3868

NETWORK

IBBT

Internet on Train
Architecture for service continuity

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Overview

- Introduction
- Bandwidth requirements
- TR@INS architecture
- MIP versus MMP-SCTP
- Conclusions

Introduction – Demands

- Need for broadband applications in car, train,...
  - broadcast information (TV-like)
  - interactive multimedia (videoconferencing, gaming, ...)
- High density users who demand high bandwidth and high QoS

Introduction – Trends

- Internet on the train
  - rising concept
  - trials in several countries
- Deployment of new wireless technologies, but ...
  - no complete coverage
  - roaming is expensive

Introduction – Needs

- Need for an architecture that combines
  - broadband access
  - seamless handover
  - Quality of Service guarantees
  - scalability

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Introduction – Our work

- Estimation of BW requirements for train
- Proposal of a new architecture to satisfy the needs of an broadband internet-on-train network
- Comparison of two possible inter-working mobility solutions
  - Mobile IP (MIP)
  - Mobile Multi-Path SCTP (MMP-SCTP)

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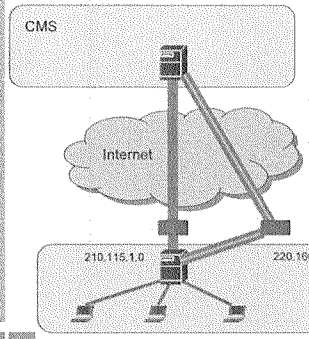
Services

- Passengers
  - Increase cell phone coverage
  - Best effort
    - Email, Surfing, VPN, Chatting
  - Streaming
    - Music, Video
  - Interactivity
    - VoIP, Video phony, Gaming
- Crew
  - High priority
    - CCTV, Crew communication, M2M

Increasing bandwidth requirements

Architecture – MMP-SCTP

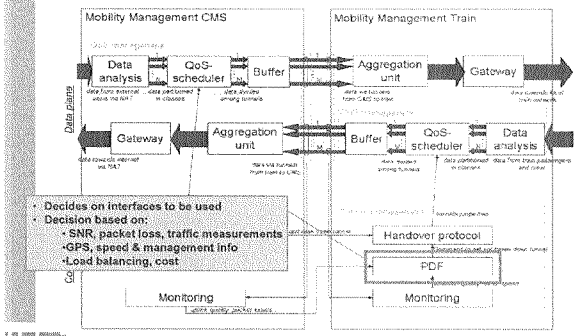


SCTP (Stream Control Transport Protocol)
- reliable transport protocol on top of a potentially unreliable connectionless packet service
- selective acknowledgements (SACKs)
- multihoming

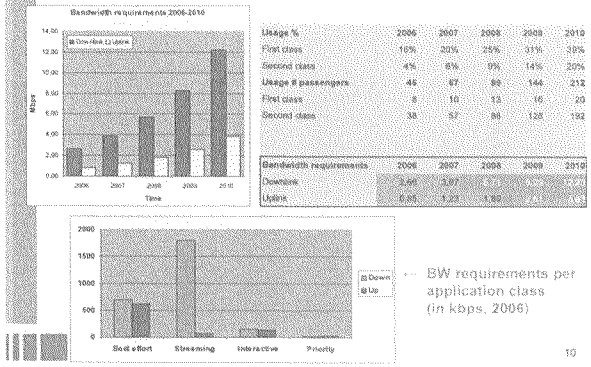
mSCTP (mobile SCTP)
- support of dynamic address reconfiguration

Mobile Multi-Path SCTP (MMP-SCTP)
- uses multiple links simultaneously for data transfer
- seamless handover for mobile hosts that are roaming between IP networks

Architecture



Bandwidth requirements

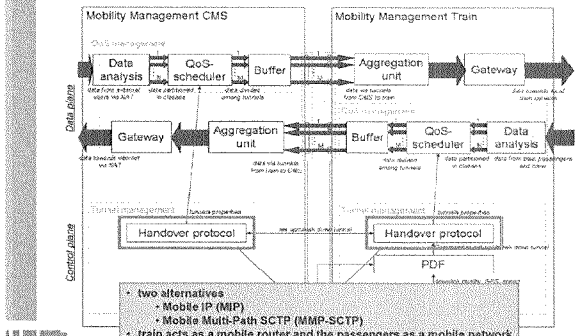


- BW requirements per application class (in kbps, 2006)

