European Commission

Horizon 2020
European Union funding
for Research & Innovation

Measuring Mobile Broadband Networks in Europe

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RIPE71 Plenary @ Bucharest, RO

EU H2020 Project

Partners: Simula(coordinator), Celerway(Norway), Telenor(Norway), IMDEA (Spain), KaU(Sweden), NET1(Sweden), POLITO(Italy), Nextworks(Italy)

Budget: 6.5M €

MONROE

- Vision
- Who can benefit?
- Study Case: MBB Coverage in Norway

MONROE

- **Vision**
- Who can benefit?
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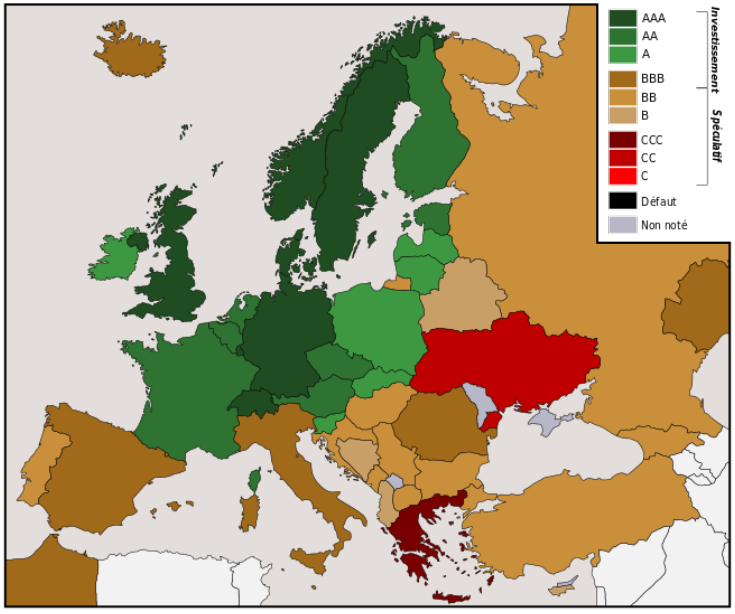
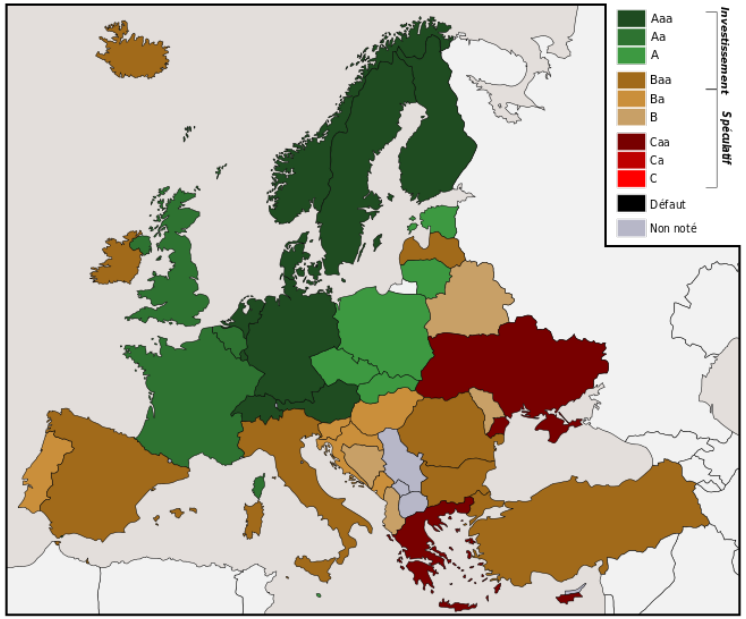
Mobile Broadband (MBB) Networks

The popularity of mobile devices combined with high-capacity 3G and 4G mobile networks, has radically changed the way most people access and use the Internet.

Rating of MBB Networks in Europe



Standard & Poor's
Notation financière à long terme des États européens
14/07/2015
Source : S&P (http://www.standardandpoors.com/home/en/eu)



Moody's
Notation financière à long terme des États européens
18/01/2014
Source : Moody's (http://www.moodys.com/)

Objective data on the performance and stability of MBB

Price, bandwidth, reliability and application performance

MONROE Vision

*Design, build and operate an **open**, **European-scale**, and **flexible** hardware-based platform to run experiments on operational 3G/4G Mobile Broadband networks with WiFi connectivity*

- Use the platform for:
  - identification of key MBB performance parameters, thus enabling **accurate**, **realistic**, **persistent** and **meaningful** monitoring and performance assessment
  - examination and evaluation of **innovative protocols and services** for MBB networks

