

# Challenged Internet Access Network Technology Infrastructure

26. Treffen der  
VDE/ITG-  
Fachgruppe 5.2.4

Mobilität in IP-  
basierten Netzen

The Future of  
Broadband  
Wireless  
Between  
Feasibility and  
Profitability

2008-02-28



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[www.tzi.org](http://www.tzi.org)



- World-largest research project on wearable computing, [www.wearitatwork.com](http://www.wearitatwork.com)



- Open-Source Linux-based home theatre software for set-top boxes and home PCs, [www.freevo.org](http://www.freevo.org)

CHIANTI

- Challenged Internet Access Technology Infrastructure, [www.chianti-ict.org](http://www.chianti-ict.org)

scaleNet

- Scalable and converged multi-access operator's network architecture, [www.scalenet.de](http://www.scalenet.de)



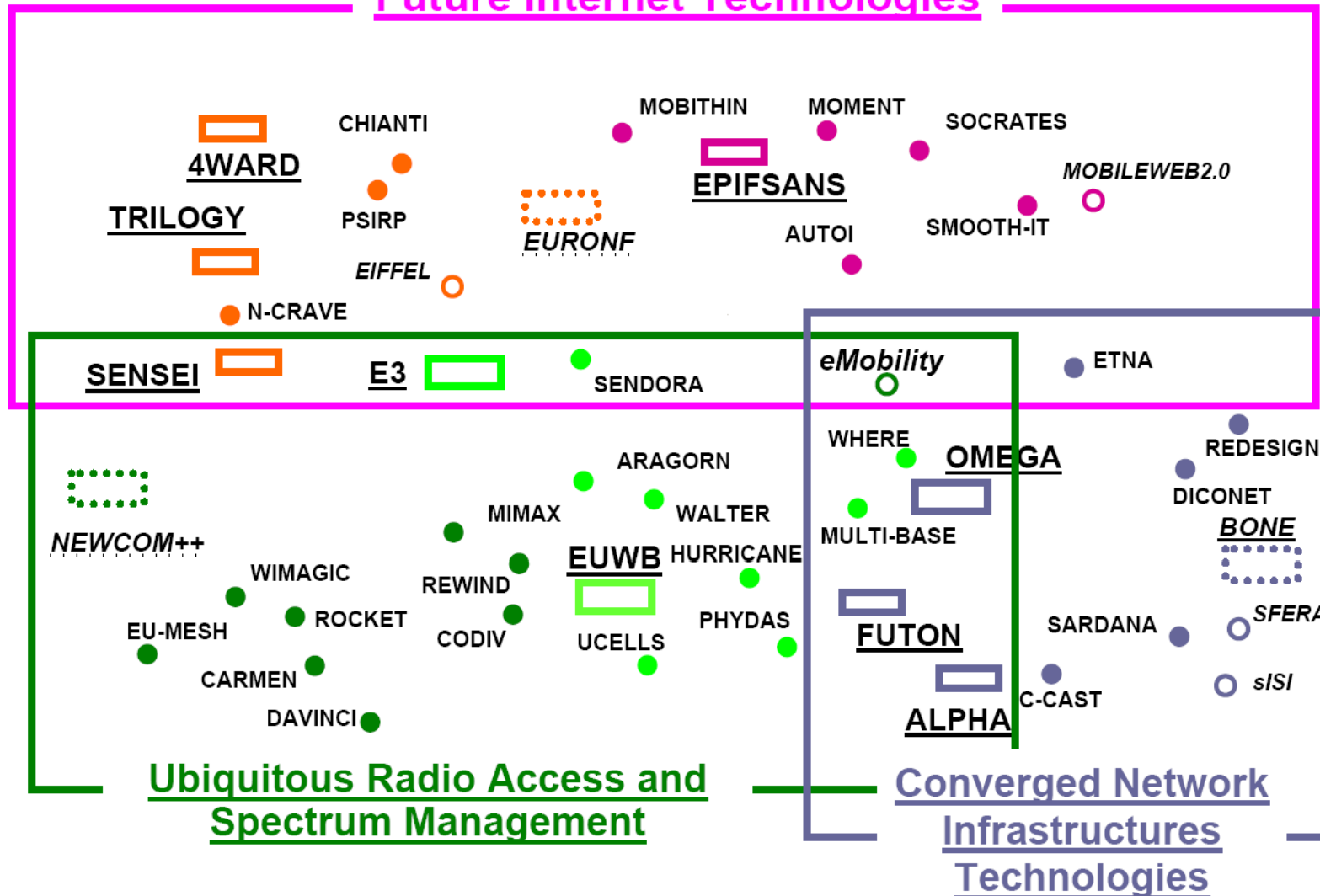
- Architecture and Design for the Future Internet, <http://www.4ward-project.eu>

# ICT Future Networks Projects



CHIANTI

## Future Internet Technologies



# Presentation Overview



CHIANTI

I. Why? — CHIANTI Motivation

II. What? — CHIANTI Approach

III. CHIANTI@TZI



CHIANTI – VDE/ITG-Workshop on The Future of Broadband Wireless  
2008-02-28

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# Why we need CHIANTI



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At the time the Internet was designed, end systems were:

- **Stationary**
- Interconnected through **permanent**, wired links.

