

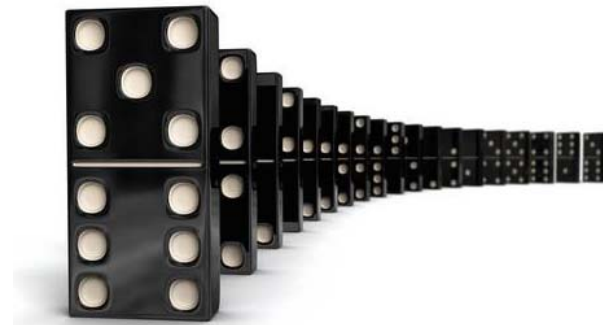
# Measurements to inform policy makers and end consumers

Ahmed Elmokashfi

AIMs 2017

03/03/2017

**N**  **RNET**  
*EDGE*





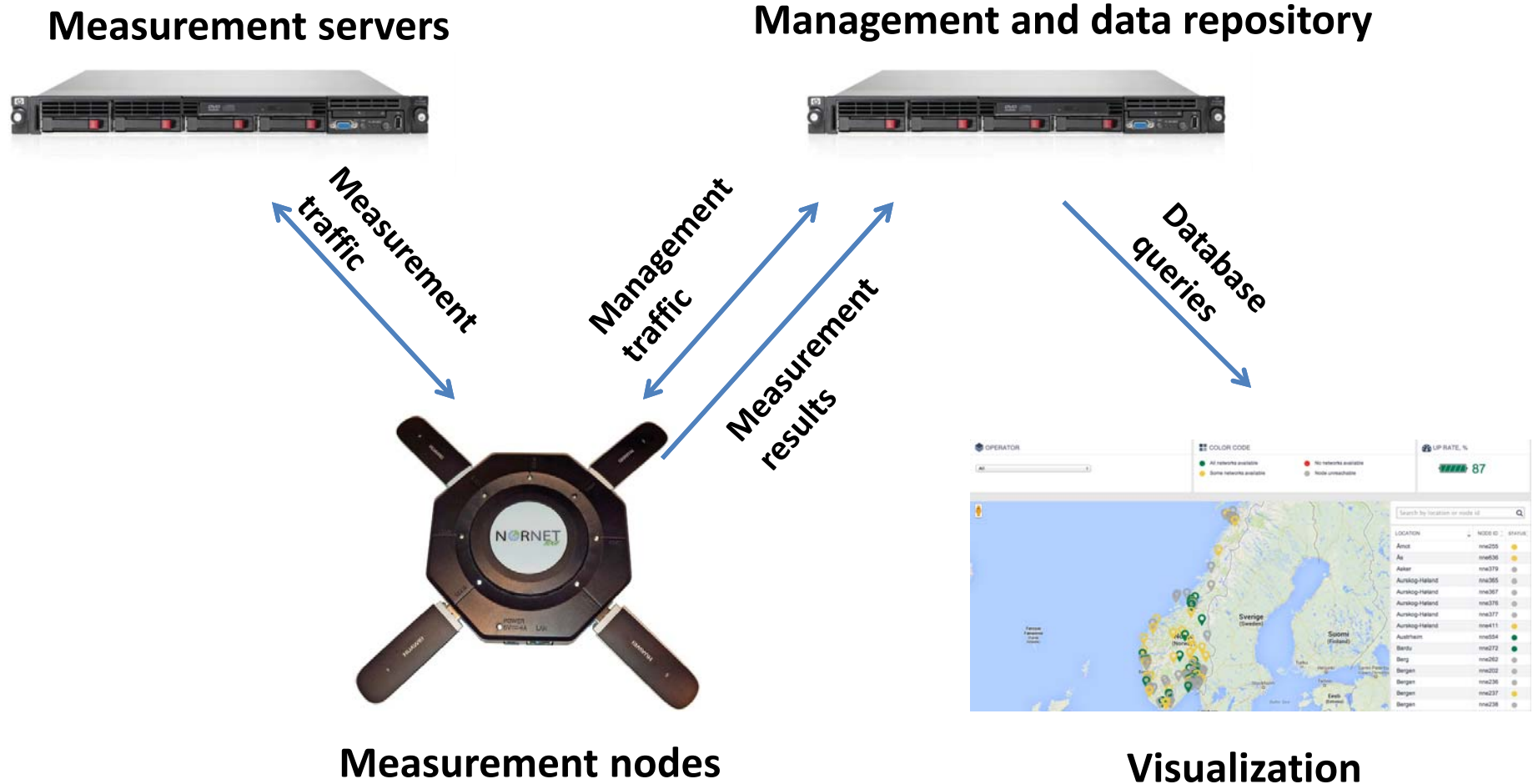
Measurement nodes spread across Norway

About 100 active stationary measurement nodes and seven nodes on regional trains

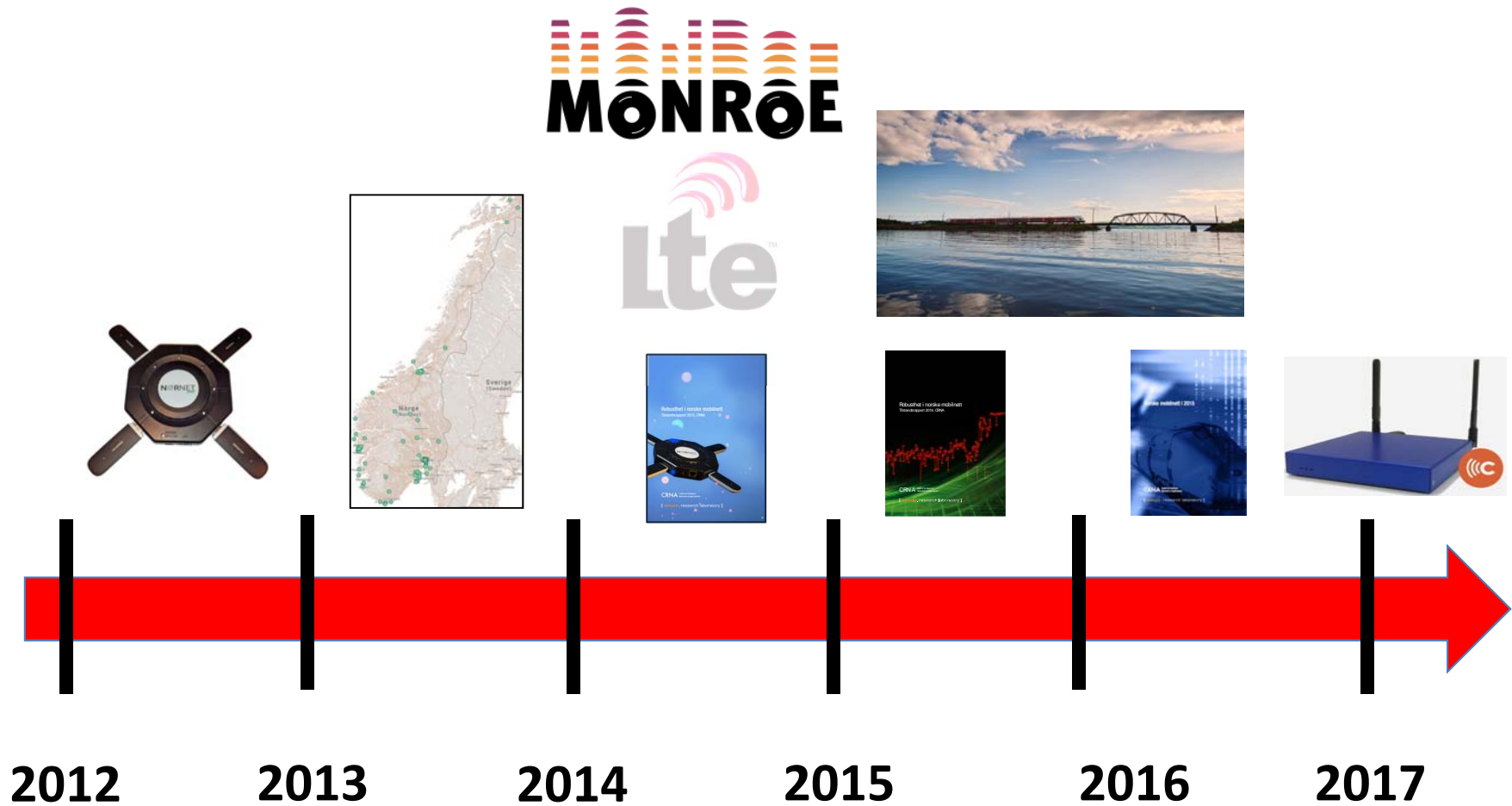
Multi-homed to all major Norwegian MBB operators