Interaction with Similar Projects

- User access and experiment scheduling through **PF7 FED4FIRE**
- Compatible **FP7 mPlane** architecture
- Builds on top of **NorNet Edge**
- Collaboration with **WiRover**

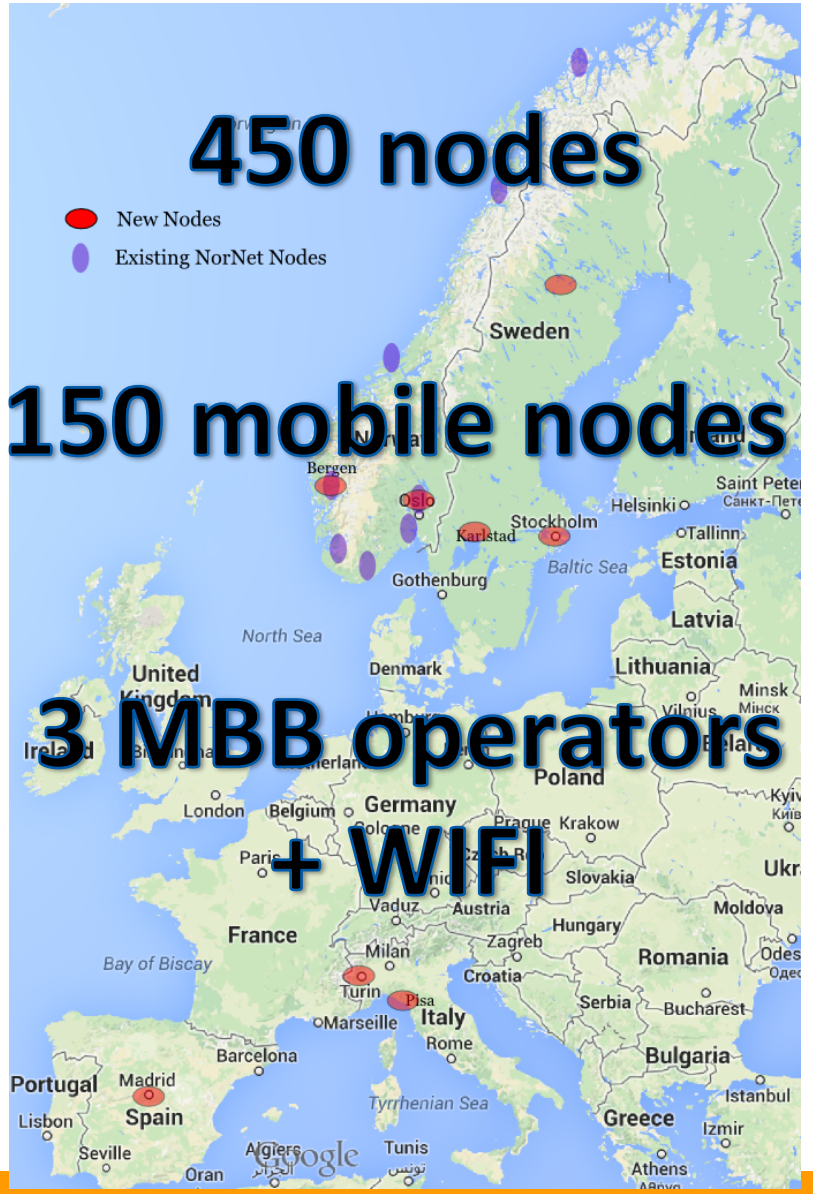
- Open to collaboration with other measurement platforms for building a unitary set of metrics that accurately describes the performance of home and mobile broadband

Coverage of MONROE

- Build on the existing ***NorNet Edge*** infrastructure, consisting of 200 dedicated operational nodes spread across Norway
- Extend the Coverage to 4 European Countries (Norway, Sweden, Spain, Italy)
  - Comparison of different configurations, regulations, frequencies and operator strategies in and among different countries

Capabilities and Functionality of MONROE

- Nodes are linux based measurement boxes :
  - Allows kernel modifications
  - Different demanding applications
- Nodes on buses, trains and trucks
  - Impact of mobility
  - Rural vs City
- 3MBB operators and WiFi
  - Experimenting on different access technologies
  - Explore new ways of combining them for performance and robustness
  - New opportunities, i.e., 4G/WIFI handover