At that time it was not a design objective:

- To support highly **mobile** hosts
- Or to **frequently switch** access technologies



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# Why we need CHIANTI



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But in future and partly already today:

- Nomadic and mobile hosts will dominate the market
- There is high demand for ubiquitous connectivity

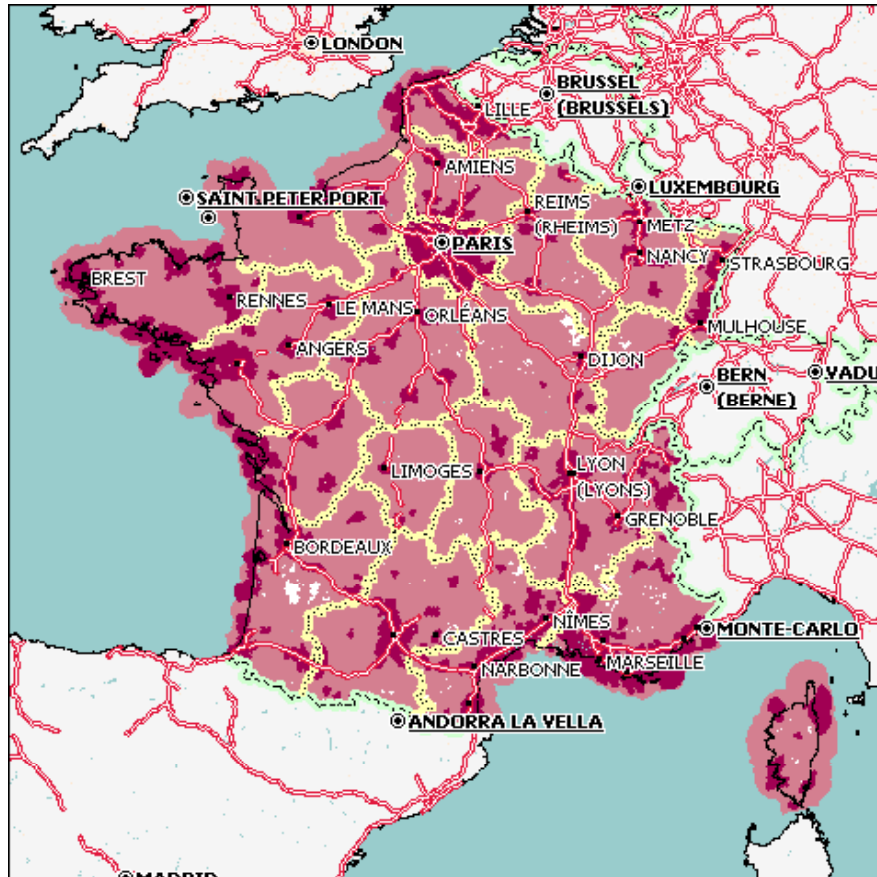
Still, in the foreseeable future, the goal of

- Providing "always connected" network access for mobile users **will not be met** as wireless links are always subject to limitations:
  - Geographical coverage,
  - Interference,
  - Obstacles on the radio link
  - Last but not least: economic reasons.

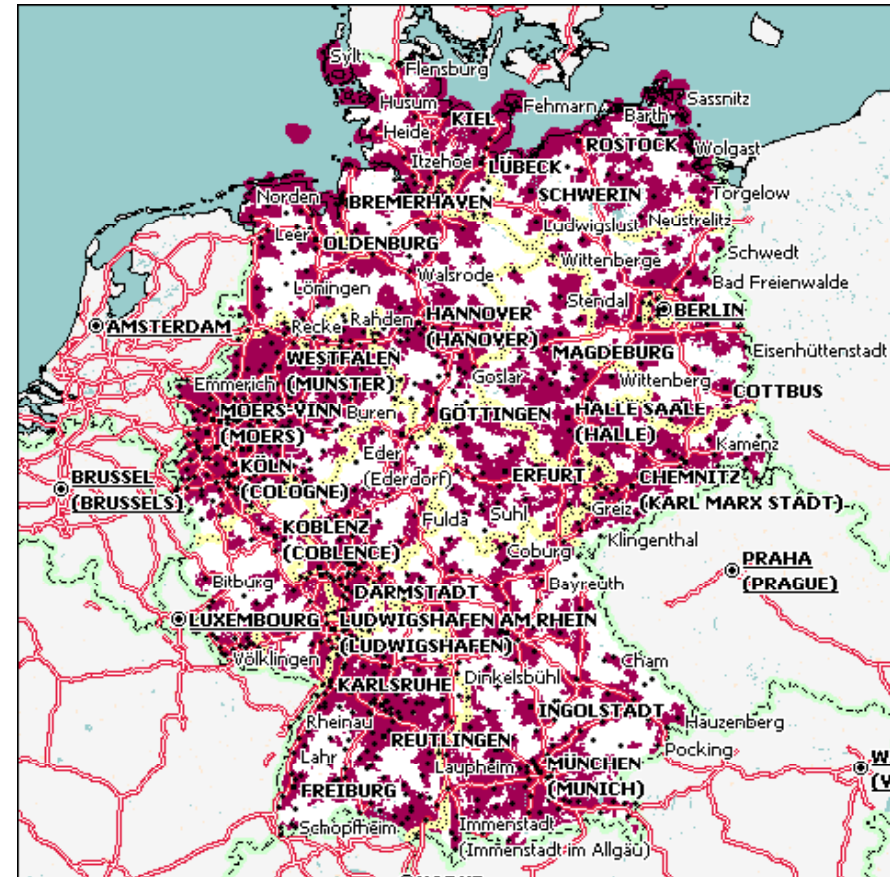


# Why we need CHIANTI

## Sample Geographic Coverage:



SFR network in France ( GSM + 3G )



Vodafone network in Germany ( 3G )

# Why we need CHIANTI

## Sample Geographic Coverage:

European multi carrier coverage (overlay / sum):



