



Collaborative Sharing of Quality of Service Information for Mobile Service Users

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mobihealth[®]
putting care in motion

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Presentation Layout

- Problem Description
 - QoS-requirements vs. QoS-provisions, state-of-the-art solutions, identified challenge and research objectives
- New Approach: Collaborative Sharing of QoS-information
 - system design
 - case study: feasibility assessment in a mobile healthcare domain
- Conclusions
 - novelty
 - current and future research focus

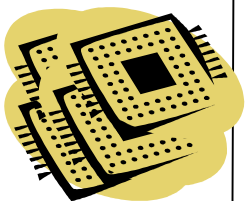


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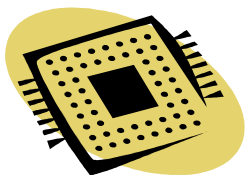
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User Computing Trends

Computers



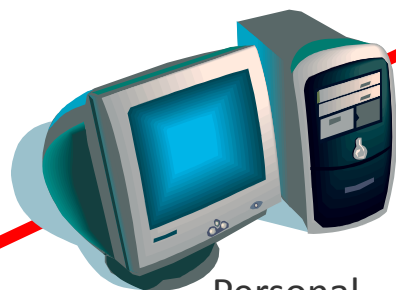
Many



One



Timesharing



Personal
Computer



Personal
Devices



Many

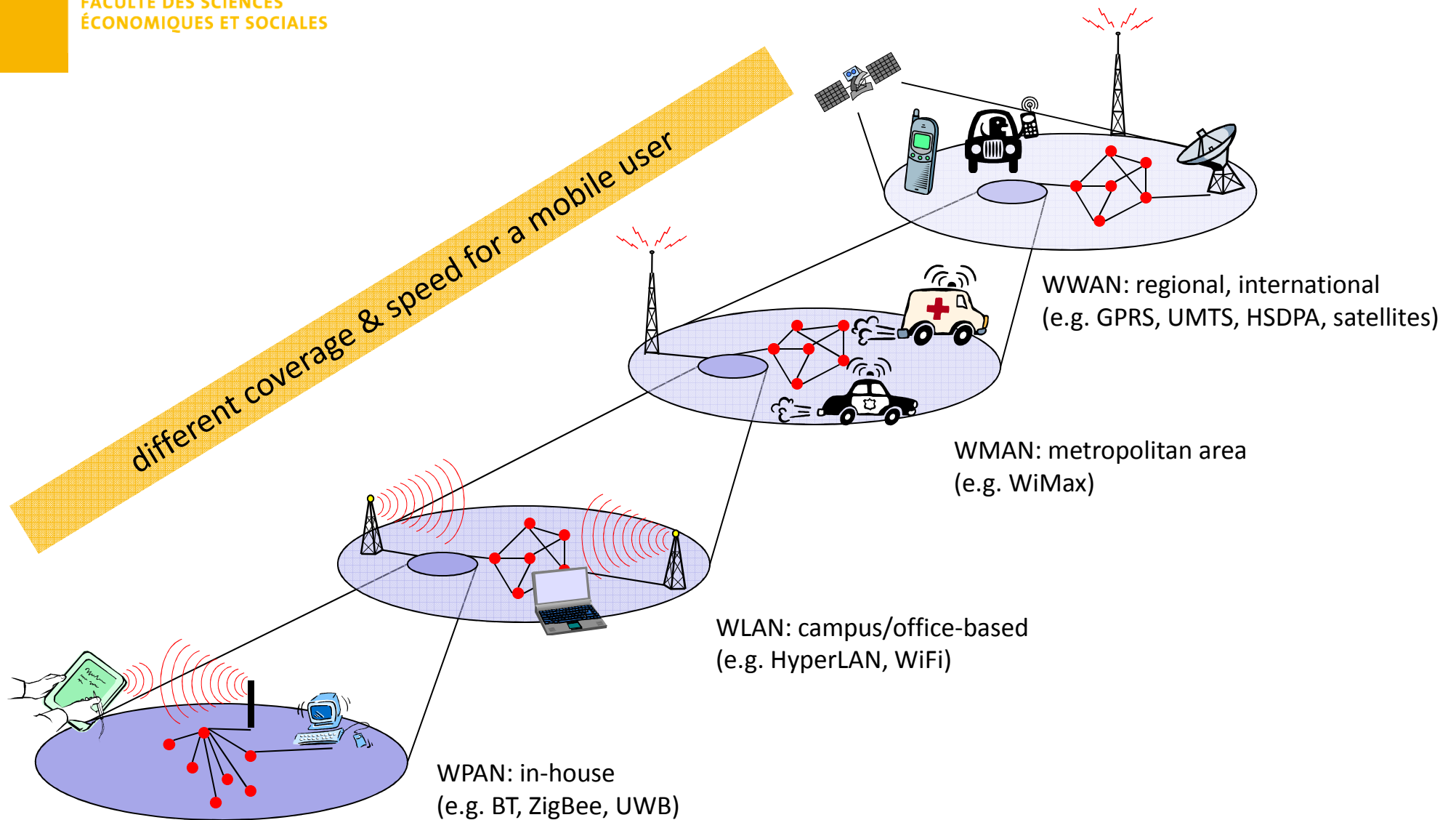


One

Persons



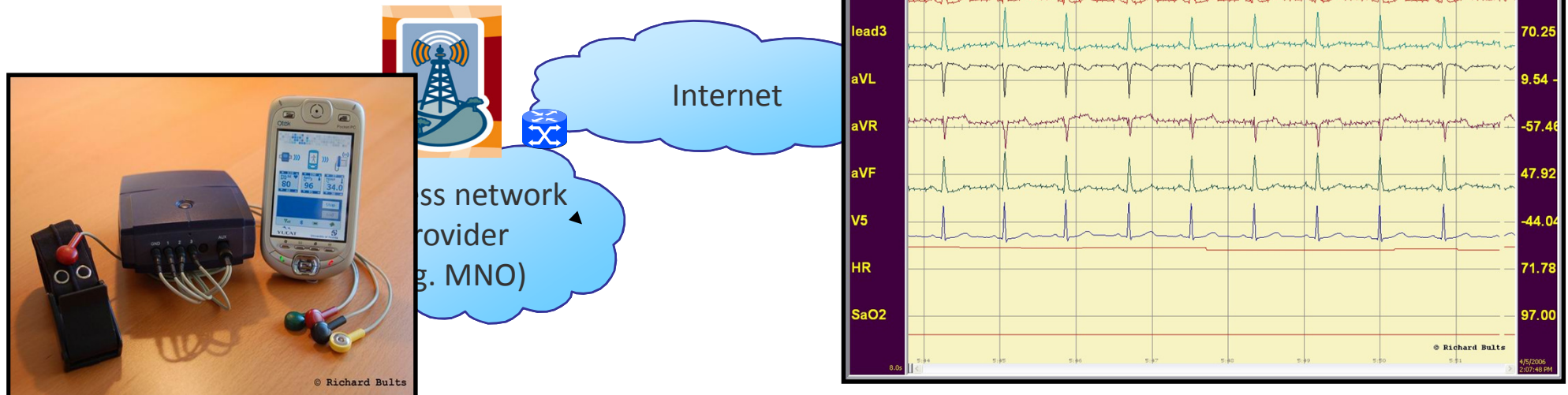
User Mobility Trends





Mobile Service

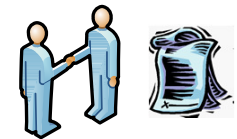
- example: health telemonitoring and teletreatment service