Operational since July 2013

# NNE measurement nodes are single board computers that run Linux



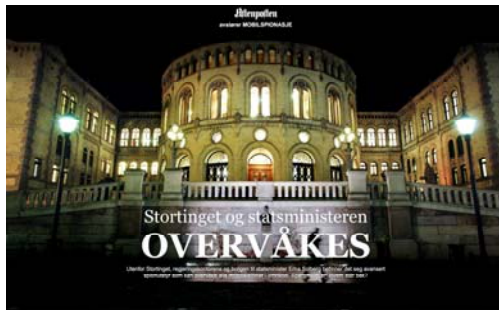
# A brief history of NorNet



# A few ways to engage policy makers and the public



Periodic measurements reports and on-demand incidents reports – *credibility?*

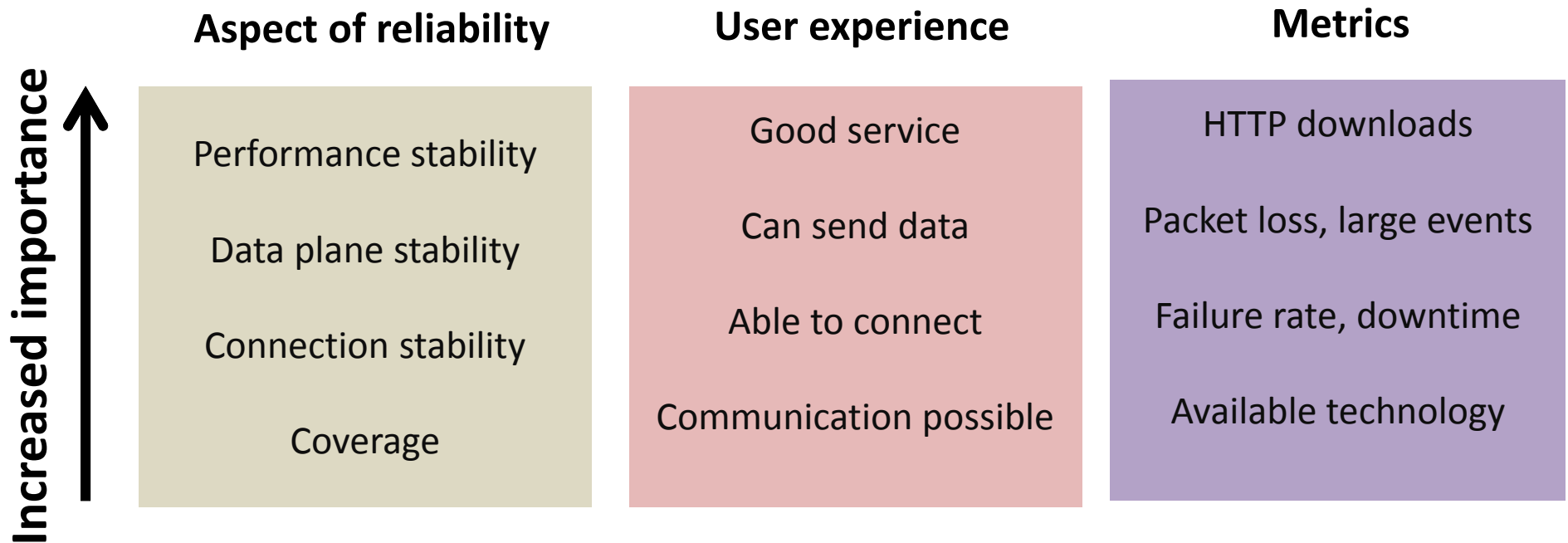


Give expert opinion – *You need to convince them to approach you*



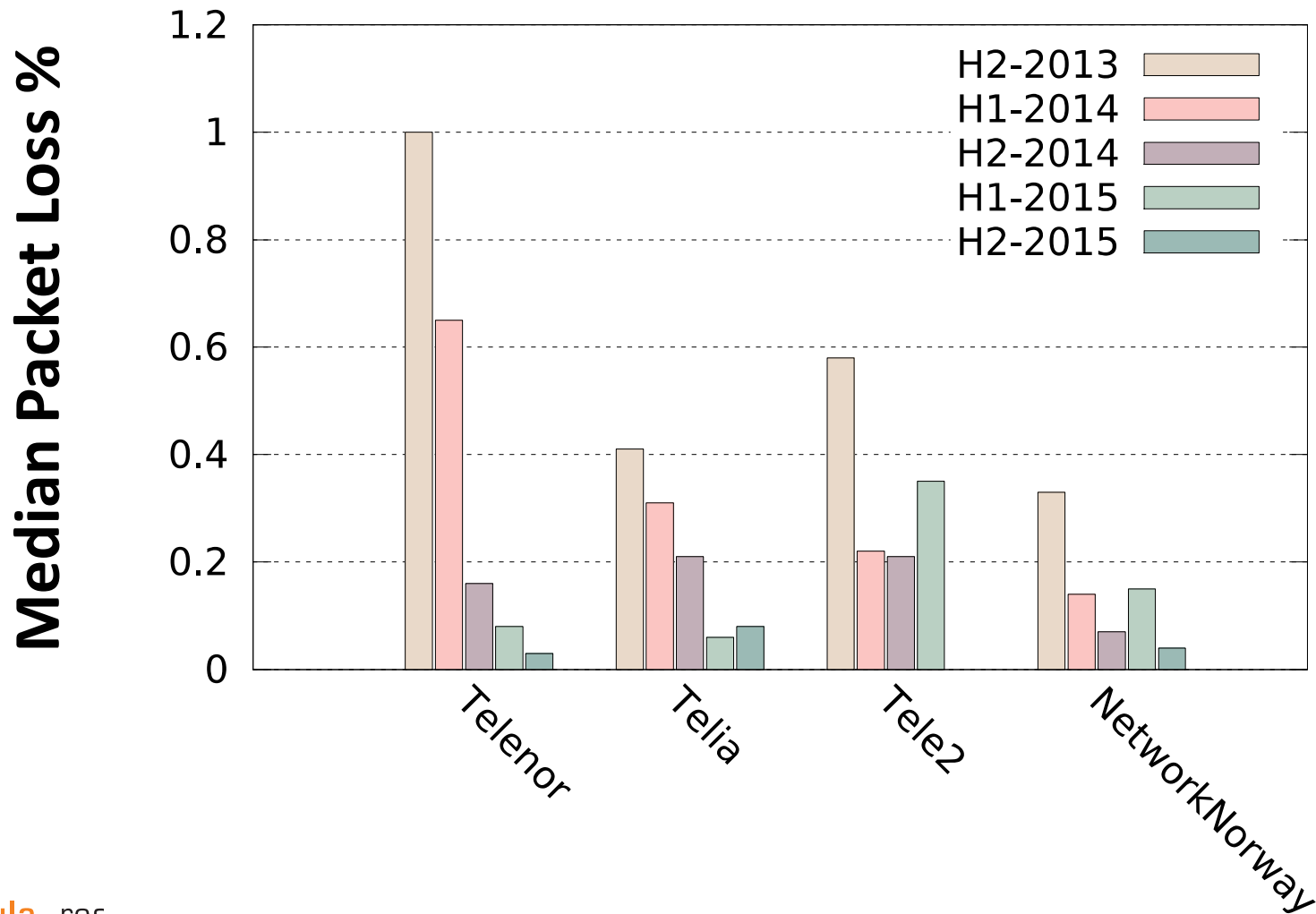
Take initiative to inform ongoing debates – *You need to follow*