3G  
 GSM only

Source:  
GSM Association  
2007



# German Rail Long-Distance Rail Network



CHIANTI

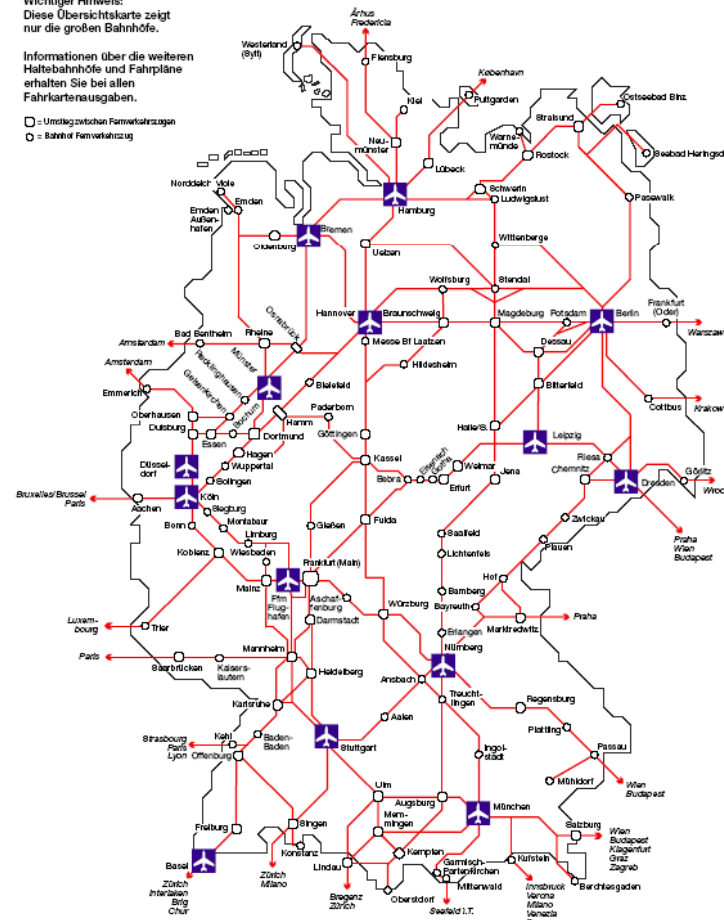
## Streckennetz DB-Fernverkehr allgemein



Wichtiger Hinweis:  
Diese Übersichtskarte zeigt  
nur die großen Bahnhöfe.

Informationen über die weiteren  
Haltebahnhöfe und Fahrpläne  
erhalten Sie bei allen  
Fahrkartenausgaben.

□ = Umstieg zwischen Fernverkehrszügen  
○ = Bahnhof Fernverkehrszug



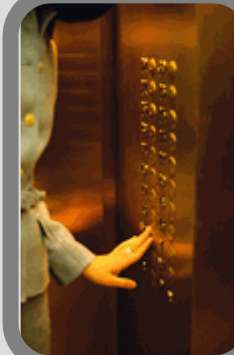
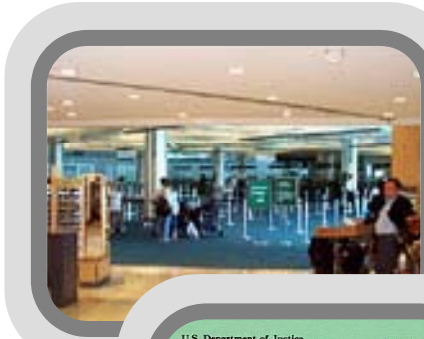
Stand: Januar 2003



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# The World is disconnected ...



U.S. Department of Justice  
Immigration and Naturalization Service

OMB No. 1515-0148

Welcome to the United States  
194W Nonimmigrant Visa Waiver Arrival/Departure Form

Instructions  
This form must be completed by every nonimmigrant visitor not in possession of a visitor's visa, who is a national of one of the countries enumerated in 8 CFR 217. The airline can provide you with the current list of eligible countries.

Type or print lightly with pen in ALL CAPITAL LETTERS. USE ENGLISH.  
This form is in two parts. Please complete both the Arrival Record, items 1 through 11 and the Departure Record, items 14 through 17. The reverse side of this form must be signed and dated. Children under the age of fourteen must have their form signed by a parent/guardian.

Item 7 - If you are entering the United States by land, enter LAND in this space. If you are entering the United States by ship, enter SEA in this space.

Admission Number  
783071273 08

Immigration and Naturalization Service  
Form I-94W (05-20-01) - Arrival Record  
VISA WAIVER

1. Family Name  
2. First Given Name  
3. Sex (Male or Female)  
4. Country of Citizenship  
5. Passport Number  
6. Airline and Flight Number  
7. Country where you are entering the United States  
8. City where you boarded  
9. City where you are leaving the United States  
10. Address of the United States contact person and phone  
11. City and State

Government Use Only

12. \_\_\_\_\_  
13. \_\_\_\_\_

Departure Number  
783071273 08

Immigration and Naturalization Service  
Form I-94W (05-20-01) - Departure Record  
VISA WAIVER

14. Family Name  
15. First Given Name  
16. Birth Date (day/month/year)  
17. Country of Citizenship

See Other Side  
Staple Here



... and will remain being disconnected.  
Even if perfect geographical coverage would be there...

# State of the Art / Ongoing Improvements



## Infrastructure

- Expanding 3G coverage
- Expanding Hot-spots
  - Wireless operators + community efforts
- Adding further networking technologies (WiMAX)
- Operator-based integration of access technologies (UMA)

## Systems and services

- Seamless mobility support at the lower layers
  - 3G, WLAN handoffs, mobile IP + optimizations
- Some transport and session layer mobility
- Rare selective support for application layer mobility only
  - E.g., SIP for multimedia applications
- Mostly reliance on mimicking fixed network connectivity in the mobile domain

The current state of the art is mainly lacking:  
- Integrated CROSS-LAYER improvement.  
- Taking application protocol (mis)design into account

# Mobile Applications



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- Many applications are asynchronous in nature
  - Theoretically no need for “always on” connectivity today
  - Examples: e-mail, file transfer, peer-to-peer, even presence and messaging
- Applications don't communicate most of the time
  - Users read, type, or do other things
  - Examples: web, e-mail, calendar, chat, presence, ...
- Users shouldn't have to perform “busy waiting”
  - Let the applications operate asynchronously and notify the user when done
  - Examples: (peer-to-peer) downloads, tabbed browsing, e-mail, ...

