- RFID security & privacy
- Wireless sensor network security
- Future Internet security
Network Security

- Embedded System Security
  - RFID Security and Privacy
    - Private Identification Protocol
    - Efficient Key exchange
  - WSN Security
    - Key establishment
    - Secure Aggregation
    - OS Security
      - Virus/worm
      - Code attestation
- Applications
  - CIP protection
  - Urban sensors
Network Security (2)

- Future Internet Security/ CyberSecurity
  - Objective1: Understanding current cyber-attacks/fraud, underground economy, Internet weaknesses.
    - Botnet monitoring
    - Localization of hidden malicious servers
    - Localization of TOR hidden servers
  - Objective2: Contribute to the Future Internet Architecture.
    - Secure positioning
    - Secure broadcast
    - OCN: Owner-Centric Networking
Owner-Centric Networking

**Main Motivation**
- When you publish on the Internet you lose control of your data
- Think of Facebook users in 10 years!

**Main ideas**
- Users publish their contents but keep control
- Can at anytime retrieve to modify or withdrawn

**OCN Principles**
- Users publish their contents on servers that they control
- Users exchange links, not contents!
- Users can only access documents via the links, cannot copy unless authorized
- At anytime, users can modify their contents...
You have received an OCN email from Claude Castelluccia.

To read it, click on this link:
http://planete.inrialpes.fr/~ccastel/ocn.txt

Thanks for using the OCN-email service.
3. Network Monitoring

- Troubleshooting of network anomalies
  - End to end or
  - Network solutions
Efficient solutions for network and traffic monitoring

- **Network troubleshooting**
  - I am accessing a server.
  - There is a problem.
  - How can I localize the problem? From me? From the server? In the middle? How important is the anomaly?

- **Traffic classification**
  - Applications encrypt their traffic.
  - Can one use the packet size and time between packets to know the origin of each stream? Web, FTP, SMTP, etc.
Network-wide traffic monitoring

- Given a large network as GEANT. Operator interested in some OD flows. Where to place monitors? How much to collect in each monitor?
Experimental Environment for future Internet architecture

- Mathematical modeling
  - Difficult to have “tractable” models

- Simulation (e.g. NS) is useful but not sufficient
  - Fast & “cheap”
  - Reproducible
  - Controllable
  - Not realistic networking conditions and code
4. Experimental testbeds

- Physical “research” testbeds
  - Local
  - Wide Area
    - Real networking stack
    - Controllable routers
    - Artificial networking conditions

- Overlays

- Virtual testbeds
  - PlanetLab, OneLab
  - Realistic networking conditions (to some extent)
  - Not controllable & Non reproducible
PlanetLab

- 815 machines spanning 405 sites and 35 countries
  nodes within a LAN-hop of > 2M users
- Supports *distributed virtualization*
  each of 350+ network services running in their own *slice*
Experimental Environment for future Internet architecture

- An integrated validation chain
  - Realistic models
  - Scalable Simulations
  - Controllable Experimentation

- A rigorous benchmarking methodology
  - Environment representation
  - Experiments results storage and comparison
Experimental Environment for future Internet architecture

- Federating Research Testbeds
- Adding more heterogeneity to the PlanetLab testbed
- Making easier Experimentation
- Enhancing network simulations
Revisiting Protocols Evaluation

- Leverage on our experience on NS3 and Onelab
  - Experimental and simulation platforms
- Use collaboration with physicist
  - Non-linear/chaos theory

⇒ Revisit current protocols evaluation with new tools
  ⇒ Expect to find new surprising results
  ⇒ Make a methodological progress
Software

- NS-3 Simulator (www.nsnam.org)
- OneLab build of PlanetLab (www.onelab.eu)
- MultiCast Library Version 3
- LDPC large block FEC codec
- WisMon & Wextool
- WiMAX NS-3
- BitHoc
- ...

Main Collaborations

- **INRIA groups:** Maestro, Trec, Temics, Hipercom
- **French groups:** LIP6, ENSICA, EURECOM/GET, INLN, LIA, U. Evry, etc.
- **Industrials:** Ericsson, Nokia, SUN, Docomo, Expway, Hitachi, Alcatel, FT R&D, LGE, STM, Motorola, Intel, Netcelo, NEC, Boeing, etc.
Planète project team

http://planete.inria.fr