Overview

- Introduction
- Measurements
- Architecture
- **MIP versus MMP-SCTP**
  - Overhead
  - TCP performance without handover
  - UDP performance with predicted handover
  - UDP performance with unpredicted handover
- Conclusions

Architecture

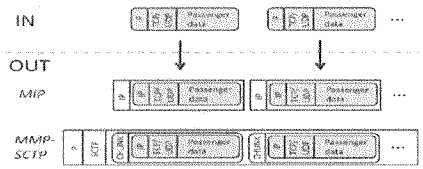


Overview

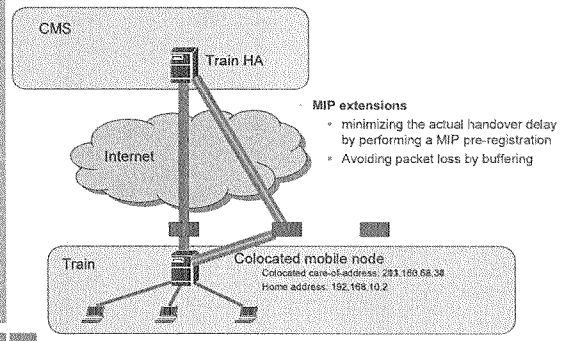
- Introduction
- Bandwidth requirements
- **Architecture**
  - PDF
  - Mobility management
  - MIP
  - MMP-SCTP
- MIP versus MMP-SCTP
- Conclusions

MIP versus MMP-SCTP - Overhead

- **both protocols involve overhead in order to ensure transparent mobility to the user**
- **IP packets are encapsulated in MIP or MMP-SCTP packets**

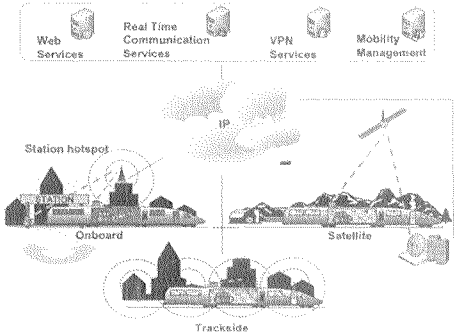


Architecture – MIP

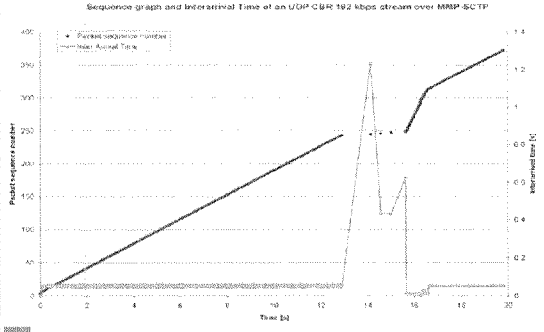


MIP extensions
- minimizing the actual handover delay by performing a MIP pre-registration
- Avoiding packet loss by buffering

Architecture



UDP performance with unpredicted handover for MMP-SCTP



Overview

- Introduction
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- Architecture
- MIP versus MMP-SCTP
- **Conclusions**

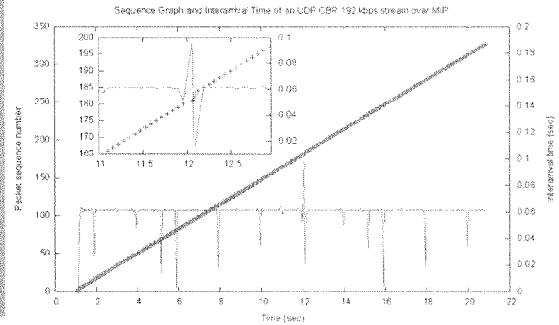
Conclusions

- **Proposed architecture can satisfy the needs for an internet-on-train network**
- **MIP versus MMP-SCTP**
  - MIP and MMP-SCTP are both able to handle predicted handovers seamlessly
  - MMP-SCTP has a higher overhead than MIP
  - MMP-SCTP has built-in reliability which is beneficial in case of abrupt handover