# A framework for measuring reliability at multiple levels

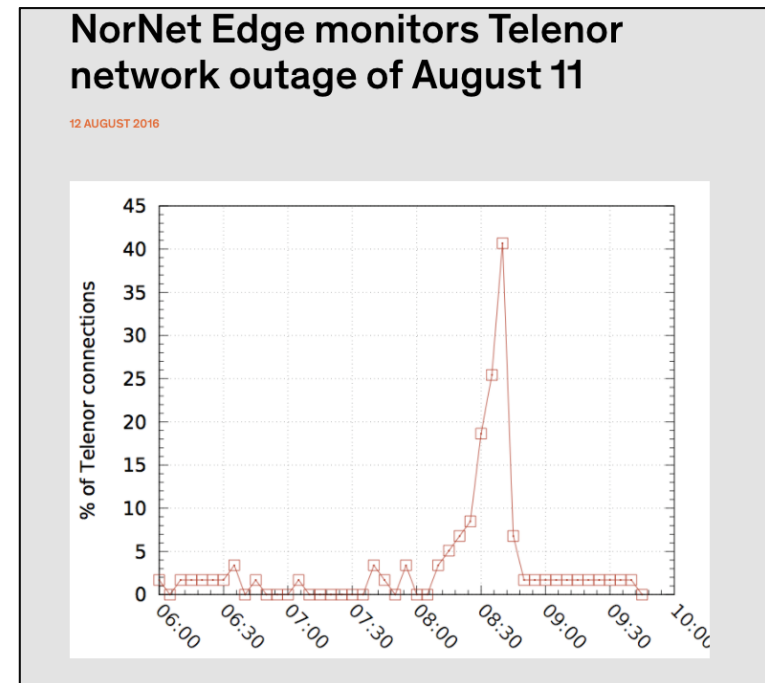
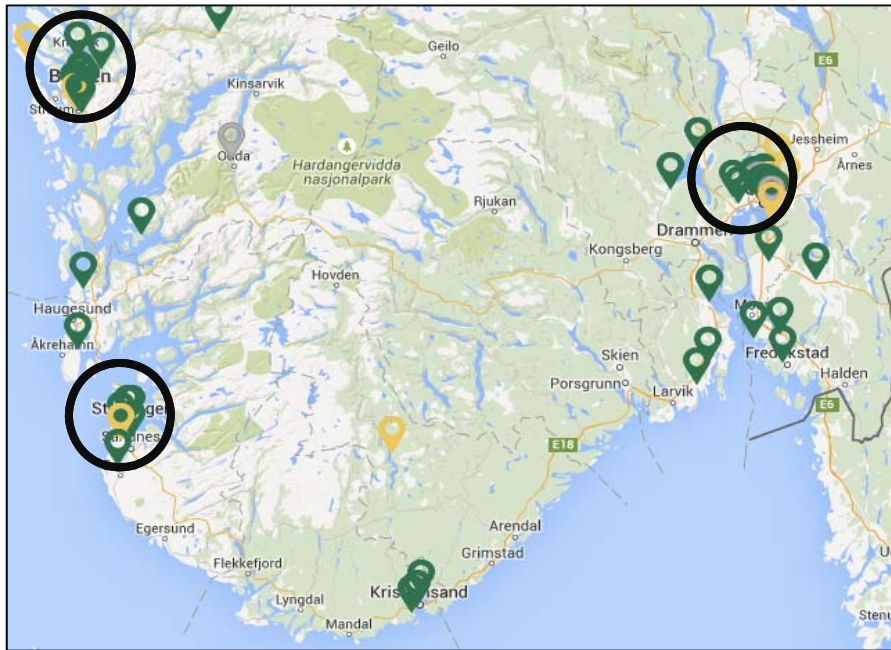


Baltrunas et al. ACM IMC 2014

# Permanent dedicated measurement are important to evaluating performance over time



# The spread of NNE nodes helps identifying local, regional and global outages

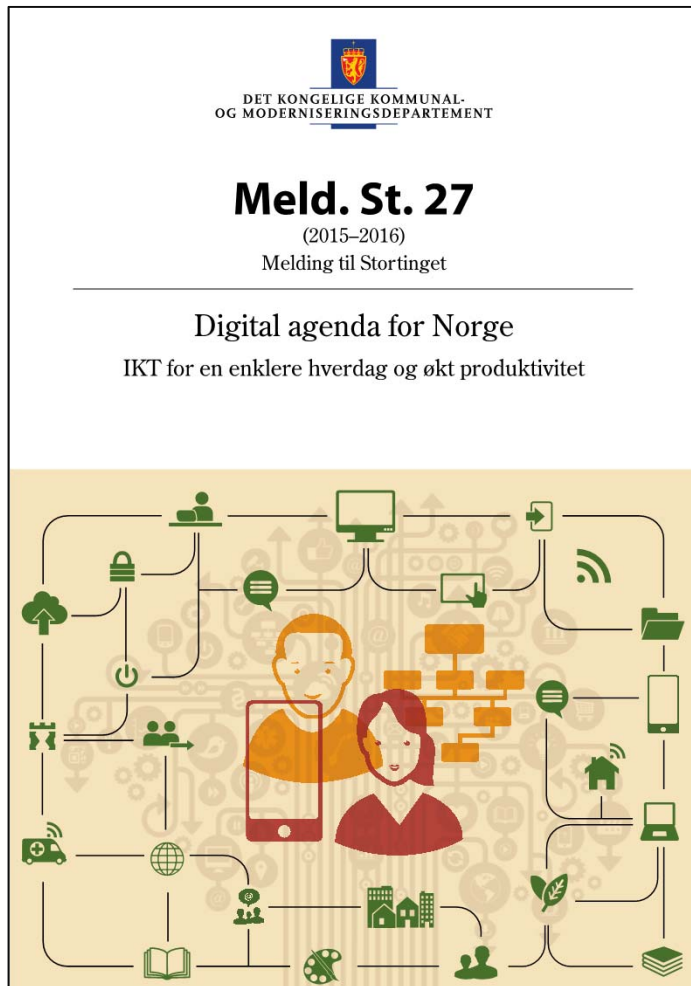


Reporting on outages gives consumers more details than operators postmortem brief press releases

Baltrunas et al. IEEE Infocom 2015, Zhou et al. NetSci 2016



# The government has recognized the role of measurements in it's 10-year plan



2015–2016

**Meld. St. 27**  
Digital agenda for Norge

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## Boks 29.1 Robusthet i mobilnett

Det finnes ingen allment akseptert metode for å måle og kvantifisere robusthet i mobilnett. Feilfrekvens i ulike nettverkskomponenter og støttesystemer, endringer i dekningsforhold, vedlikeholdsrutiner, stabilitet i tilkoblingen til nettet, pakketap og stabilitet i ytelse er alle parametere som sier noe om den totale robustheten i et mobilnett.