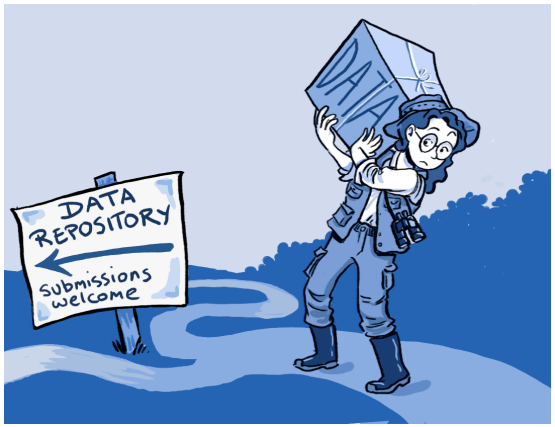


MONROE

- Vision
- **Who can benefit?**
- Study Case: MBB Coverage in Norway

Lowering the Barrier for External Users

- Experimental platform open to external users
  - Open Datasets and Measurement Methodology
  - Open tools to analyze the datasets
  - Open access to platform for external users selected from upcoming open calls
  - Experimentation as a Service (EaaS)
  - Flexible measurement nodes, allowing kernel modifications



Who can benefit from MONROE?

Regulators and society at large: (Nkom)

- Assess the stability and performance of MBB networks to guide regulations and spur competition

Users/consumers:

- Make informed choices on which network provider to choose

Who can benefit from MONROE?

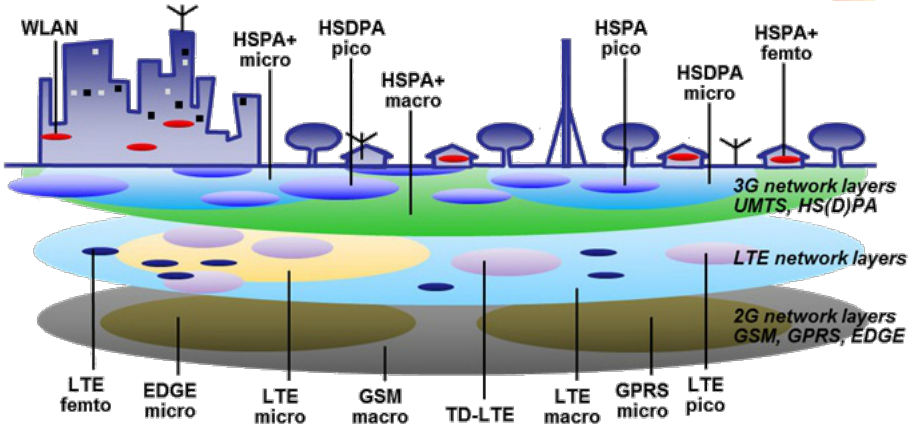
Organizations and businesses: (Nextworks, Celerway and LiveU)

- Assess the quality of services that depend heavily on mobile networks in their operations

Who can benefit from MONROE?

Researchers, innovators and experimenters: (All academic partners, University of Wisconsin-Madison, Celerway and Telenor)

- Evaluate the performance of novel applications or protocols in a real operational setting



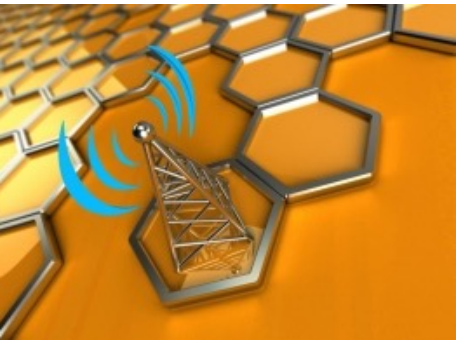
Who can benefit from MONROE?

Operators: (Telenor, NET1 and Telefonica)

- Test performance from the users' perspective
- A good alternative to expensive drive-tests for coverage assessing
- Frequency planning, more cost-efficient investments, and better network utilization

Users

Operators



Business

MBB Metrics
Applications
Protocols

Research

Regulators

MONROE

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- **Study Case: *MBB Coverage in Norway***

