etomic
European Traffic Observatory Measurement Infrastructure

www.etomic.org

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etomic

Advanced Network Monitoring System for Future Internet Experimentation

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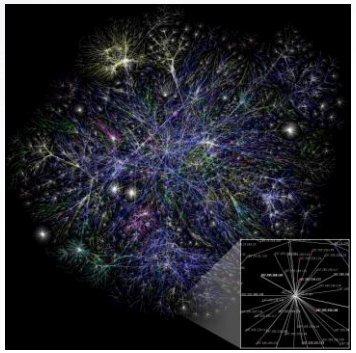
Why Internet experimental facilities are needed?

- Internet became a large scale and complex network
  - inefficient protocols
- in the Internet it is often not possible to measure traffic flows and other aspects of usage
- injecting active probes to discover these hiding properties
- Understanding the details of network and traffic dynamics
  - Topology changing
  - Queueing delay variations
  - Available bandwidth
  - One-way delay variations
  - etc.



- Models and analysis of measurement data and traffic dynamics could lead to a better design of Future Internet protocols

Existing TestBeds and Network Measurement Infrastructures

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DIMES

PLANETLAB
An open platform for developing, deploying, and accessing planetary-scale services

FEDERICA

Panlab
Pan European Laboratory Infrastructure Implementation

MLAB beta

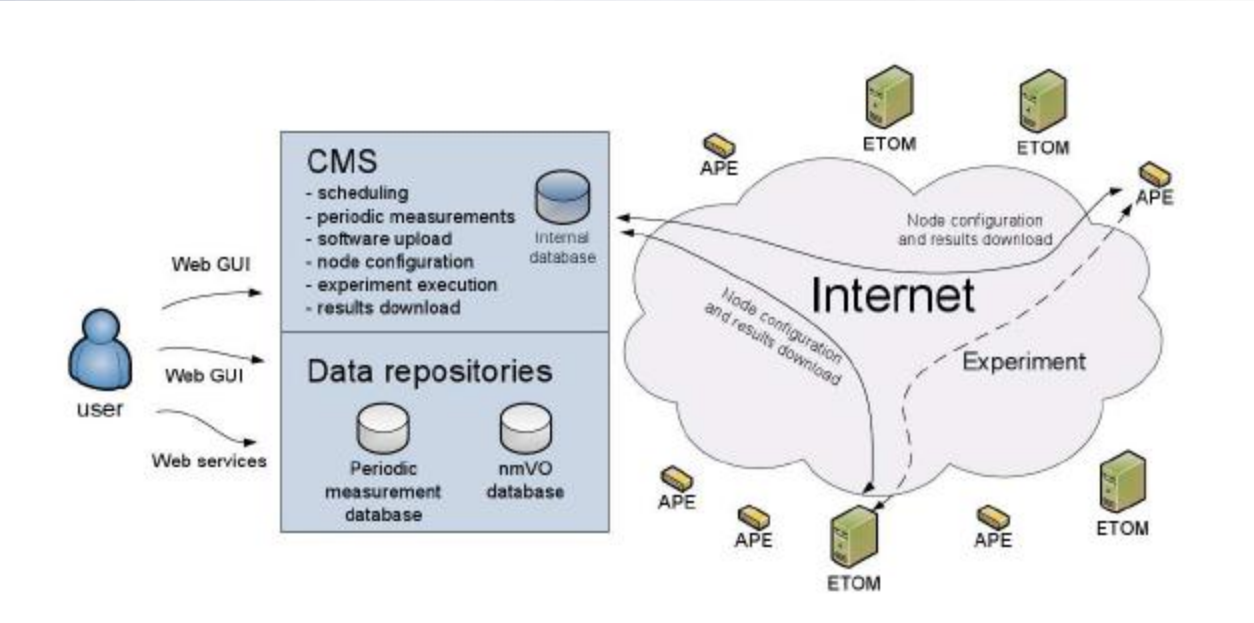
The etomic system

- The **E**uropean **T**raffic **O**bservatory **M**easurement **I**nfrastru**C**ture (etomic) was created in 2004 within the **Evergrow** Integrated Project
- Since 2005 also supported by the ***Hungarian Office for Research and Technology***
- Its goals:
  - **open access, public testbed for researcher**
  - **high precision timestamping**
  - **GPS synchronized**
- Since 2008 in ***Onelab-2* etomic** is federated in the Advanced Network Monitoring Equipment