... regardless of whether mobile or not.



Application semantics do not require permanent or “end-to-end” connectivity...

...but many application protocols do.

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# CHIANTI Approach



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Instead of focusing on seamless connectivity:

**“Seamless service perception”**

In spite of non-seamless and non-ubiquitous connectivity.

Meta-goals:

- Making life easier for mobile users
- Making mobile work time efficient
- Reducing cost for mobile enterprises



# Deployability



CHIANTI

(It would be meaningless to develop solutions that then cannot be deployed.)

- Make use of the existing Internet
  - We cannot wait for the entire network to change itself.
  - CHIANTI augments the network by adding protocol instances in the (virtual) path
  
- ➔ Making immediate use of the CHIANTI technology possible.





- Make use of the existing **end user applications**
  - We cannot and do not want to force the end users to switch to new e-mail programs or web browsers.
- To immediately introduce CHIANTI technology.

## Result:

- Immediate commercial relevance
- CHIANTI will directly lead to an increase of efficiency and productivity for mobile users.

# Application Scenarios/Validation Setups



- Scenario 1: Mobile user aboard a train
  - Vehicular infrastructure-based with operator support
  - No additional support on user devices
  
- Scenario 2: Mobile user in road vehicles
  - Bus, car, ambulance
  - More opportunistic usage of connectivity
  
- Scenario 3: Nomadic use case
  - Standalone user support
  - End-to-end principle applies to user's device

# Application Scenarios (continued)



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Protocol scenarios:

- Mail transmission (SMTP) and retrieval (POP3)
- Web browsing (HTTP)
- Streaming (TCP/UDP)
- File download (FTP)
- Multimedia streaming
- CCTV (from trains to fixed networks)



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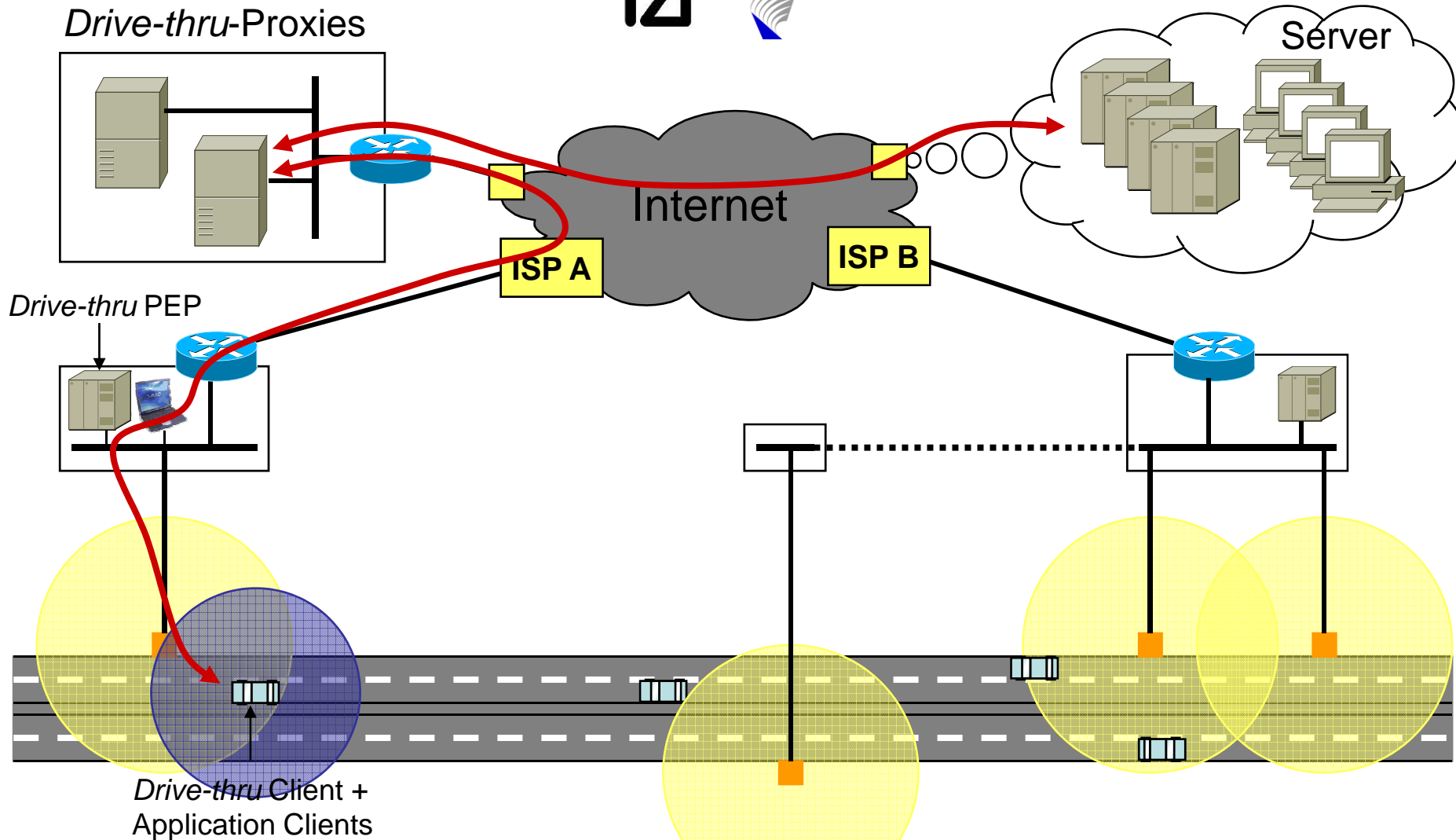
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# Experience: Drive-thru Internet