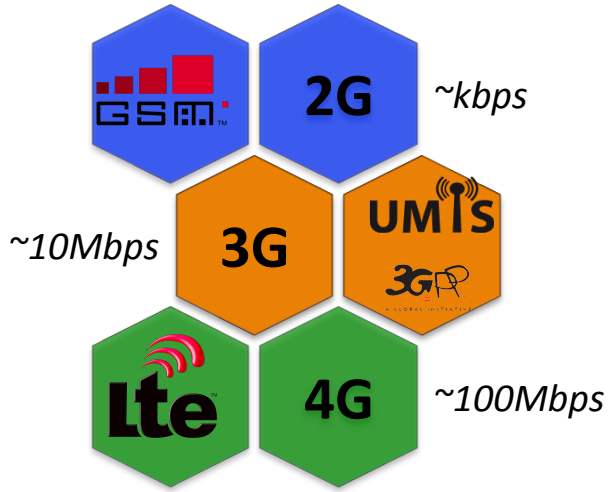
NORNET EDGE

NSB

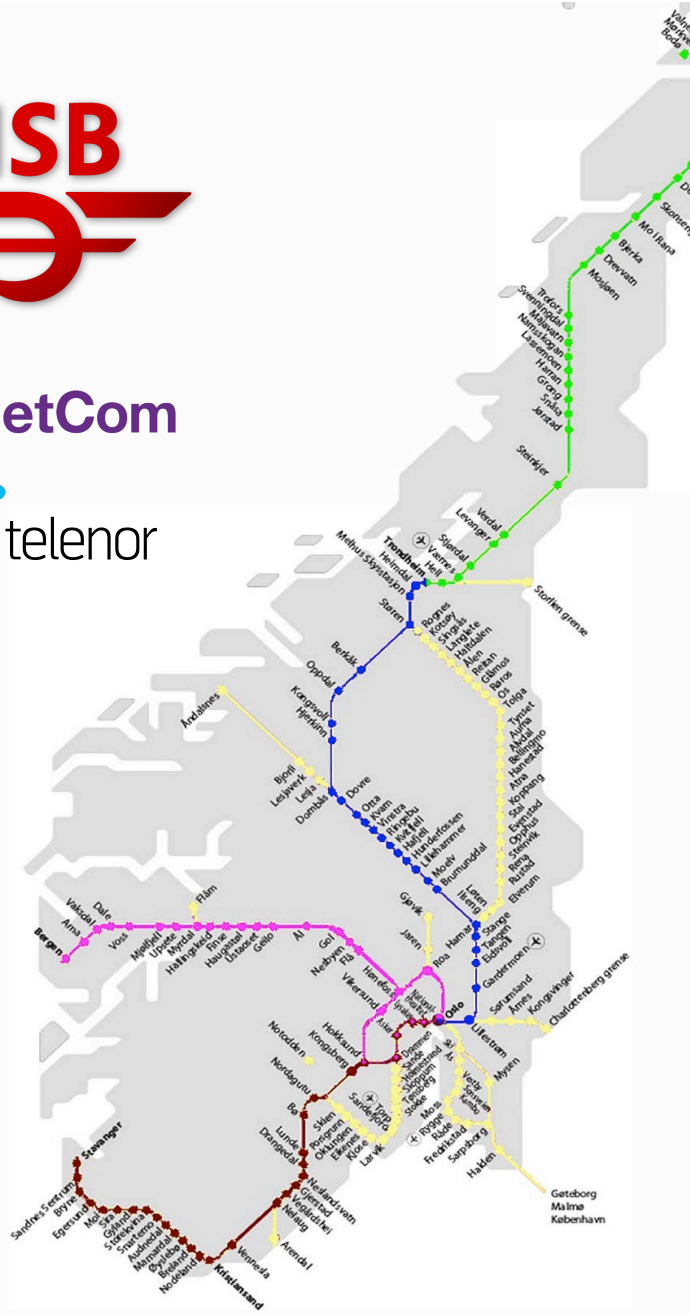
NetCom

telenor

- We propose a ***complete approach*** to coverage characterization



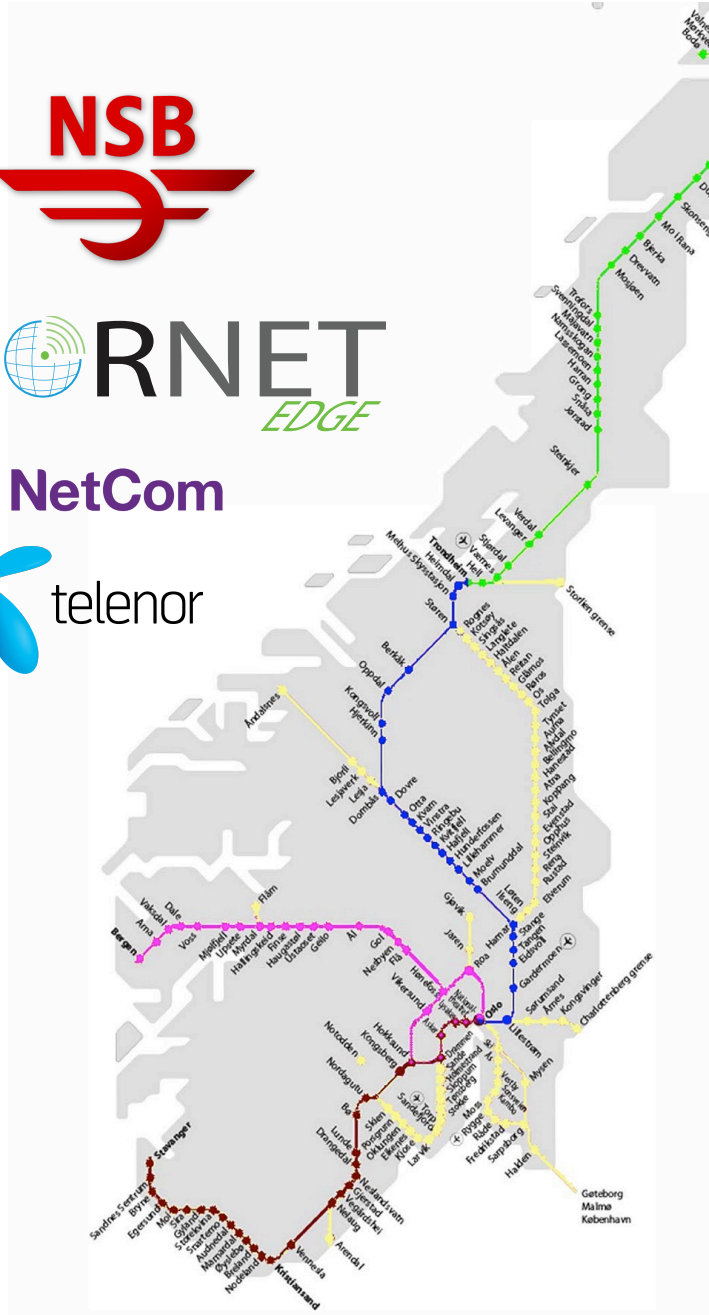
- Of interest for ***operators, regulators, end-users*** and ***businesses***



Geo-referenced Dataset

- Data collected over **5 months** (Nov. 2014 – Mar. 2015)
  - NNE metadata collected over 4 different routes: *Oslo-Voss, Oslo-Stavanger, Oslo-Trondheim, Trondheim-Bodø*
  - GPS data from the Norwegian railway system with 10-15 sec granularity