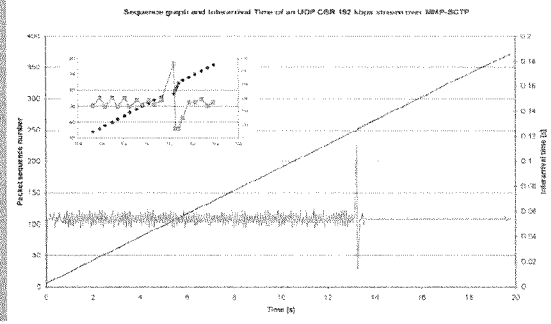
MIP versus MMP-SCTP - UDP performance with handover

- **Iperf generates downlink UDP traffic towards passenger at 192 kbit/s with payload of 1300 bytes**
- **Handover simulation between satellite and HSDPA**
- **MIP results:**
  - no packet loss
  - all packets arrive in order
  - inter-arrival time peaks and stabilizes again
- **MMP-SCTP results:**
  - no packet loss → no retransmissions
  - all packets arrive in order
  - inter-arrival time peaks and stabilizes again

UDP performance with predicted handover for MIP



UDP performance with predicted handover for MMP-SCTP



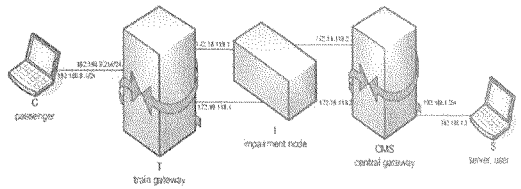
MIP versus MMP-SCTP - Overhead

- **Theoretical overhead calculation**
  - The ratio of the extra bits sent (the MIP or MMP-SCTP headers) to the total of bits sent without a mobility protocol

Passenger UDP or TCP payload	% Overhead			
	UDP		TCP	
	MIP	MMP-SCTP	MIP	MMP-SCTP
50	25,64	27,18	22,22	27,63
100	15,03	16,67	14,29	16,97
500	3,29	6,72	3,7	6,72
1000	1,95	5,30	1,92	5,30
1400	1,4	3,85	1,39	3,85

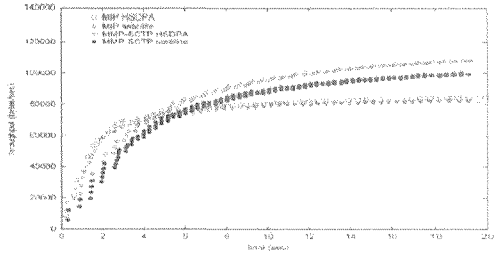
  - MMP-SCTP has more overhead than MIP

MIP versus MMP-SCTP – Testbed

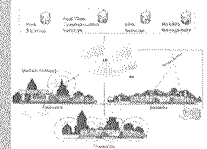


MIP versus MMP-SCTP - TCP performance without handover

Moving average of the throughput for TCP-traffic comparison between MIP and MMP-SCTP without handover



IBBT TR@INS project



- Partners
  - IBBT-partners
    - UGent - IBCN
    - UGent - MICT
    - UAntwerpen - PATS
  - Industrial partners

televic | Nokia Siemens Networks | Newtec

- Manpower effort
  - 26 MY
- Budget
  - 2.7 M€
- Duration
  - April 2006 – March 2008

References

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16th IST Mobile & Wireless Communications Summit Budapest, Hungary 1-5 July 2007

HOME

- Summit Date: **1-5 July 2007**
  - Tutorials: **1 July 2007**
  - Summit technical program: **2-4 July 2007**
  - Workshops: **5 July 2007**

General Information

The Department of Broadband Infocommunications and Electromagnetic Theory of Budapest University of Technology and Economics, and the Scientific Association for Infocommunications, Hungary (HTE) cordially invite you to participate in the 16th IST Mobile and Wireless Communications Summit that will be held 1-5 July, 2007 at the University Congress Centre of Eötvös Loránd University, Budapest, Hungary.

The IST Mobile and Wireless Communications Summit is a major conference organized annually in Europe, sponsored by the European Commission. In 2007 it will be held in Budapest, capital of Hungary. It is the first time that the Summit goes to a Central-European country, new member state of the European Union.

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