# Drive-thru Internet Architecture

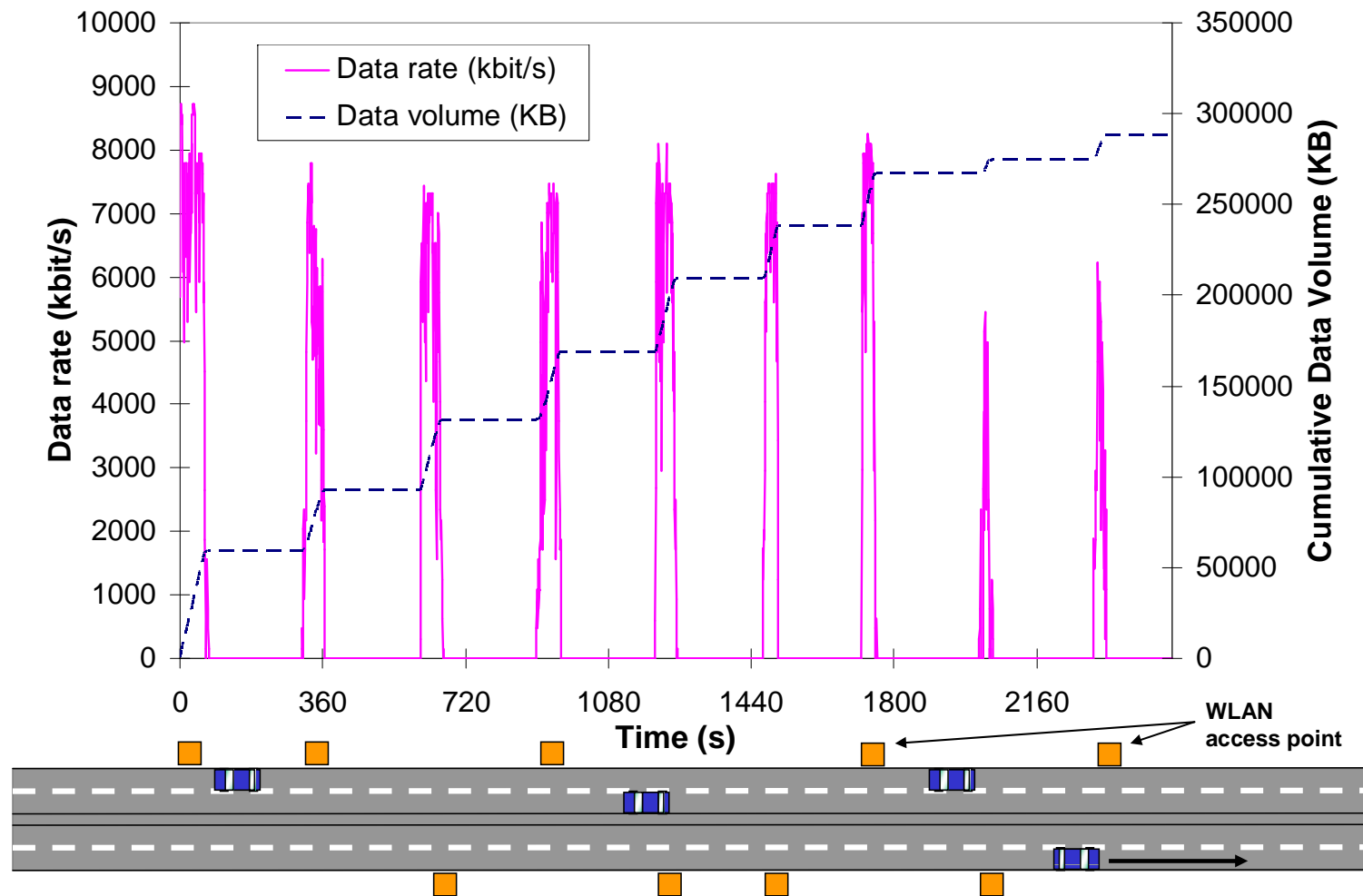


# CHIANTI Approach



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Data rate and as of today theoretical cumulative volume for intermittent connections.



Source:  
Drive-tru Internet project



# Nomad Digital: Connecting Trains



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## Southern



- 90km of WiMAX/ 3G track – 70% WiMAX / 30% 3G
- Passenger Internet Access provided by T-Mobile
- In commercial service for 2 years (since April 2005)

## Heathrow Express



- Launched April 2007 on all 14 trains – 4 and 5 car units
- WiMAX coverage in all tunnels – world first
- Passenger Internet Access provided by T-Mobile

## NS / KPN



- “Proof of concept” in trial with KPN for NS
- 350 trains to be installed in 2008
- Passenger Internet Access, in-car screens with “infotainment”, real-time PIS

>12 other projects are currently in development in UK and internationally – e.g. USA, Singapore, China, Malaysia, Dubai, Sweden, etc.