  - One run = a train trip on a given route

- Merge the ***NorNet Edge measurements*** with the ***GPS dataset*** to generate **geo-tagged data points**



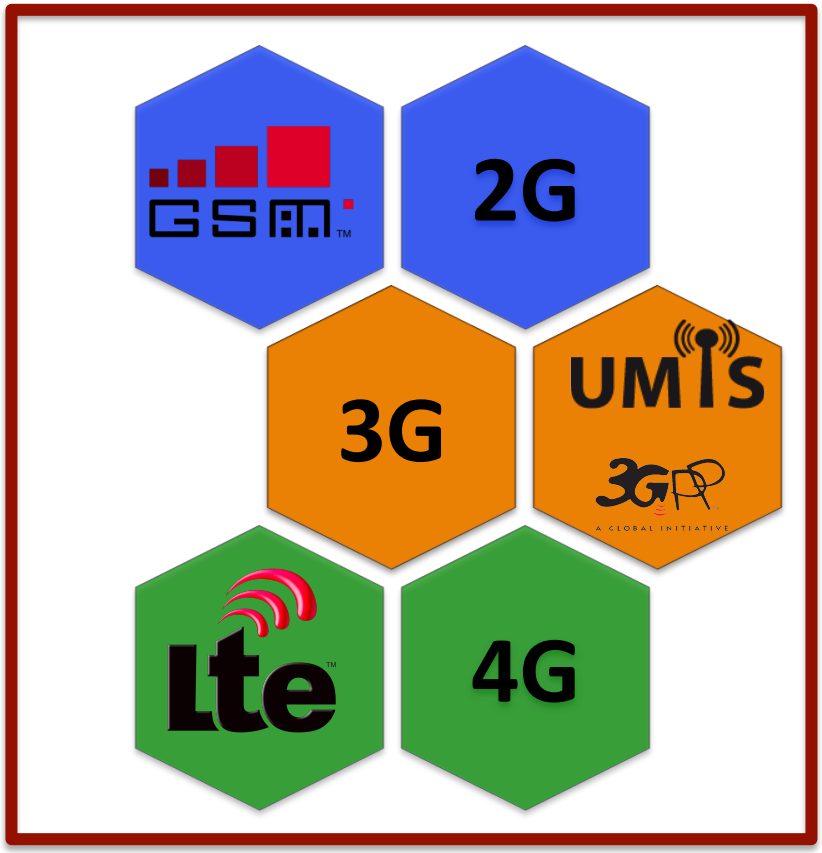
Data Morphing

- **Geographical data binning**
  - Tackle limitations of the geo-referenced dataset
  - Group the geo-tagged data points into 2km x 2km geographical bins
- **Coverage Chart time series**
  - Distribution of the 4 different levels of RAT within a grid block
  - Time series -> all the trips the train makes on every route over 5 months