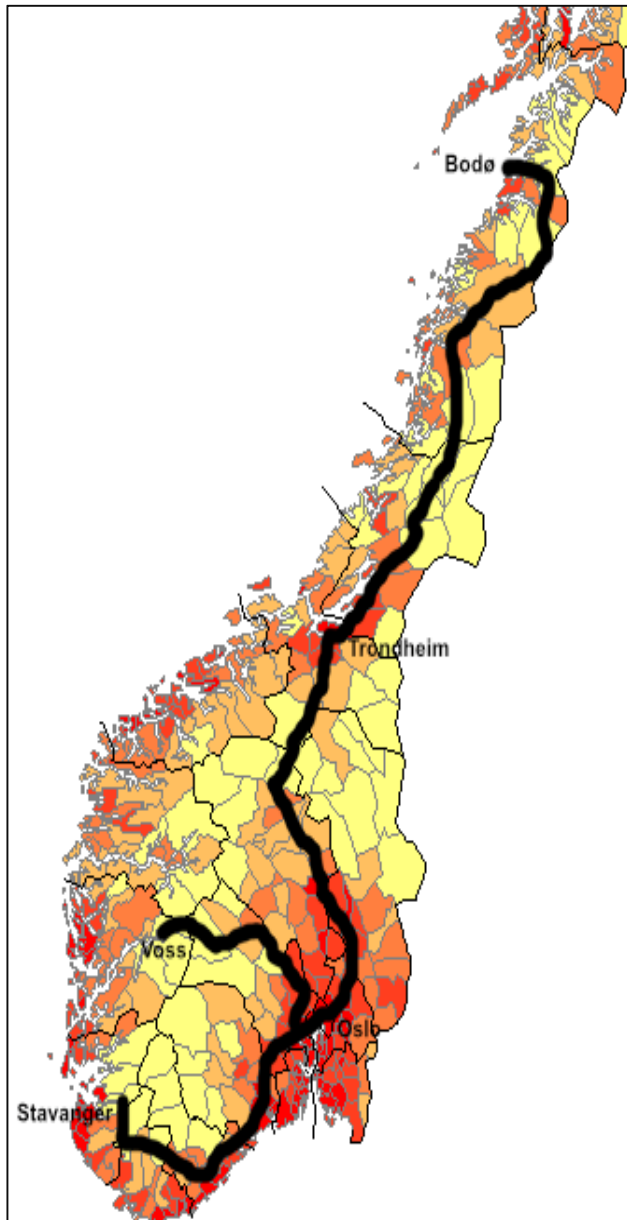
Robuste nett-senteret (CRNA) på Simula har målt robustheten i de norske ekomnettene de siste par årene. De måler opplevd robusthet på tre ulike nivåer. Stabilitet i tilkoblingen fanger opp hvor ofte og hvor lenge en mobilforbindelse mister kontakten med mobilnettet. Stabilitet i dataplanet sier noe om evnen til å sende data gjennom mobilnettet når kontakten er etablert. Stabilitet i ytelse beskriver evnen til å levere en jevn og forutsigbar ytelse til to typiske applikasjoner.

Den brukeropplevde stabiliteten i nettet har blitt bedre fra 2013 til 2014. Målingene viser

færre brudd i tilkoblingene, færre pakketap og høyere og mer stabil ytelse. Målingene viser at det arbeides godt med robusthet hos de norske mobiltilbyderne. Forbedringen gjelder alle tilbydere på så godt som alle måleparametre. Det må imidlertid understrekes at det kun foreligger data for to år. Så langt er det derfor ikke grunnlag for å konkludere med en trend som man kan forvente vil føre til ytterligere forbedringer i tiden fremover. Fortsatte målinger de kommende årene vil kunne gi et datagrunnlag for en mer presis analyse av hvilke utviklingstrekk som styrer robustheten i nettene.

Det er videre interessant å merke seg at nedetiden for brukerne kan reduseres med en faktor på 10 ved å koble seg til to ulike mobilnett. Ved tilkobling til to uavhengige nettverk, kan over 50 prosent av målenodene som er spredt ut over landet oppnå tilkobling til minst ett nett 99,999 prosent av tiden.