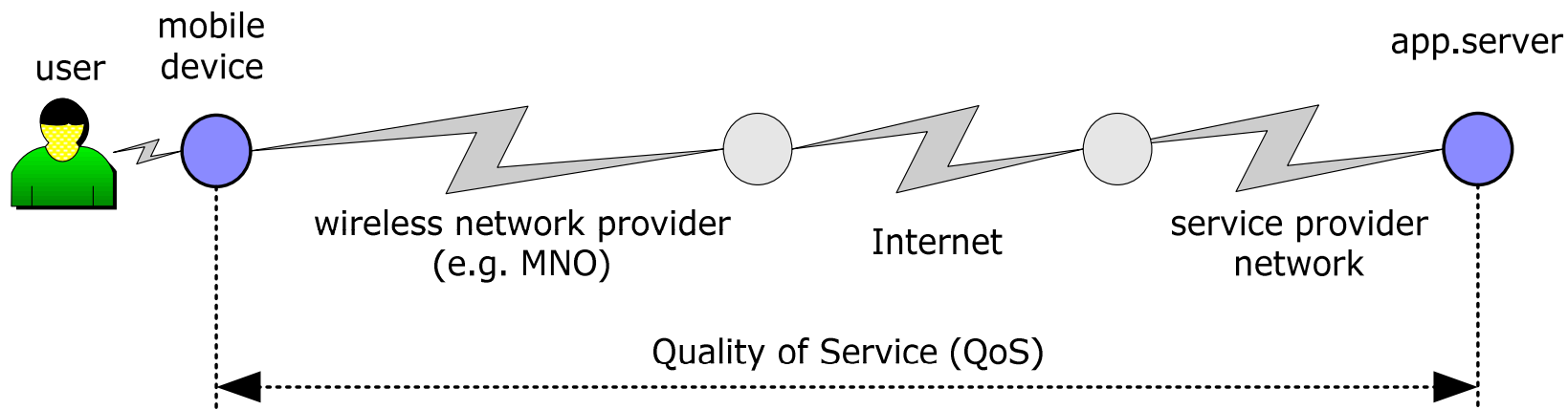


Quality of Service

- Quality of Service (QoS)
 - “collective effect of service performances which determine the (*objective*) degree of satisfaction of a user” (ITU-T, 1993)
 - QoS requirements and QoS provisions expressed *quantitatively* in terms of criteria
 - e.g.: speed, accuracy, dependability, security level and monetary cost



Service Level
Agreement (SLA)





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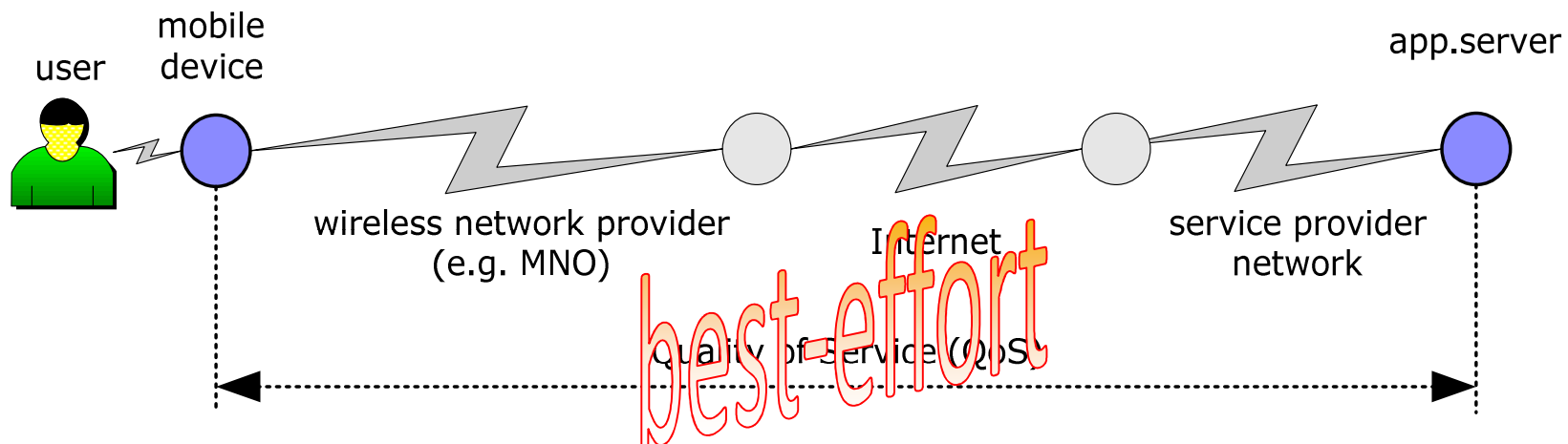
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Problem Description



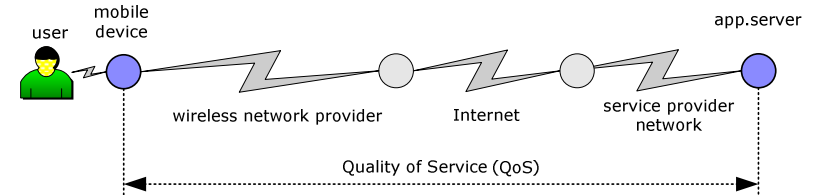
Required QoS vs. Provided QoS

- Success of service delivery depends on QoS provided by underlying heterogeneous networking environment
 - QoS requirements can change anywhere-anytime, e.g. patient's emergency
 - QoS provisions can change anywhere-anytime, e.g. highly mobile user





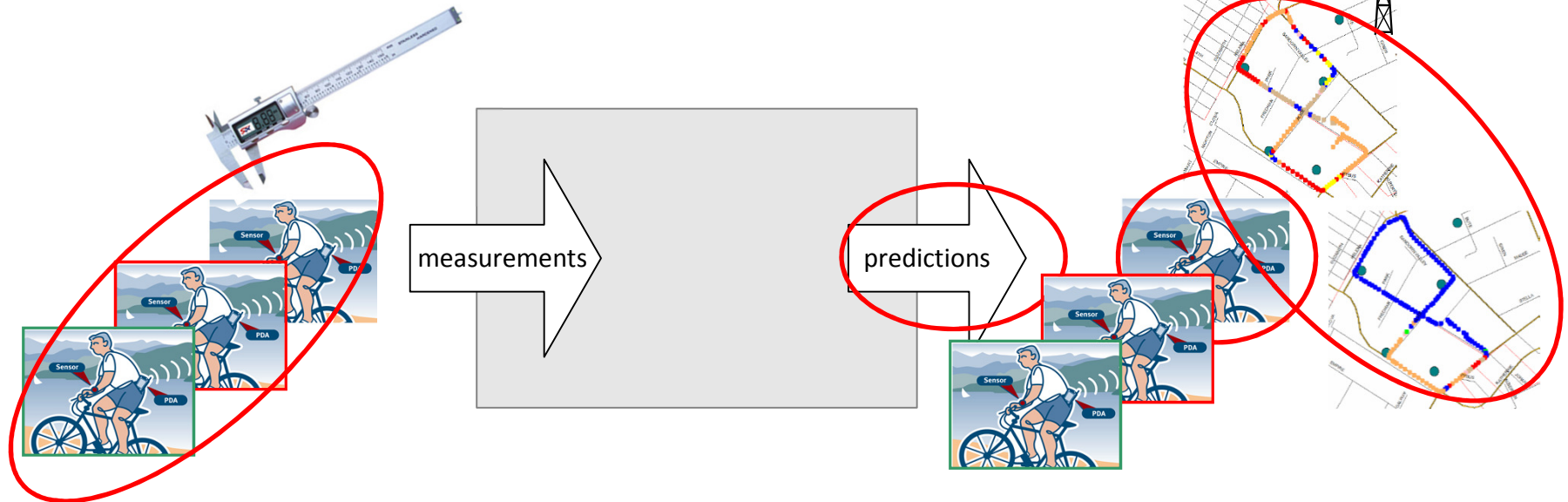
State-of-the-art



- traditional QoS-management
 - e.g. admission control, resource negotiation/reservation
- Mobile Network Operators
 - user 'lock-in'
- service providers
 - non-interactive applications e.g. mobile gaming
 - proprietary application-protocols, details concealed e.g. Skype
- identified challenge : user-centric approach
 - monitor 'best-effort' QoS > quantify patterns > predict 'best-effort' QoS