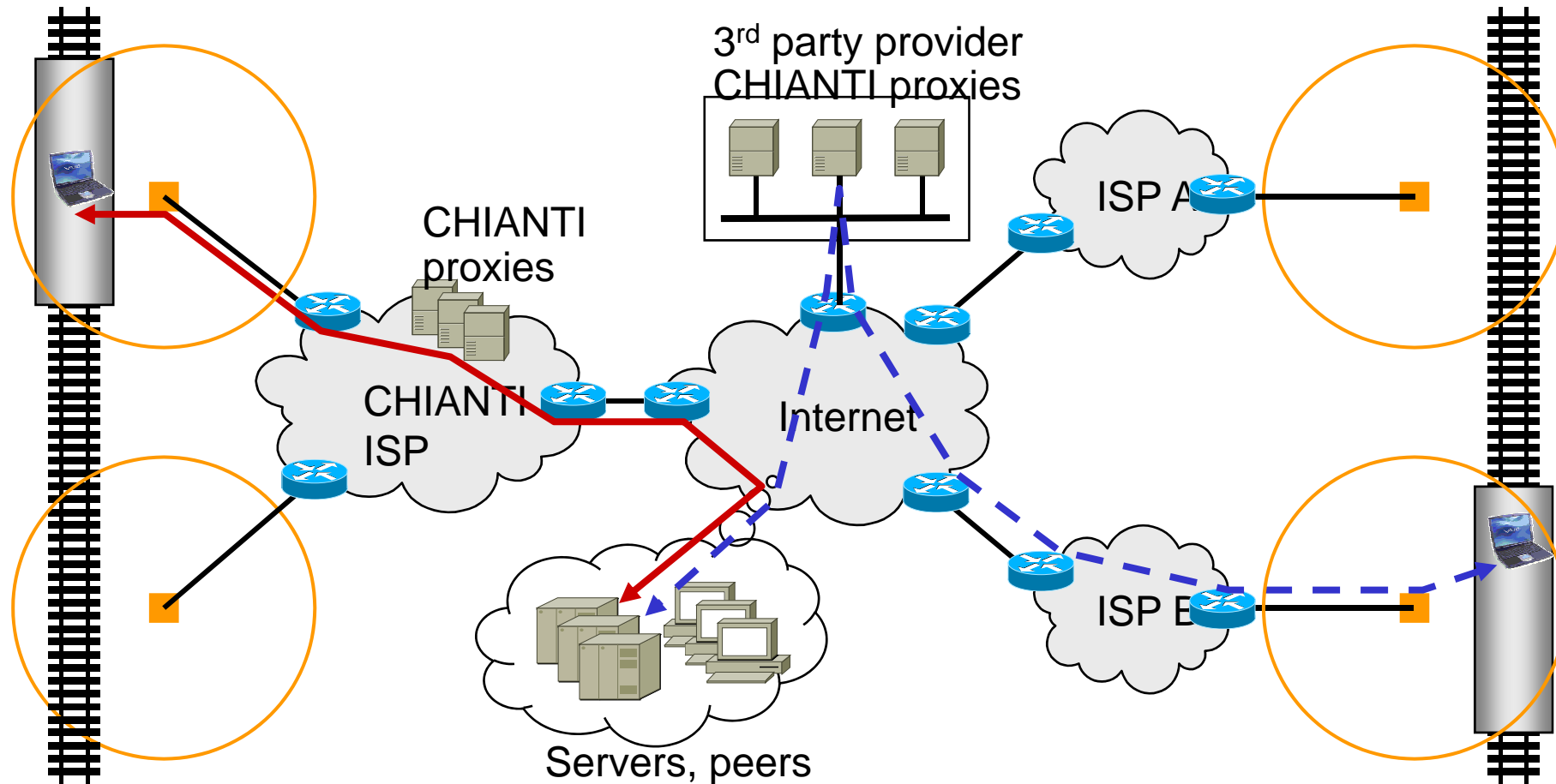


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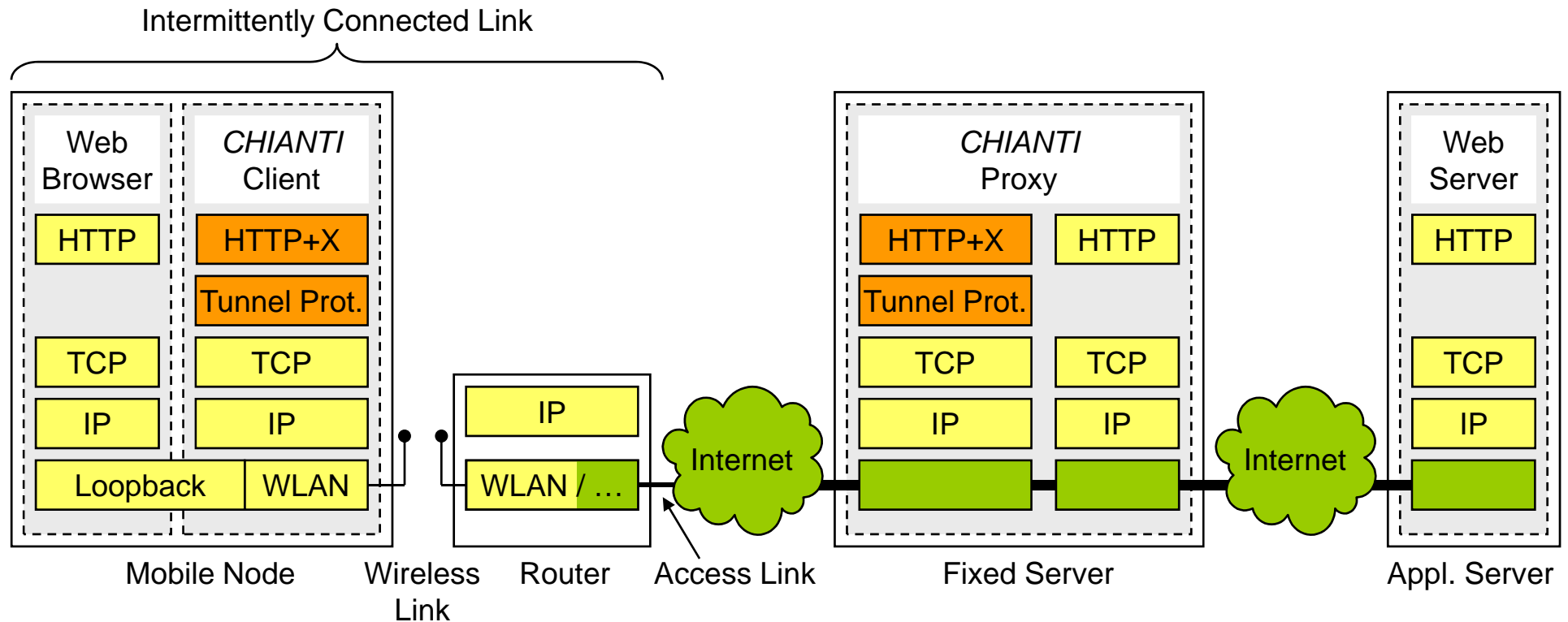
# Train Scenario