# Use data to inform policy decisions

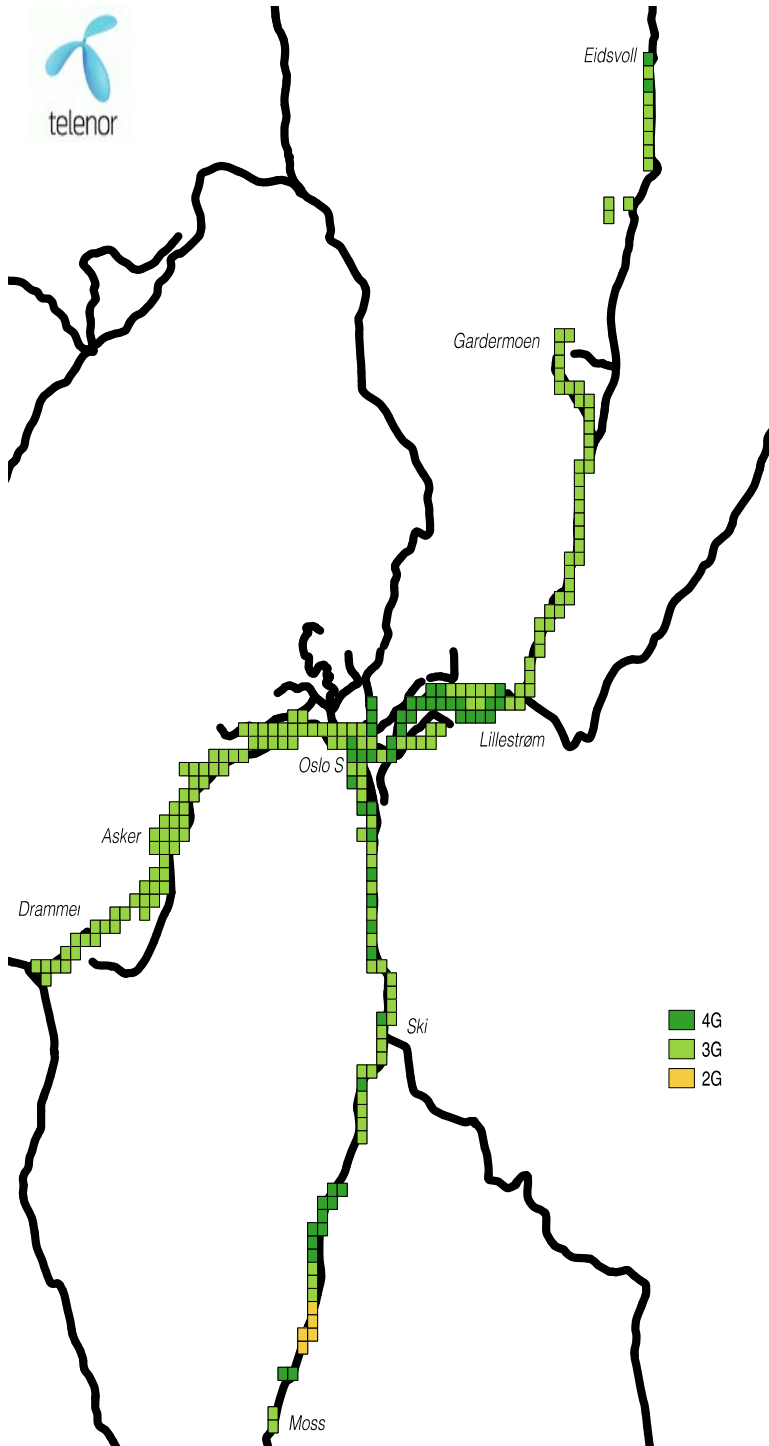


- Coverage on trains is bad, so shall we invest in signal repeaters?

Nodes on trains continuously measure experienced coverage (4G, 3G, 2G, No coverage)

Geo-tag all measurements and map them to 1kmx1km grids

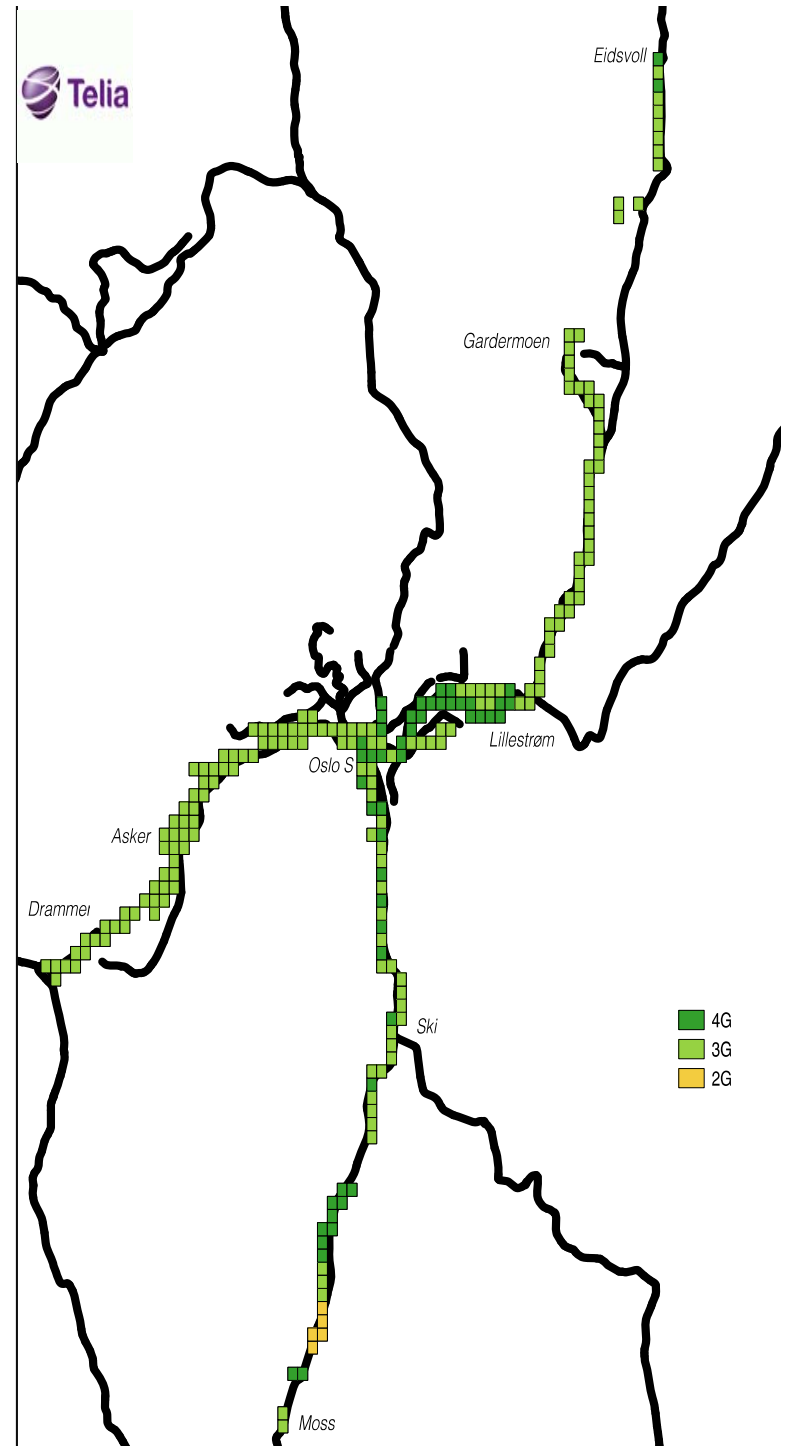
Measure typical coverage (most experienced) and optimistic (the best technology seen > 10% of the time)