Research Objectives



1. novel system: requirements and design
 - collaborative sharing of QoS-information for mobile users (Mobile Web 2.0 paradigm)
 2. predictions feasibility assessment
 - collect extensive set of measurement data at user device
 - test hypothesis of collaborative QoS-information sharing by mobile users
- based on the above - point to a possible QoS-management framework



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System Design

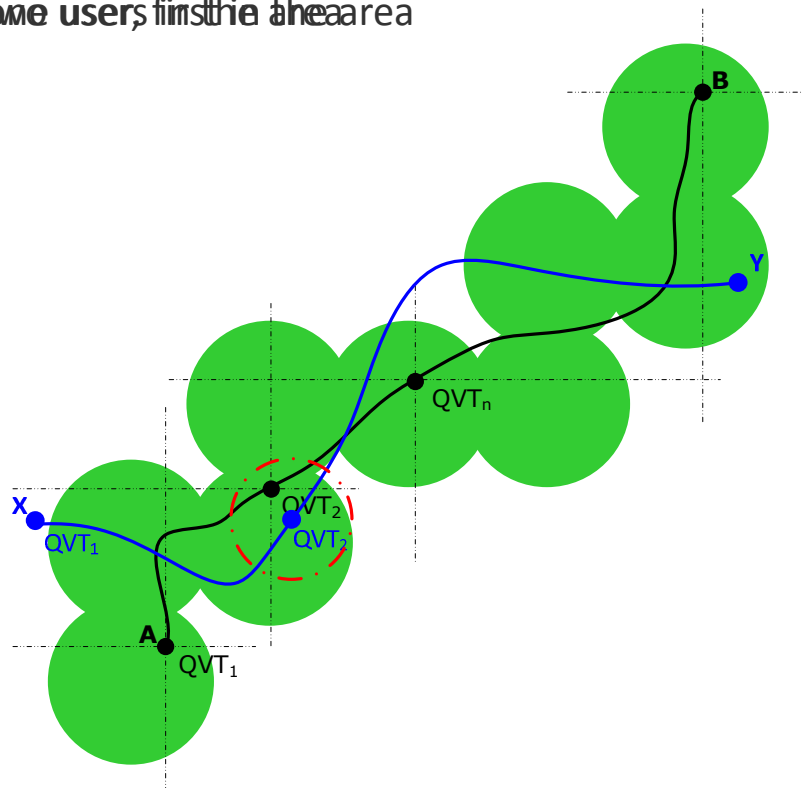


Collaborative Sharing of Information

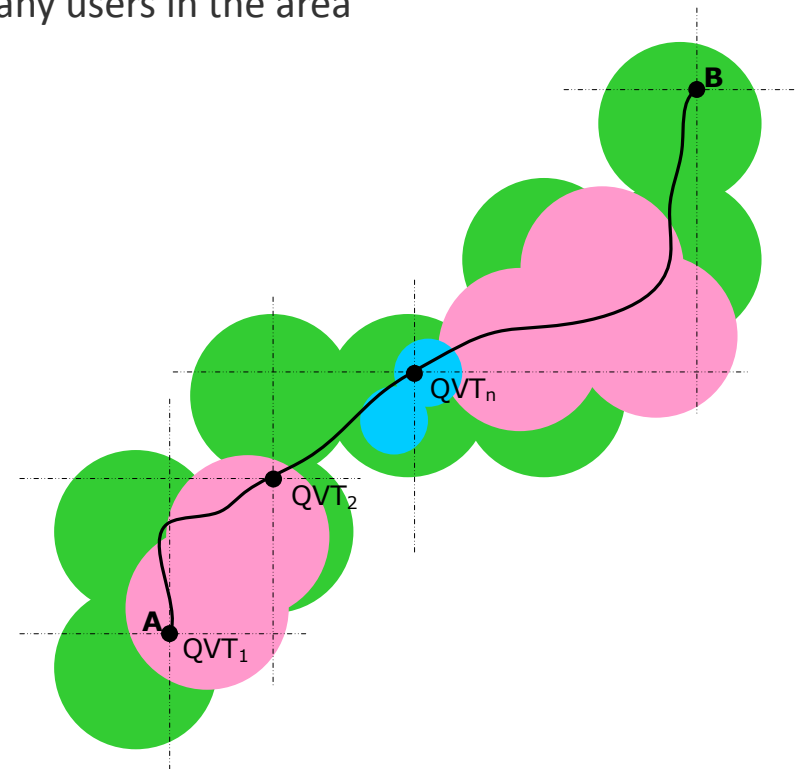
- QoS Virtual Tags (QVT): encapsulates measurements and predictions information



one user in the area

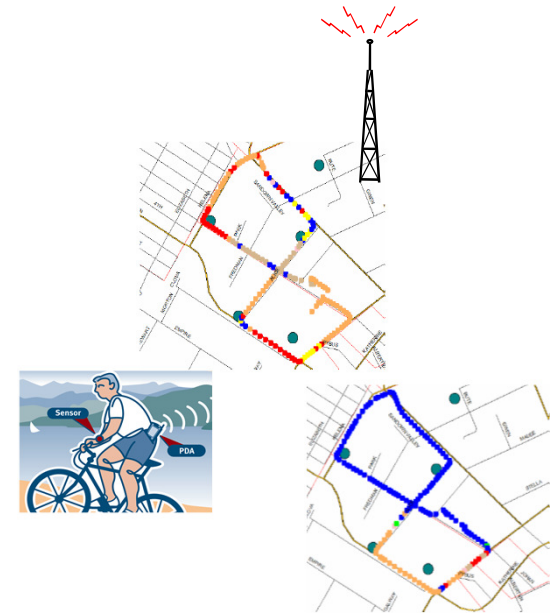
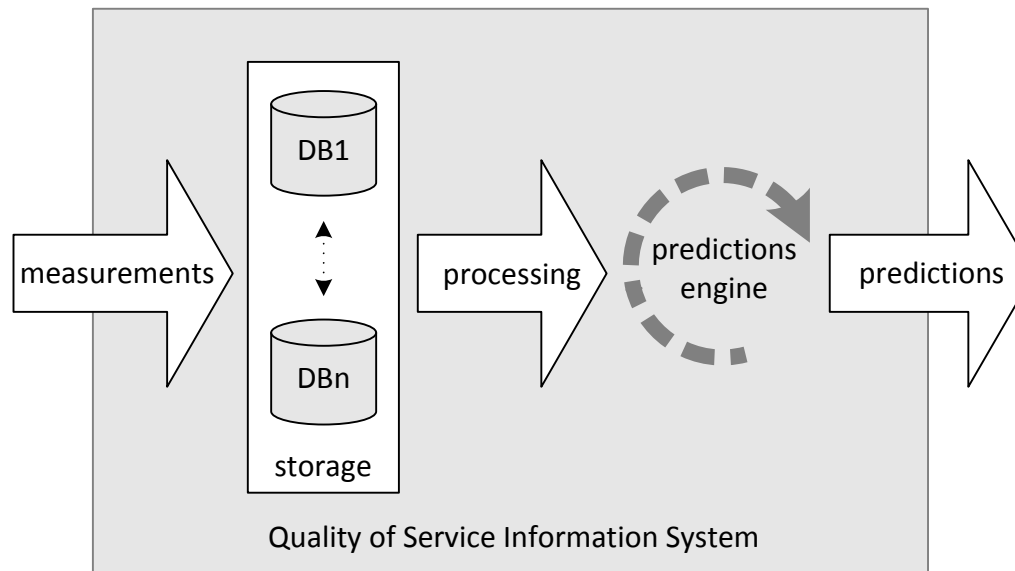
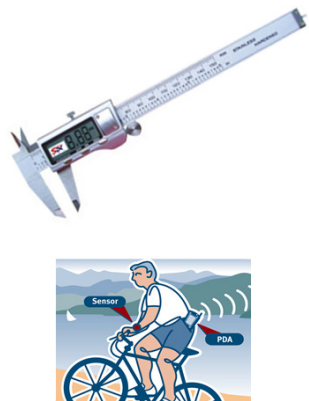