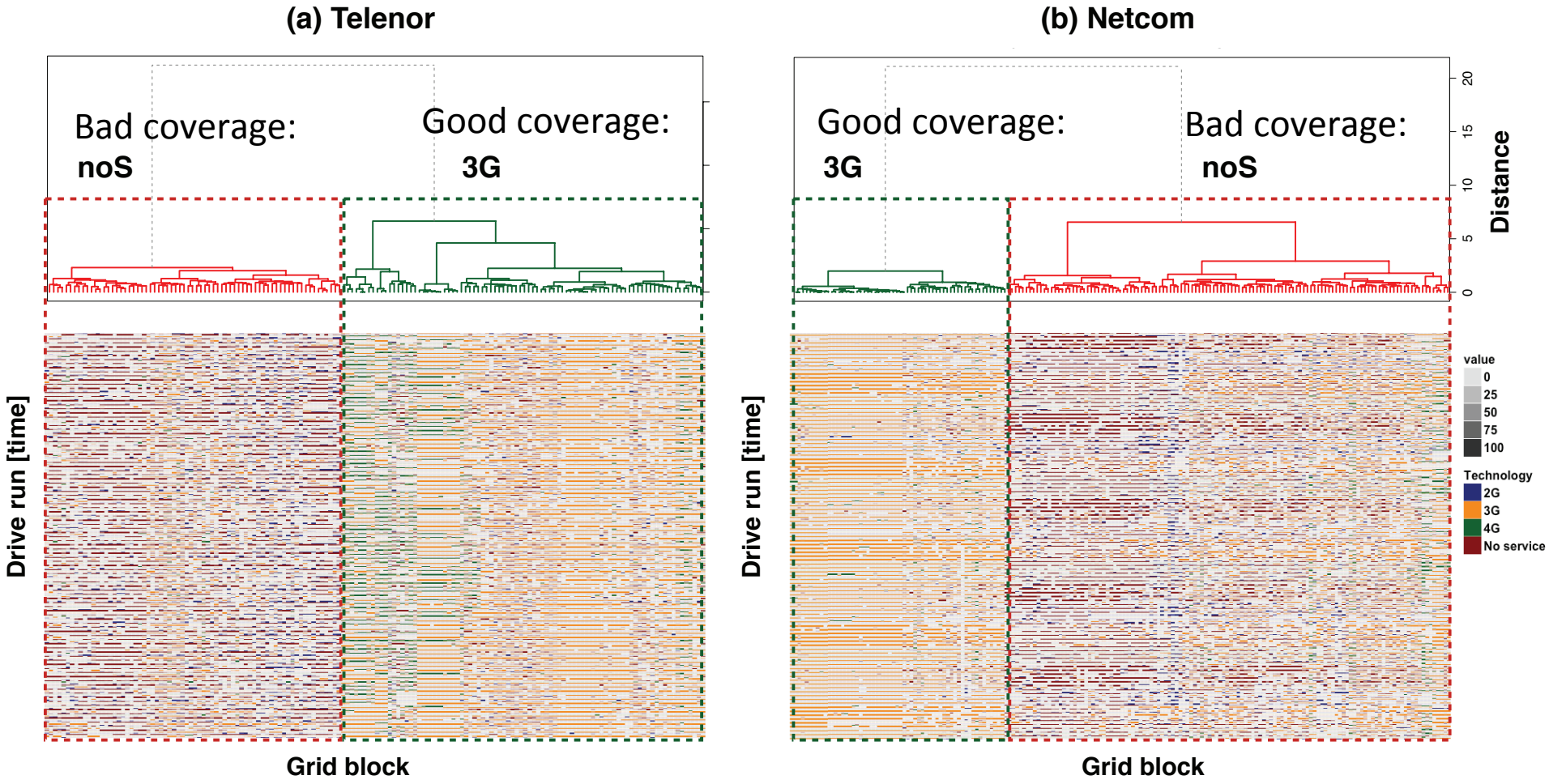
Coverage Chart: {2G:20%, 3G:40%, 4G:20%, noS:20%}