# System Architecture

(draft for nomadic use case)



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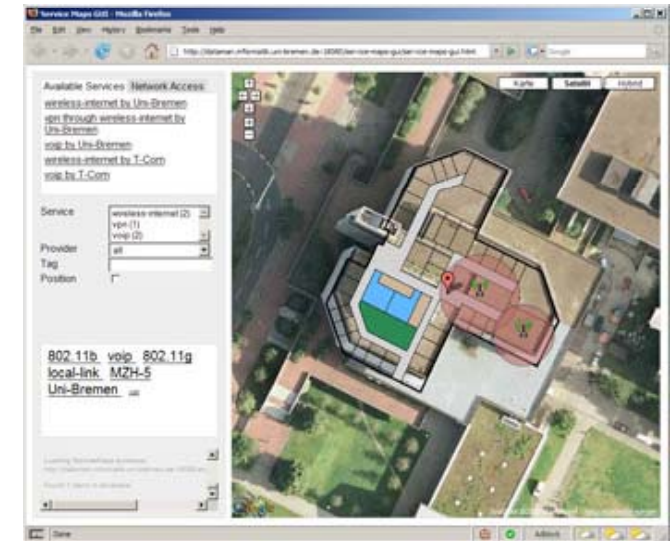
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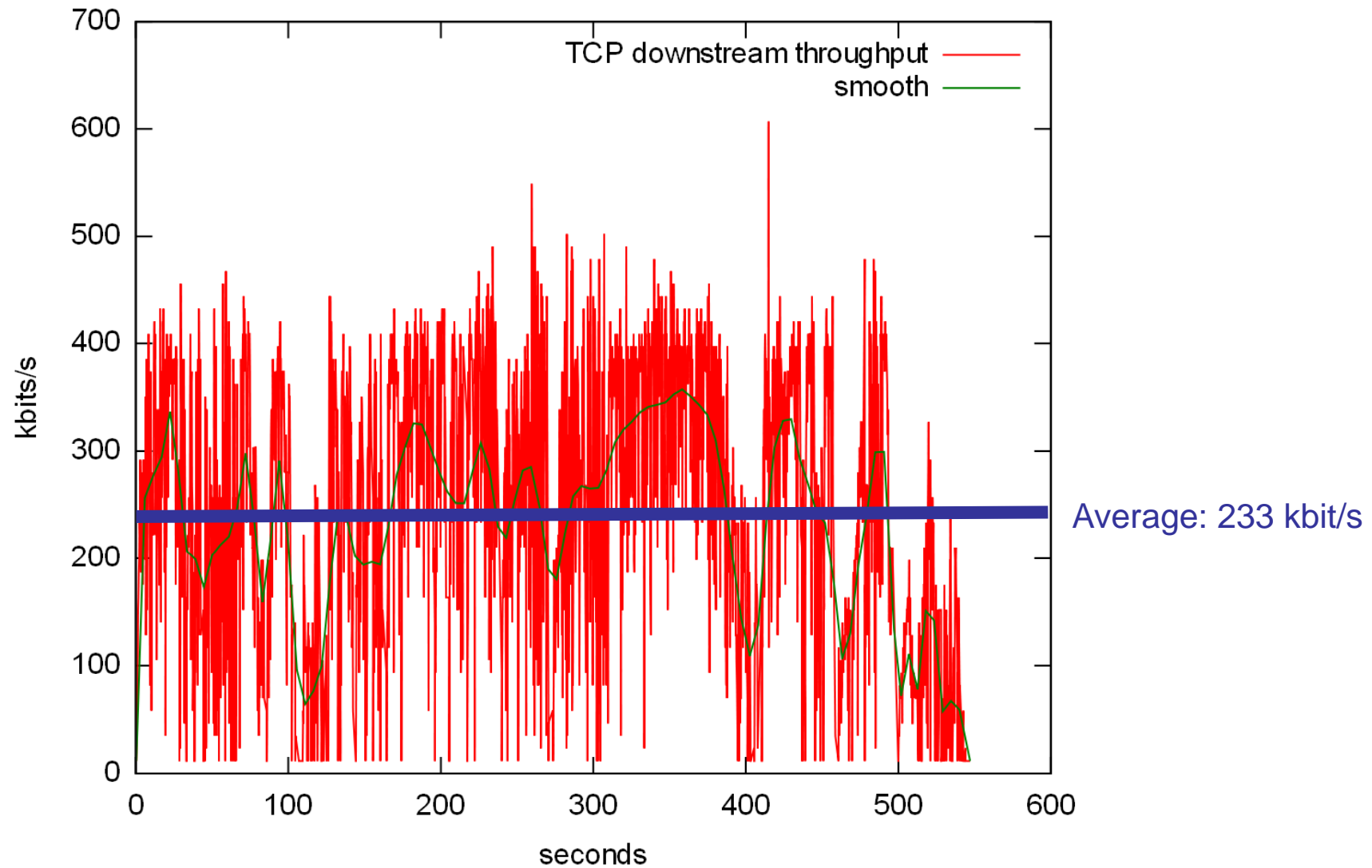
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# TZI Research Topics