many users in the area





System Design

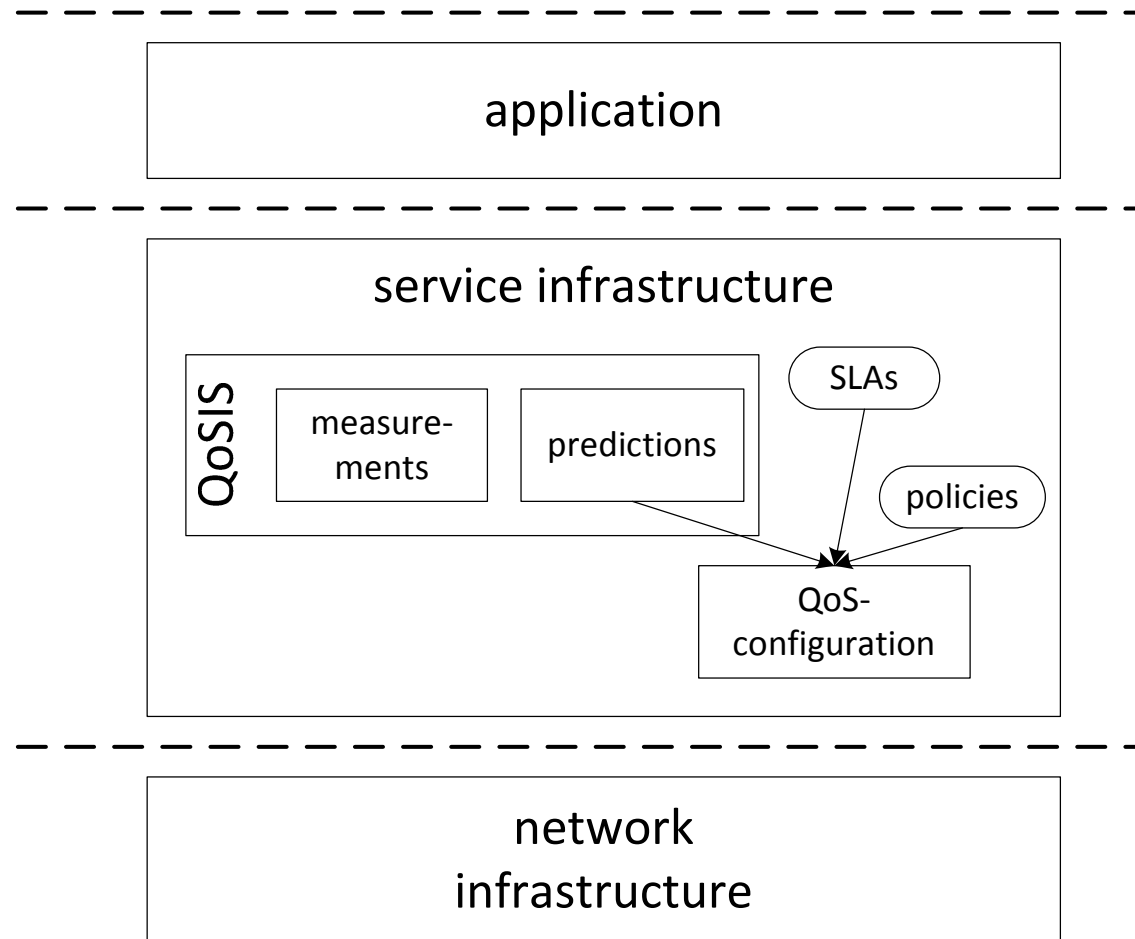




System Design: QoS-management



mobile
service user





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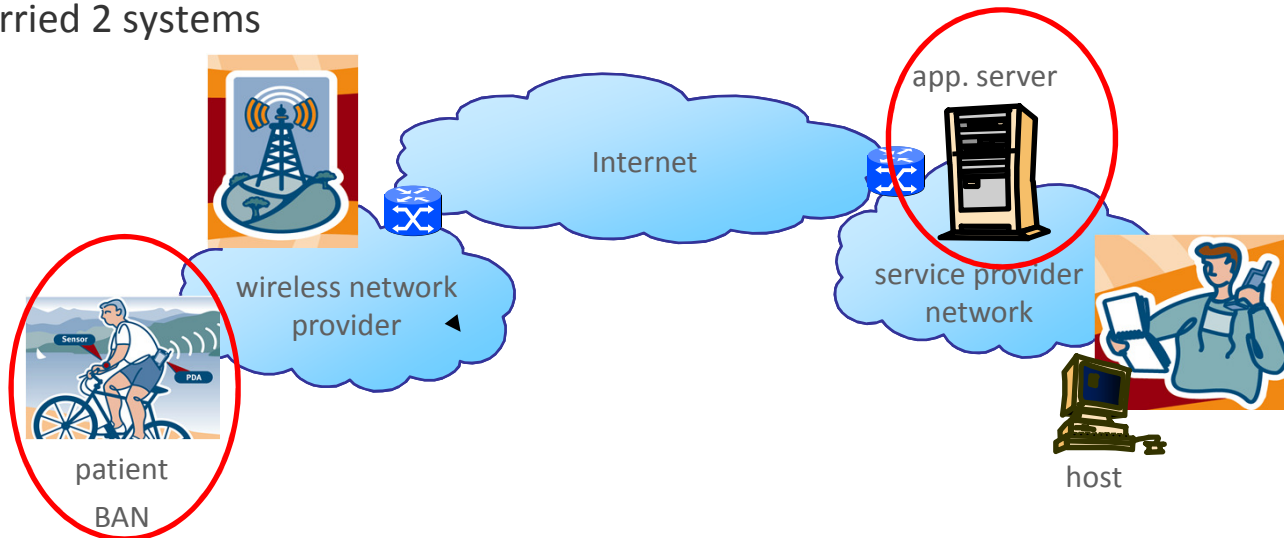
Case Study

mobile healthcare services



MobiHealth System

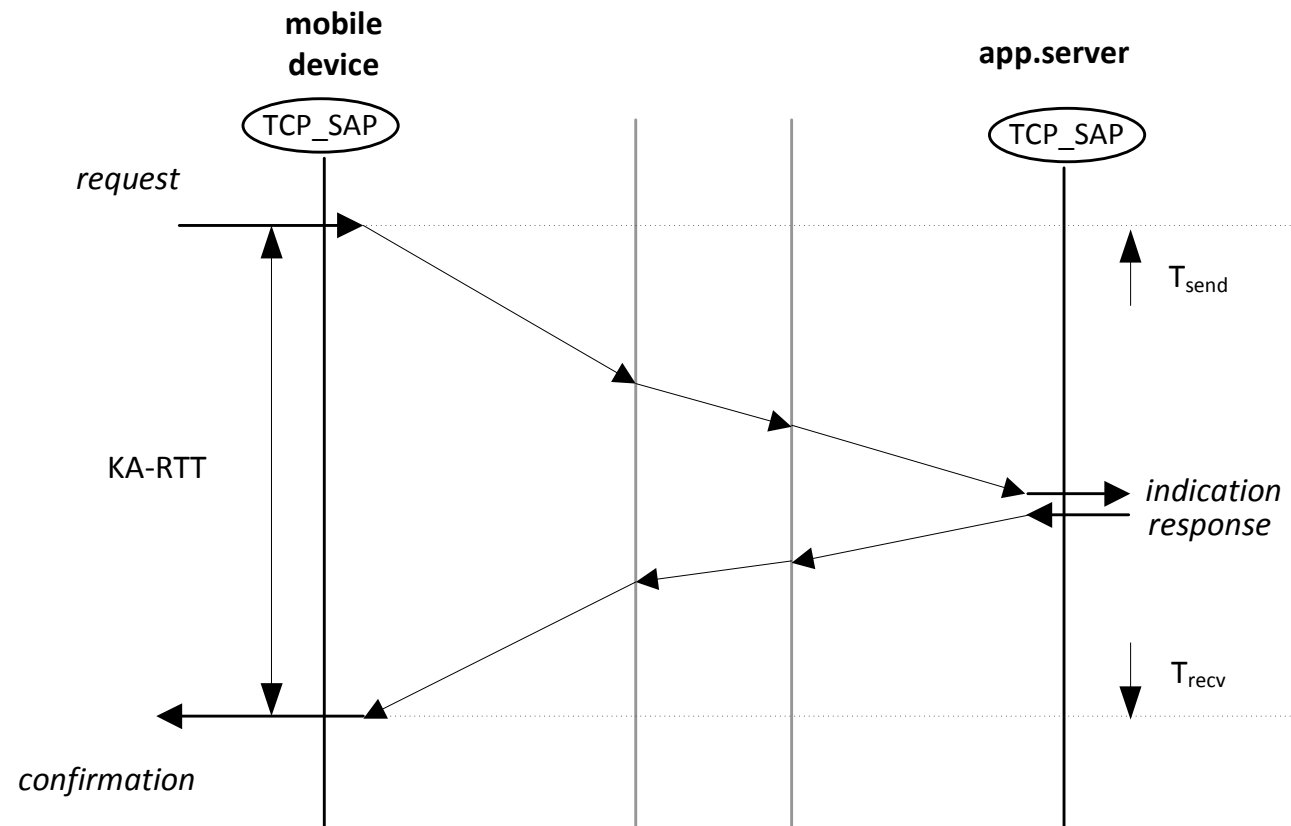
- patient: COPD (Chronic Obstructive Pulmonary Disease) telemonitoring user
 - vital signs: ECG, heartrate, temperature, plethysmogram, oxygen saturation
 - carried 2 systems