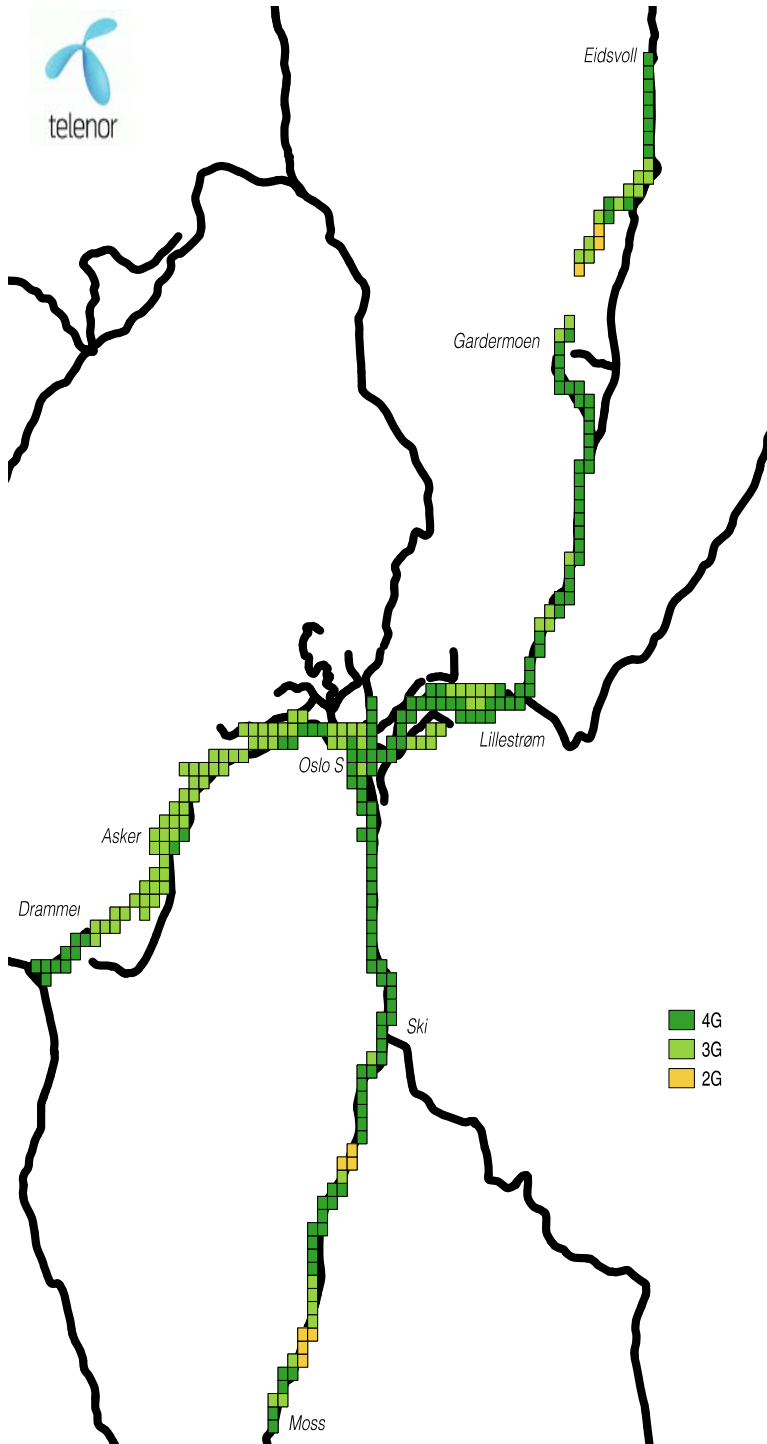


## Local train stretches

Typical coverage

Technology seen the most

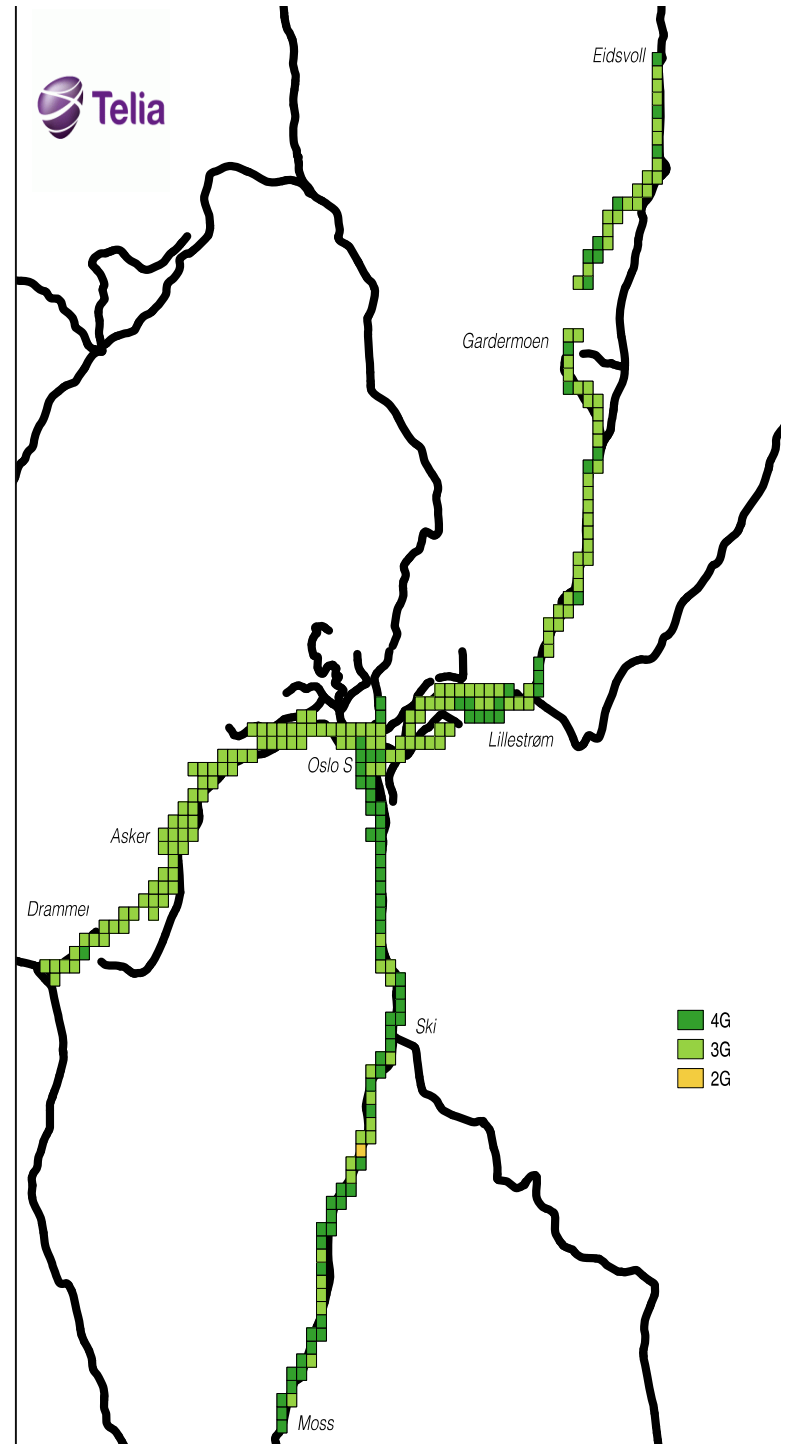




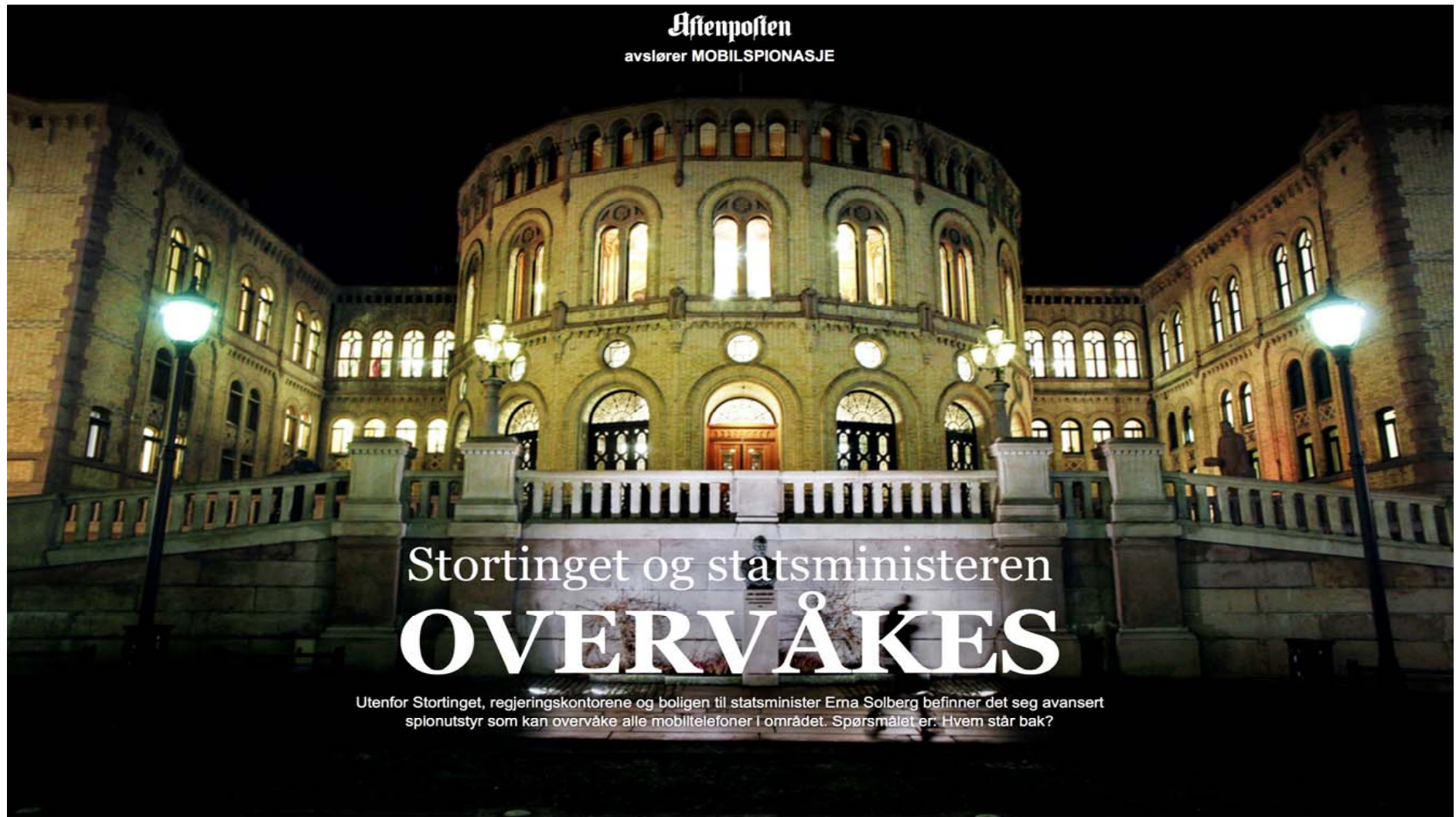
## Local train stretches

Optimistic coverage

Best technology seen at least 10% of the time



# Rogue cell phones surveillance devices in Oslo?



# Take initiative to inform current debates



Norges raskeste nett

Tek.no, test 23.05.2016. Gjennomsnittshastighet hele Norge: Telenor gjennomsnittshastighet 14,7 Mbps. Hastighet varierer etter abonnement og andre forhold. Les mer