Coverage Chart

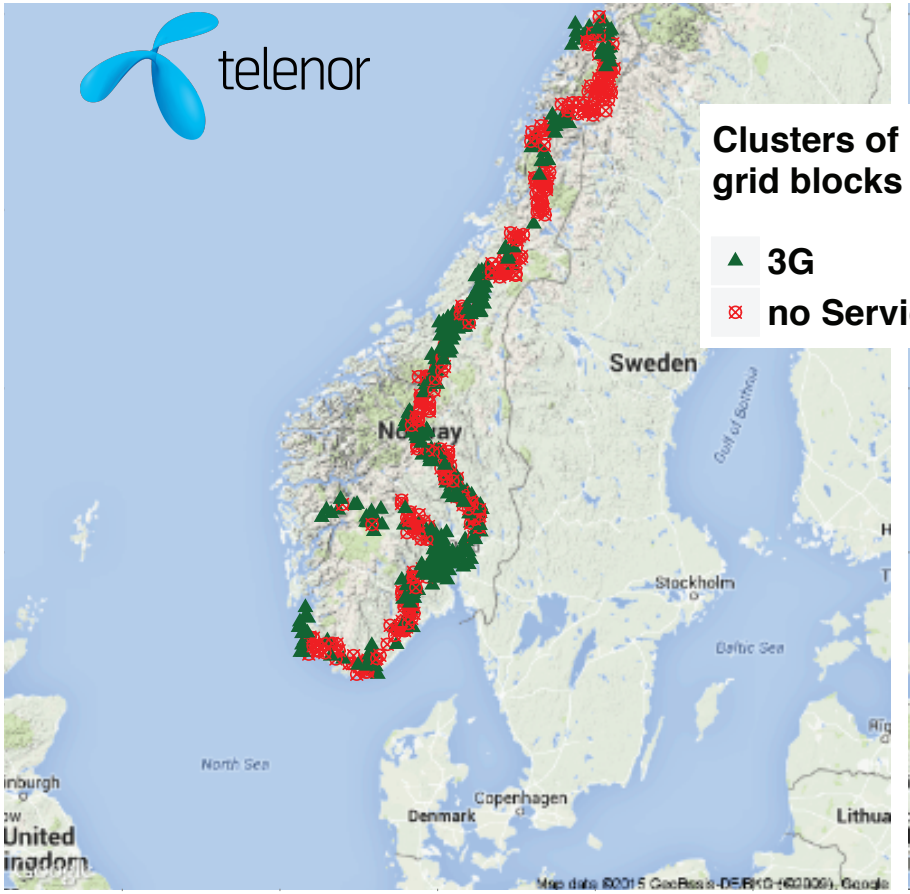
Grid Block -- Coverage Chart: {2G:20%, 3G:40%, 4G: 20%, noS:20%}



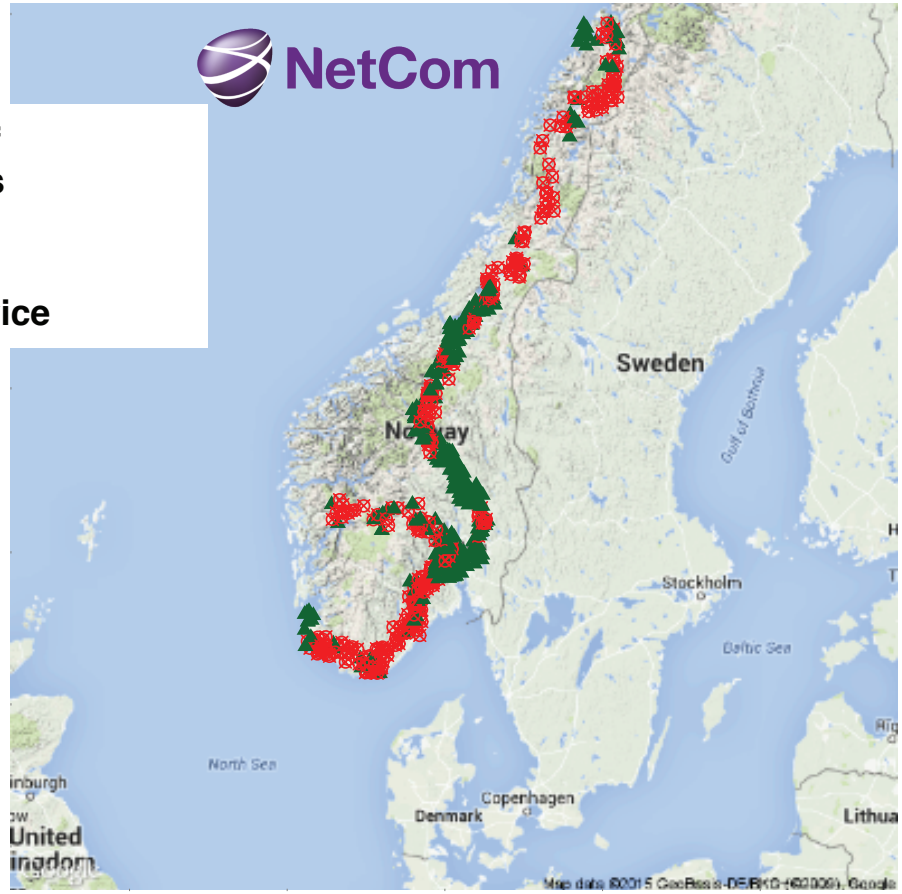
How can we identify patterns in coverage?