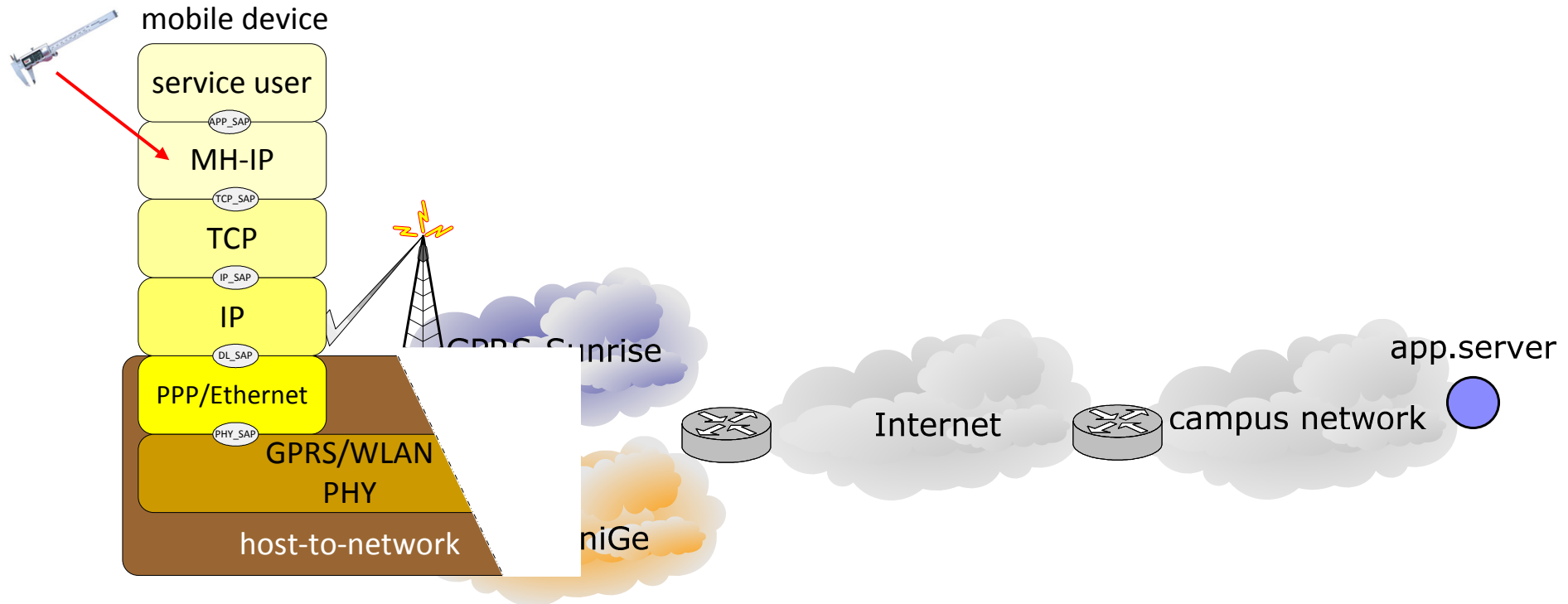
KA-RTT Definition

- Performance criterion: *speed*, performance measure: *delay*
- Keep-Alive Round Trip Time (KA-RTT)





KA-RTT Measurements

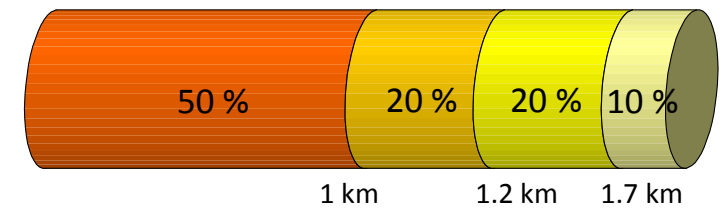
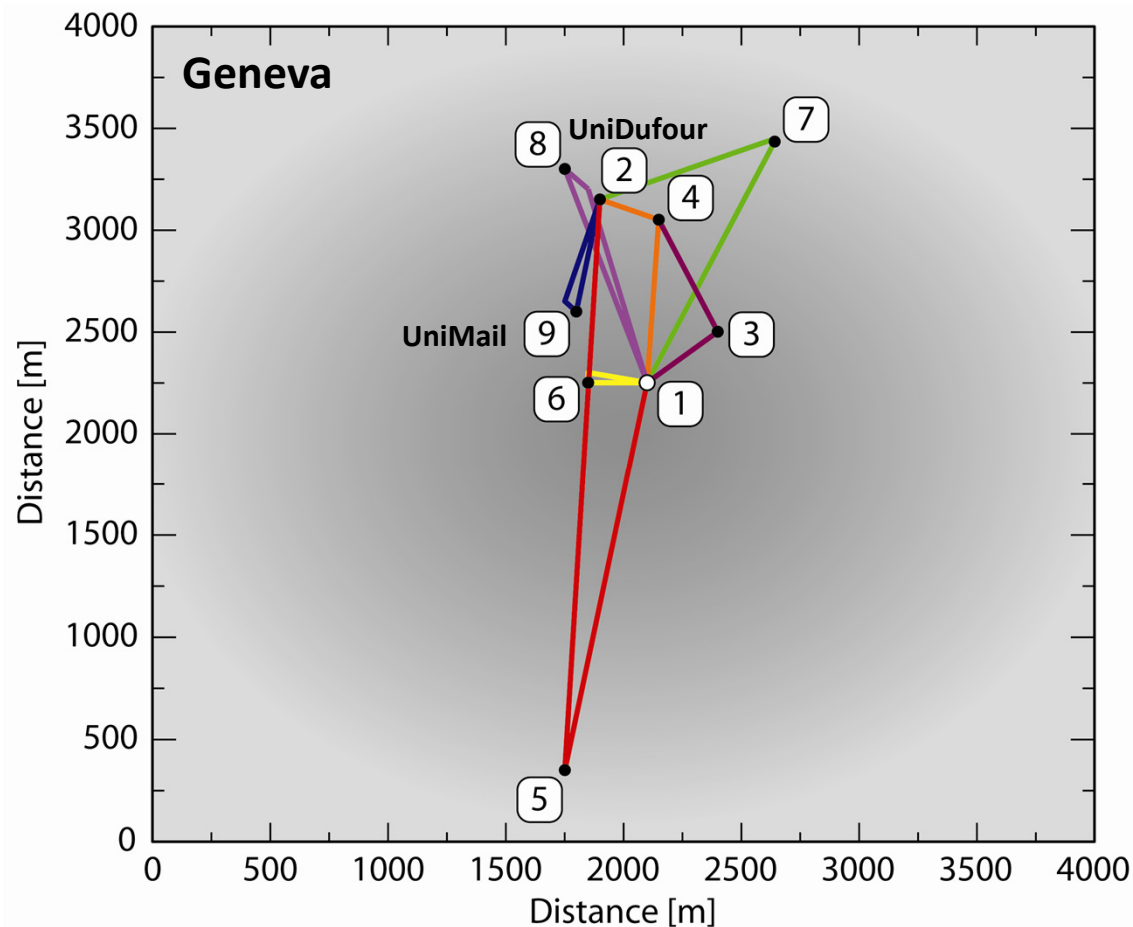