4G+

Norges raskeste nett

Hos Telenor får du best taledekning i Norge, både ute og inne.

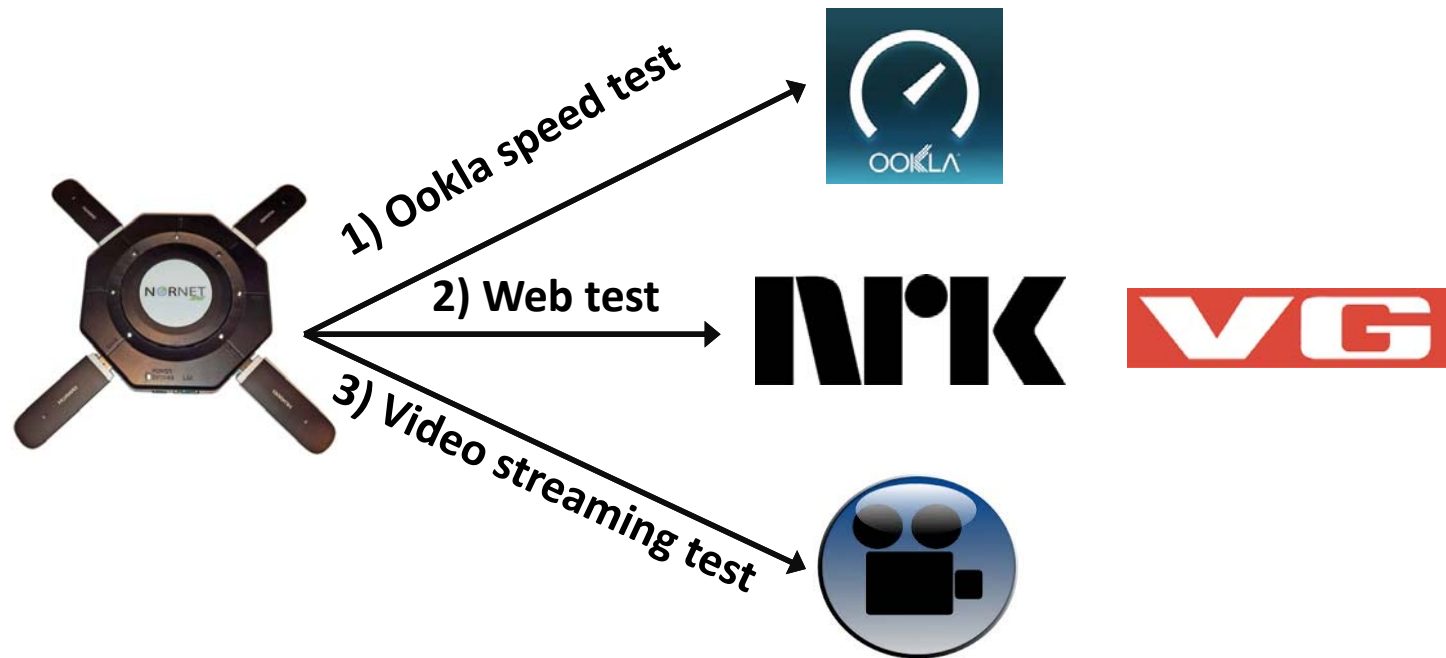
→

– Telenors bruk av «Norges raskeste nett» er å villedde forbrukerne

Forbrukerombudet krever at Telenor stanser eller endrer annonsene som viser til Tek.nos.dekningstest

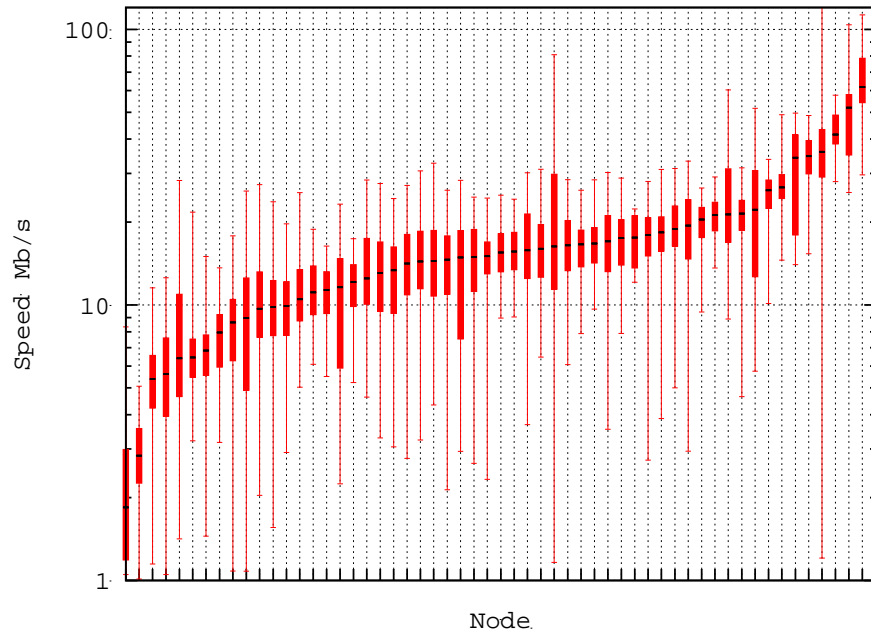
The pitfalls of using speedtest results by operators in their marketing campaigns.