Which areas have which coverage profile?



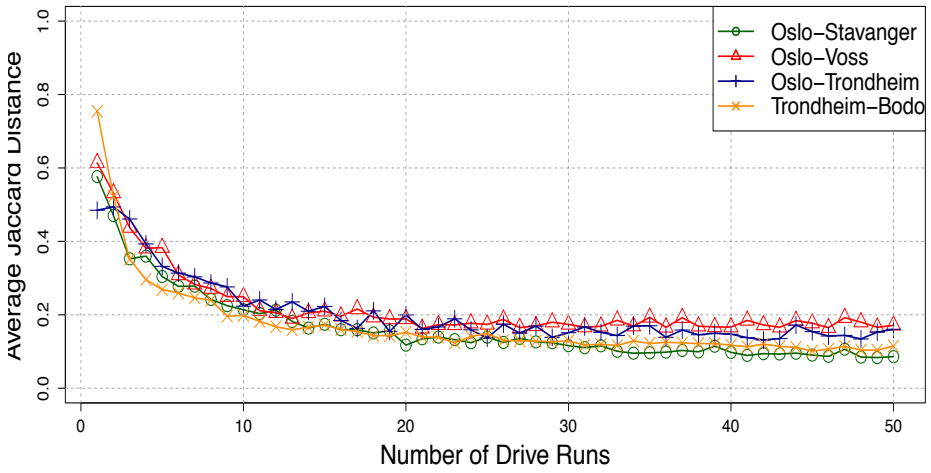
a) Telenor



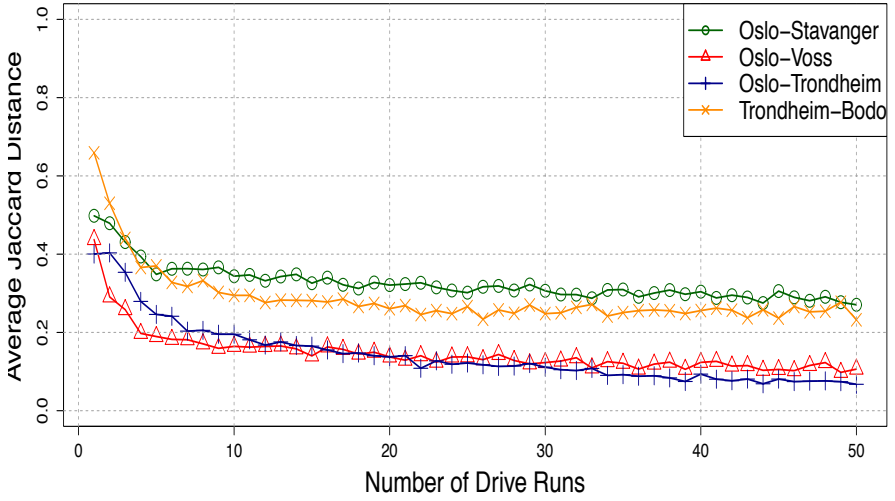
b) Netcom

Stability of Coverage Profiles and Similarity of Runs

telenor



NetCom



Current Status and Timeline

- Started March 1st 2015 (will run 3 years)
  - Currently working on
    - System design and proof-of-concept implementation
    - HW selection - completed
- **First Open call – December 2015**
  - **Up to 150k € support for experiments or extensions to the testbed (HW and SW)**
  - https://www.monroe-project.eu/opencalls/
- Prototype implementation is ready in March 2016
- Testbed open to external users in June 2016
- Testbed open to all users in March 2017

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https://www.monroe-project.eu/

Open Calls:
https://www.monroe-project.eu/opencalls/

First Open Call – December 2015
Funding of up to 150,000 EUR for an external user

MONROE Use Cases

- ***Key MBB Metrics***
  - *Network tomography*
  - *Traffic analysis with Tstat*

Tstat

- ***Application Performance***
  - *Video applications*
  - *Web services*

- ***Protocol Innovation***
  - *Internet Path Support*
  - *Multipath protocols*
  - *Traffic Offloading*