- new KA-RTT value every 10 seconds



MobiHealth User Mobility

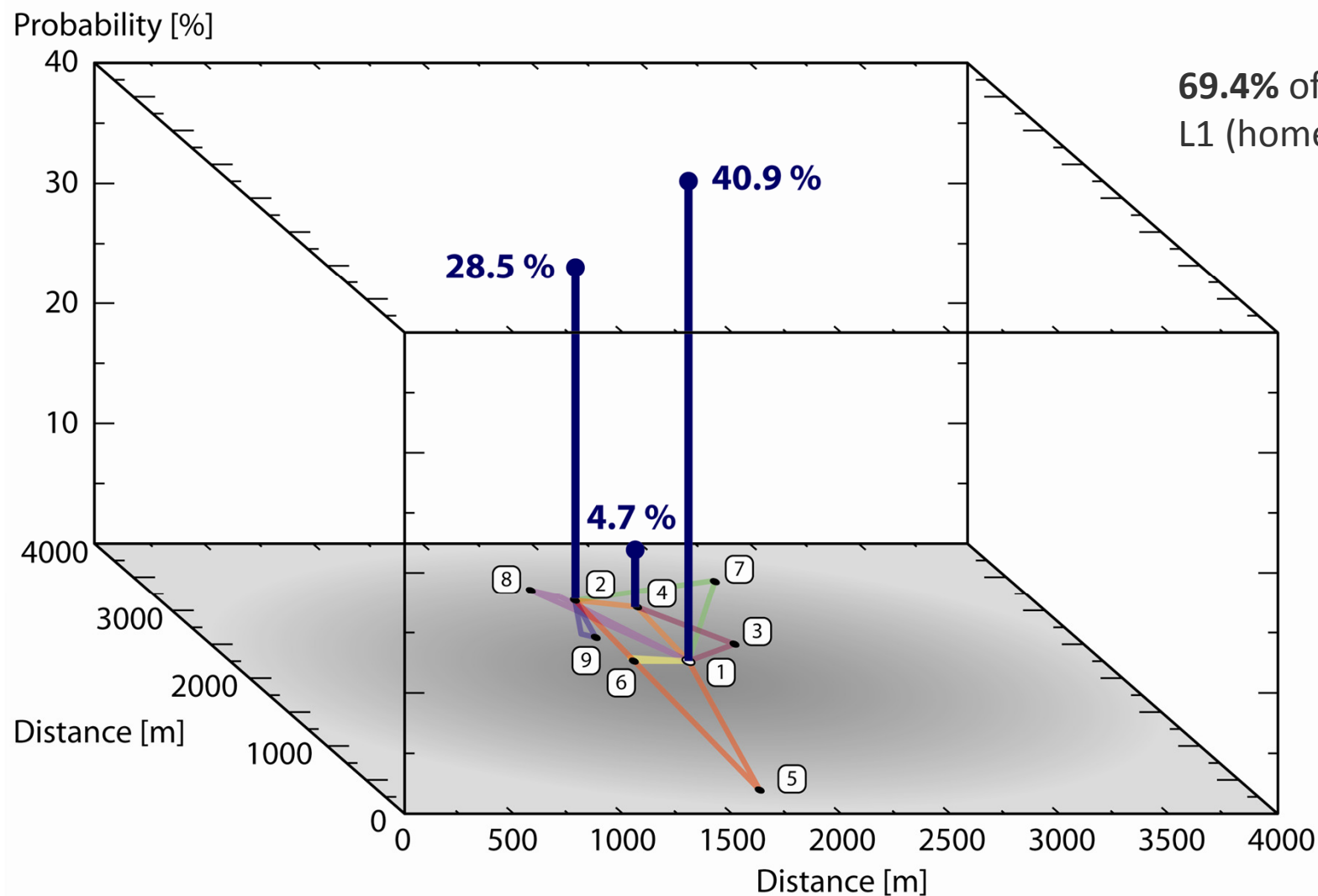
- Timeframe: mid Nov - mid Dec 2007



distance from L1 (home)
(90% of time – below 1.7 km)

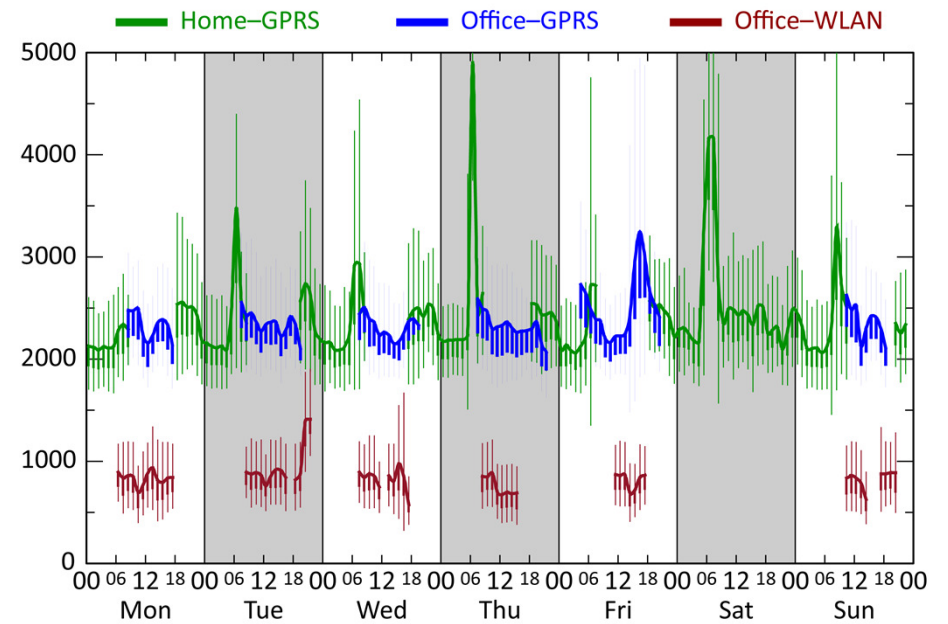
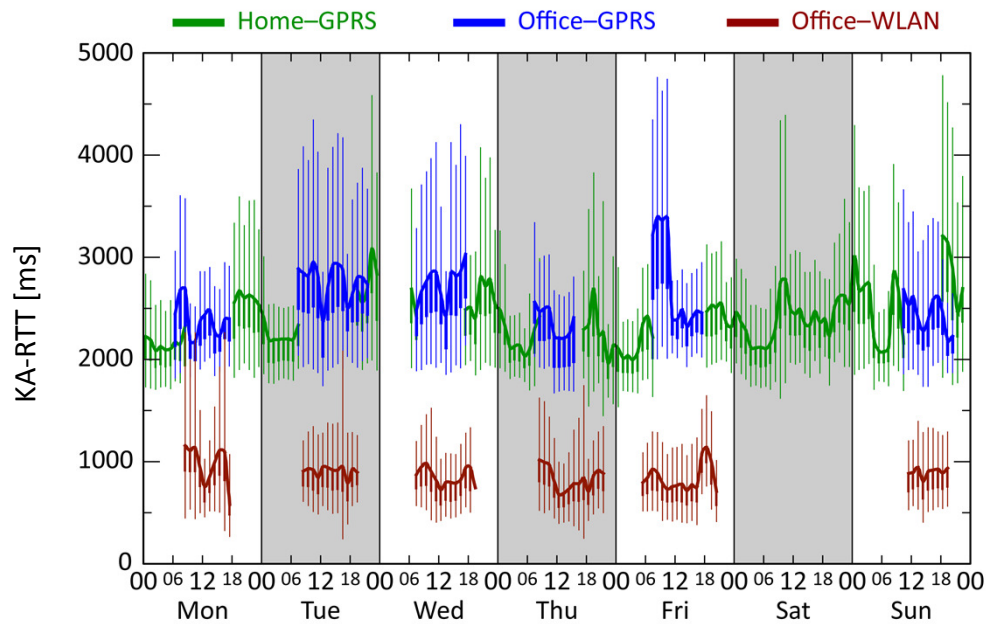