# Measure download speed in connection with web and streaming performance

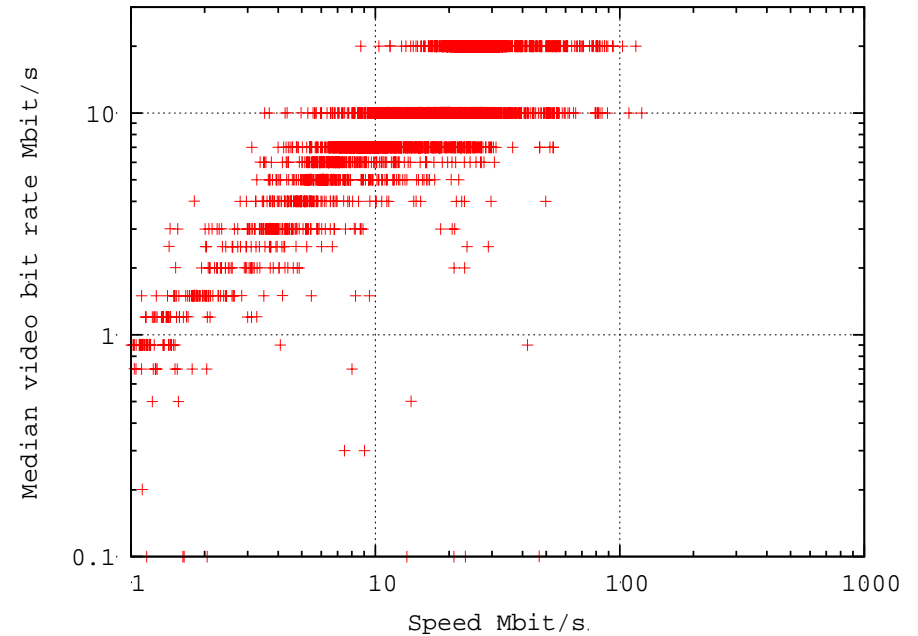
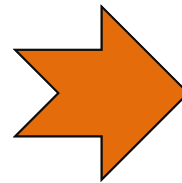


- Load the first page of the two most popular websites in Norway
- Dash streaming a 30-seconds long video that is divided into 15 chunks with bit rate from 100kb/s to 20Mb/s

# More meaningful metrics are needed



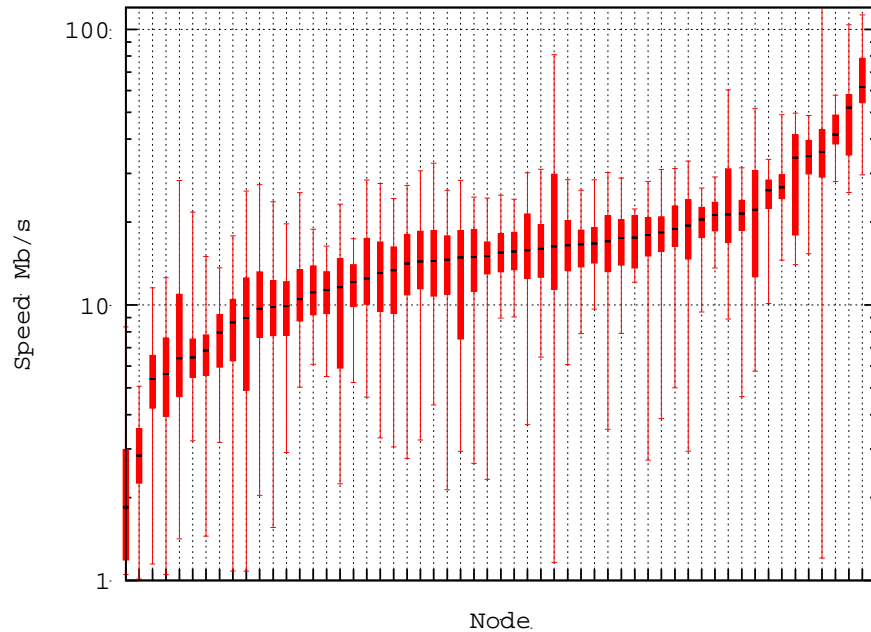
Speed varies widely although the nodes are stationary!



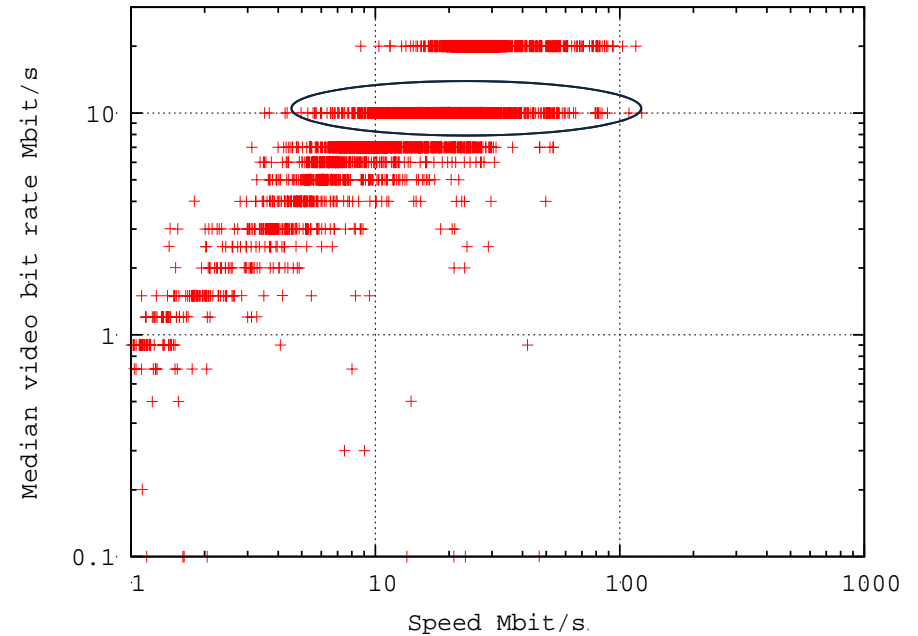
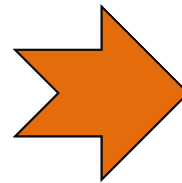
And that happens over a very short time scale.



# More meaningful metrics are needed



Speed varies widely although the nodes are stationary!



And that happens over a very short time scale.

# Dedicated end-to-end measurements are indispensable to all key stake-holders

- Informing policy can happen in different ways including:
  - Publishing periodic reports
  - Reporting on incidents
  - Take initiative to contribute to ongoing debates
- The needed input does not necessarily map to exciting research problems
- This is a whole different kind of impact
- There is however still a number of open difficult questions – This is likely to get more exciting

# Some interesting questions that can have policy implications

- Vulnerability of digital infrastructures to attacks and large scale failures
- Digital sovereignty. What if we put up a digital border?
- Measure new technologies like VoLTE, NB-IoT
- Congestion in cellular networks
- Access security in cellular networks