- Analysis of use cases and business models
  - Analyze mobile communication usage patterns
  - Technical and economic roles
- Protocol analysis and development
  - Measurements of (transport) protocol performance
  - Traffic traces for modeling and simulating communication patterns
  - Development and evaluation of robust transport protocols
- Architecture design
  - CHIANTI support functions wrt to Future Internet concepts
  - Adapting to challenging network conditions: from robust channel coding to DTN
  - Security: from transport security to transaction security
- Application Development
  - Disconnection tolerant application design for better perceived connectivity
  - Robust media-streaming



# UMTS-HSDPA in practice



# Vehicular Measurement Platform



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<http://dev.tzi.org/retrospectiva/projects/measurements>

The screenshot shows a web browser window displaying the 'retrospectiva' website. The page title is 'blog . retrospectiva - Minefield'. The address bar shows the URL 'http://dev.tzi.org/retrospectiva/projects/measurements/blog'. The website has a dark header with the 'retrospectiva' logo and a 'measurements' sub-header. A navigation menu includes 'Blog', 'Wiki', 'Changesets', 'Browse source', 'Milestones', 'Tickets', 'New ticket', 'Search', and 'Projects'. The main content area features three blog posts:

- Fixed client HSDPA reference measurements**  
Posted by Dirk Kutscher on Feb 26 2008  
I have checked in a one-minute UMTS-HSDPA reference measurement using a fixed client with optimal reception conditions (100% signal strength) measuring TCP downstream throughput.  
The client software (as for all previous UMTS measurements) was Vodafone Mobile Connect V.9.2.1.0545.
  - <https://dev.tzi.org/repo/projects/measurements/080226-02/>
  - [Throughput graph](#)Categories: [measurements](#), [data](#), [UMTS](#), [fixed](#) | 0 comments

- UMTS measurements on Northern German Autobahn/highways**  
Posted by Dirk Kutscher on Feb 26 2008  
I have checked in a first set of UMTS in-car measurements from a 40 minute car ride in Northern Germany, assessing TCP downstream throughput. The route includes local highway (first 20 minutes) and Autobahn segments.  
[Read more...](#)  
Categories: [measurements](#), [data](#), [UMTS](#), [car](#) | 0 comments
- UMTS measurements in local train in Northern Germany**  
Posted by Dirk Kutscher on Feb 25 2008  
I have checked in a first set of UMTS in-train measurements from a 40 minute train ride in Northern Germany, assessing TCP downstream throughput.  
[Read more...](#)  
Categories: [measurements](#), [data](#), [UMTS](#), [train](#) | 0 comments

At the bottom, there is a 'Previous page | 1 2 | Next page' link, an 'RSS Feeds' icon, and a search bar. The footer of the website indicates it is 'Powered by retrospectiva'.



# Service Guides for Mobile Users

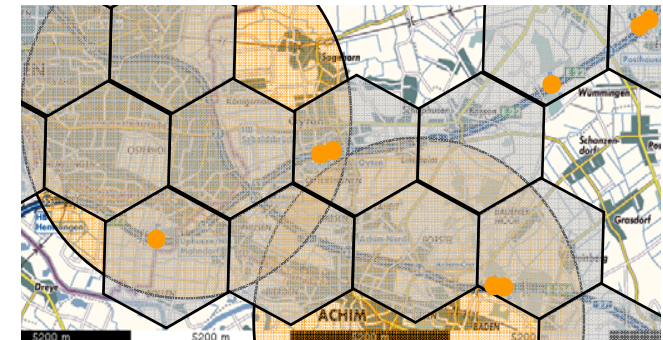


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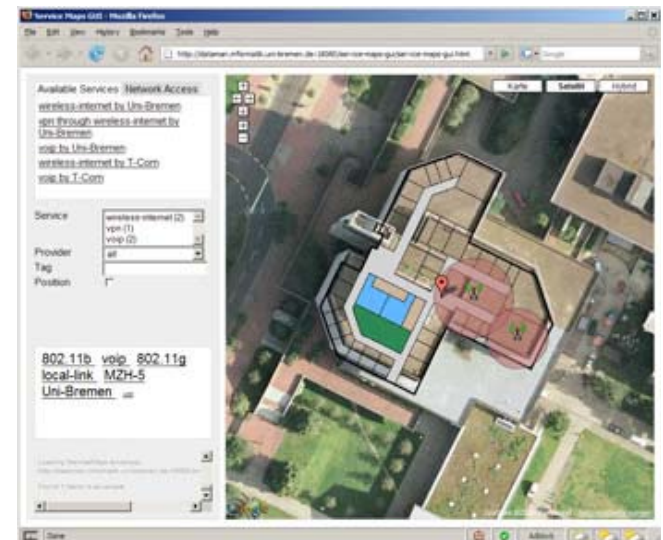
## ▶ Network Service Maps [www.service-maps.net](http://www.service-maps.net)



- ▶ Distributing network service information over wide-area broadcast networks
- ▶ Enhancing network selection and handover processes
- ▶ Most networks provide additional transport/application layer services that should be made available
- ▶ Example: WiFi-Voice (VoIP in 802.11 networks)
  - Advertising services (for supporting network selection)
  - Describing service parameters, e.g., SIP configuration (local proxy, operator's registrar)
- ▶ Network access is just a specific service amongst others
  - Local access may be used to implement higher-layer services
  - Internet access, media broadcast, local web access, video-on-demand etc.



- IEEE 802.16 coverage zone
- ⬡ 3G cell
- 802.11 WLAN hotspot



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