MobiHealth User Mobility (cont'd)



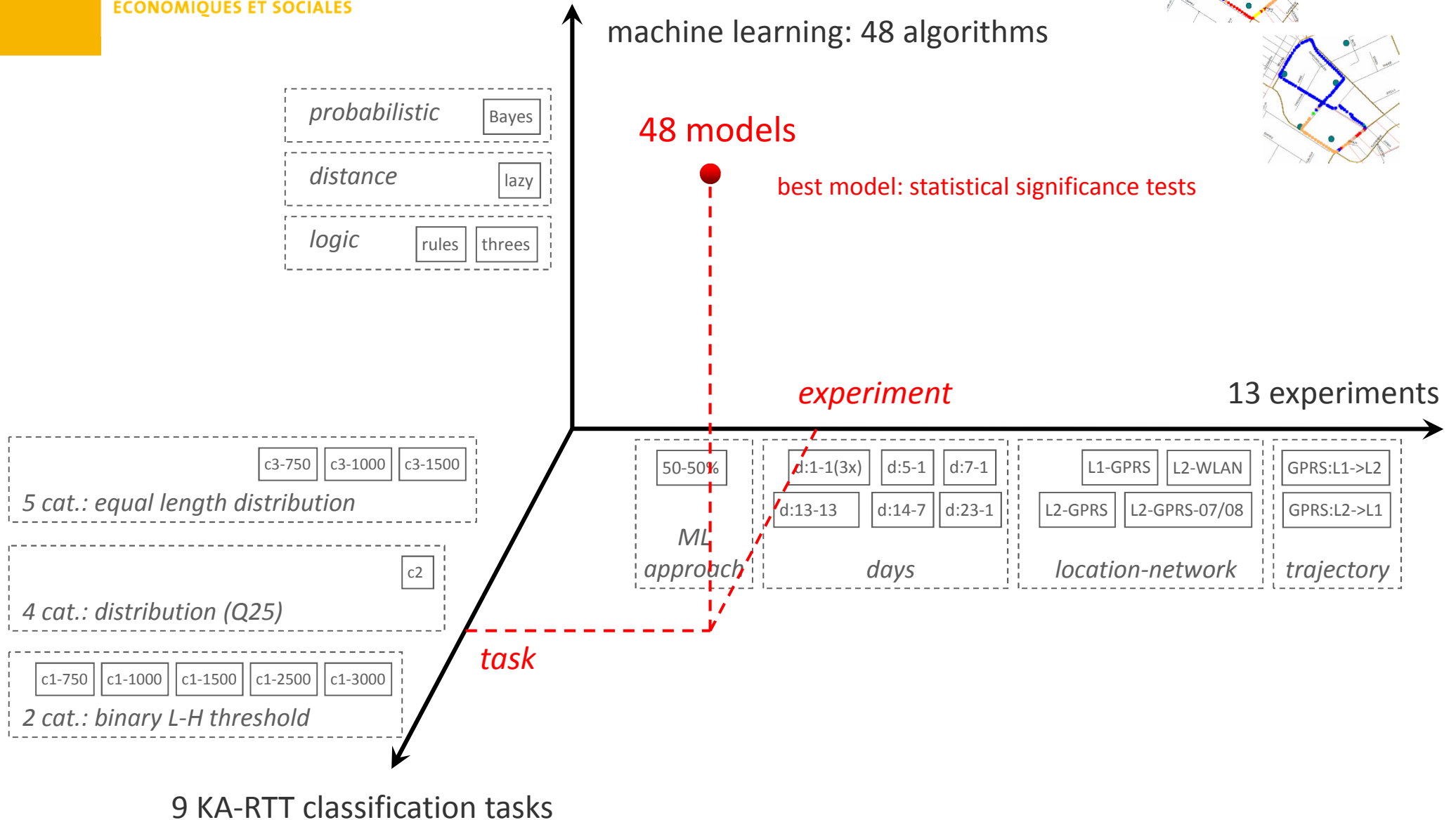
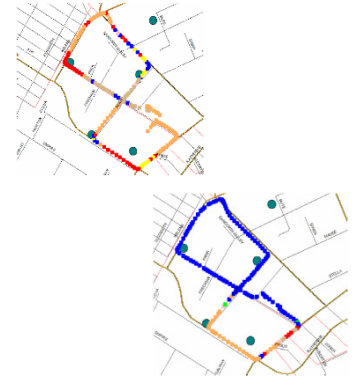


KA-RTT Statistics





KA-RTT Predictions





Collaborative-Sharing of Information

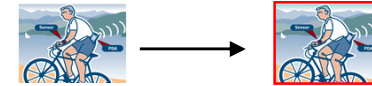
- User cases

- device 1 or device 2



- device 1 measurements → for device 2 predictions

- device 2 monitoring → for device 1 predictions



- device 1 + 2 measurements → for device 1 predictions

- device 1 + 2 measurements → for device 2 predictions



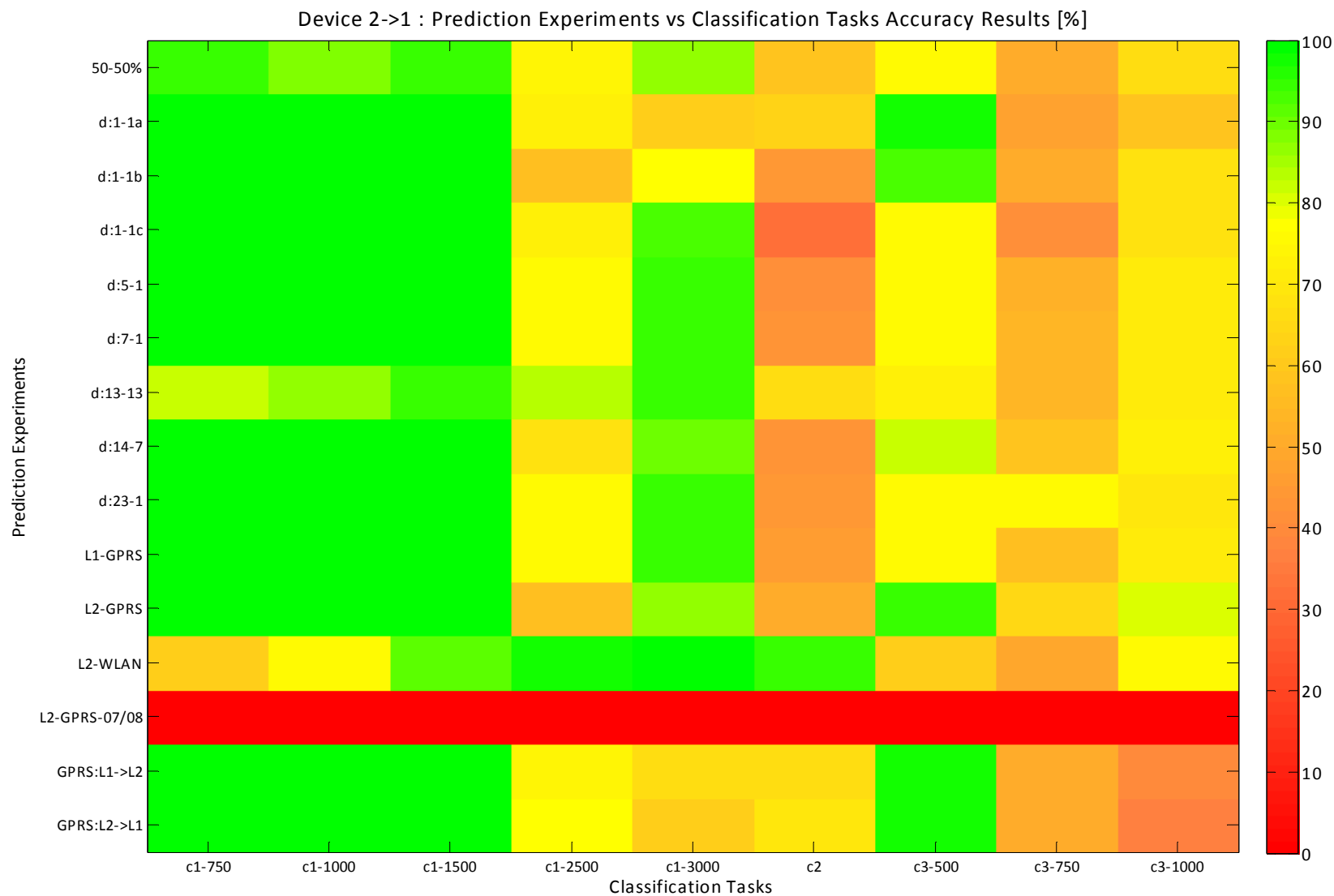


Device 1: Prediction Results



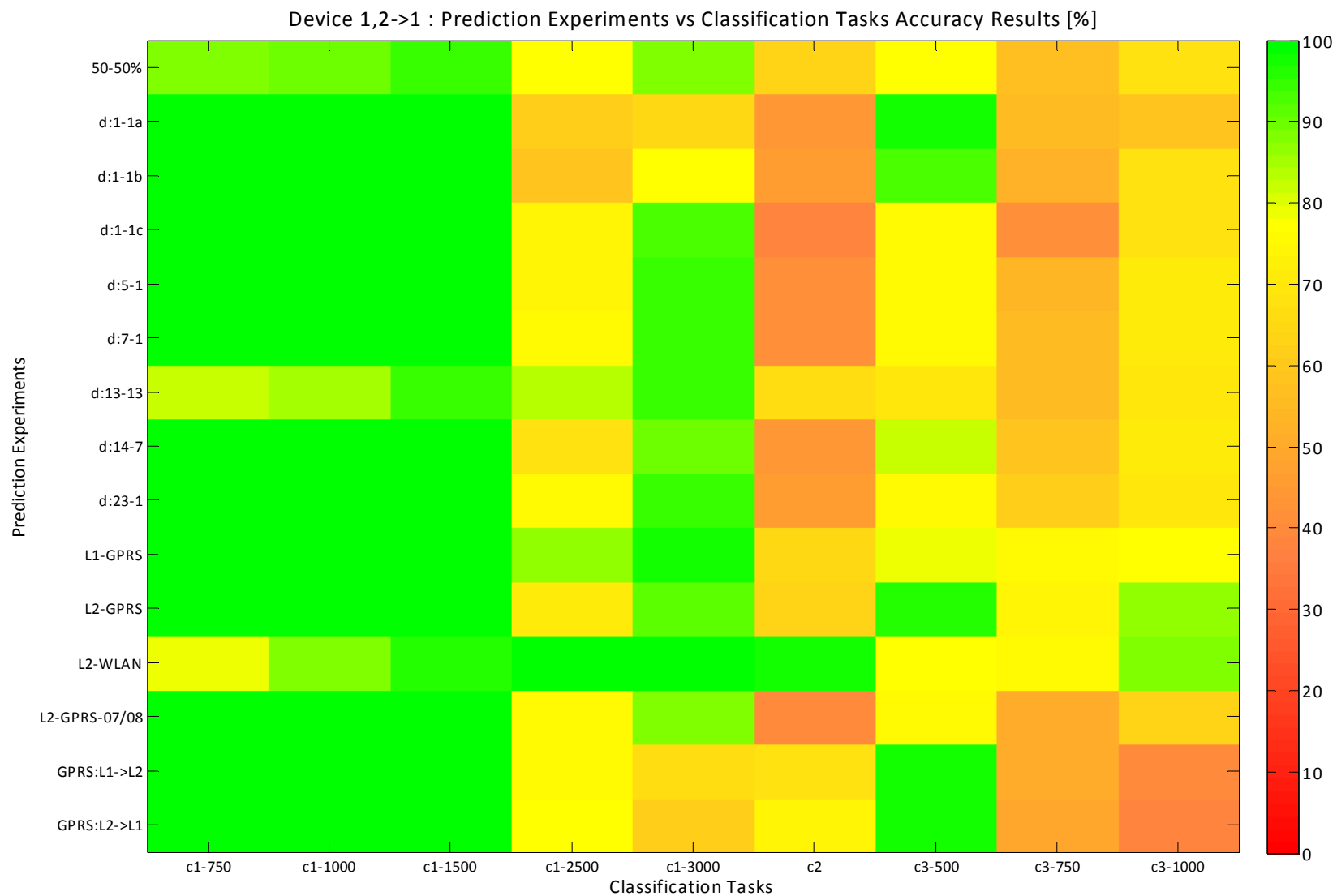


Device 2->1: Prediction Results






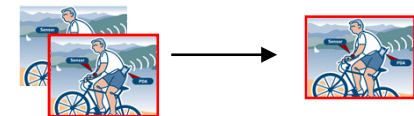
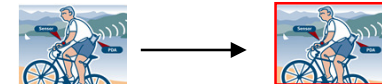
Device 1,2->1: Prediction Results





Prediction Results

- predictive attributes: location, time, wireless network provider and technology
 - most accurate are logic-based algorithms: trees and rules
- device 1, device 2 
 - accuracy > 75 %: binary tasks, fixed location and network, having collected long history
 - 69% of time user spends in top 2 locations
 - recommended history – minimum 7 days
- device 1 \rightarrow 2 or 2 \rightarrow 1
 - accuracy > 65 %+: binary tasks
 - accuracy changes on average 2 ± 13 % than if use own history
- device 1,2 \rightarrow 1 or 1,2 \rightarrow 2
 - accuracy > 95 %: binary tasks
 - accuracy changes on average 0 ± 11 % than if use own history





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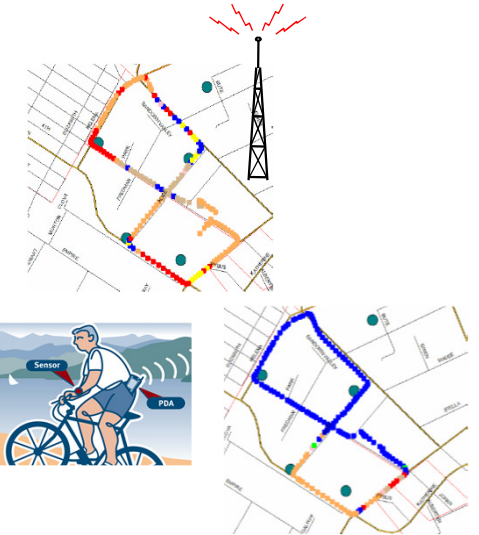
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Conclusions



Conclusions

- Proposal
 - system for collaborative-sharing of QoS-information
 - assessed technical feasibility of predicting KA-RTT delay value for health an operational telemonitoring system
- Novel approach in QoS-management - empowering mobile service users
 - builds upon a collaborative sharing of QoS-information (Mobile Web 2.0)
 - builds upon network provisions at 'best-effort' QoS level
 - beyond current QoS-management frameworks
 - beyond current user 'lock-in' in the network
 - no changes in the existing network infrastructures
- Current research: validation through prototyping
 - more predictive features not to end up with 'data dredging' (case: for device 1,2 \rightarrow 1)
 - future research: more users, applications, location areas, longer time intervals, ...





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Questions & Answers