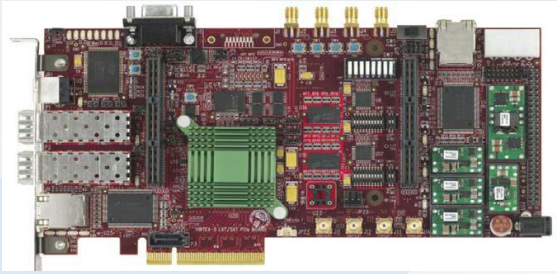
tridentcom'05
Best Testbed Award

System architecture

- Measurement nodes
  - Advanced probing nodes called ETOMs
  - Lightweight APE boxes
- Central Management System
- Data repositories
  - Network Measurement Virtual Observatory



Evolution of measurement nodes



2009

ETOMs with ARGOS cards

2008

Low-cost APE boxes

2004

ETOMs with DAG cards

ETOMs

- ETOMs with DAG
  - Intel S875WP1E server
  - Debian Linux
  - Endace DAG 3.6GE
    - 60 ns precision
  - GPS synchronized
  - Special C API for programing the DAG card
  - User space applications
    - Packet sender, capturer

- ETOMs with ARGOS
  - HP ProLiant ML370 server
  - Ubuntu Linux
  - Quad core processor
  - ARGOS card (dev. at UAM)
    - 10 ns precision
    - based on netFPGA
  - GPS synchronized
  - No need special API
  - Standard pcap library can be used

APE boxes

- **A**ctive **P**robing **E**quipment
  - **low cost** network measurment device
    - ca. 300 €
    - based on a **Blackfin** programmable board

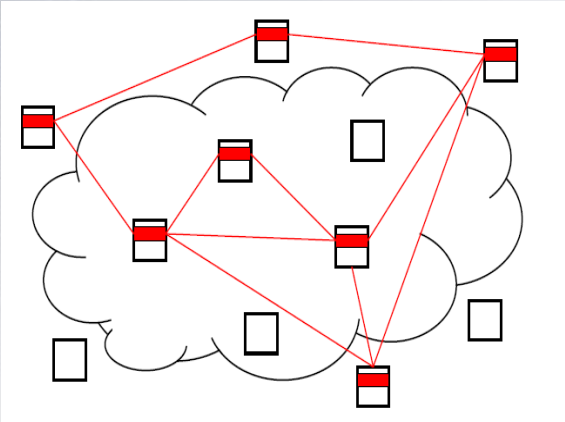
    - developed at Eötvös Loránd University
  - **100 ns** precision
  - **GPS synchronized**
  - uClinux - **Linux** operating system for embedded systems
  - **Low energy consumption** ☺
  - **web service interface** for performing predefined measurements (ping, traceroute, packet train sender, capturer, etc.)

Central Management System

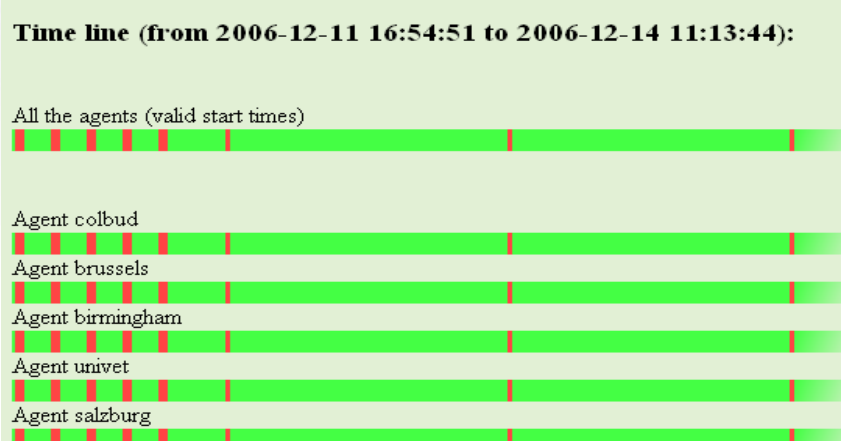
- IBM Blade server
- Key tasks
  - User management
  - Node maintenance
  - Experiment scheduling
  - Storing experimental results (temporally)
- Web GUI

Slices VS Unique timeslots

- **In PlanetLab**
  - Virtualization
  - Slices
  - Sharing the resources
    - Introducing too much unpredictability in timing measurements
  - Low precision timestamping



- **In etomic**
  - No virtualization
  - No slices
  - Unique timeslots
    - You own all the resources you need during the experimentation
  - High precision timestamping

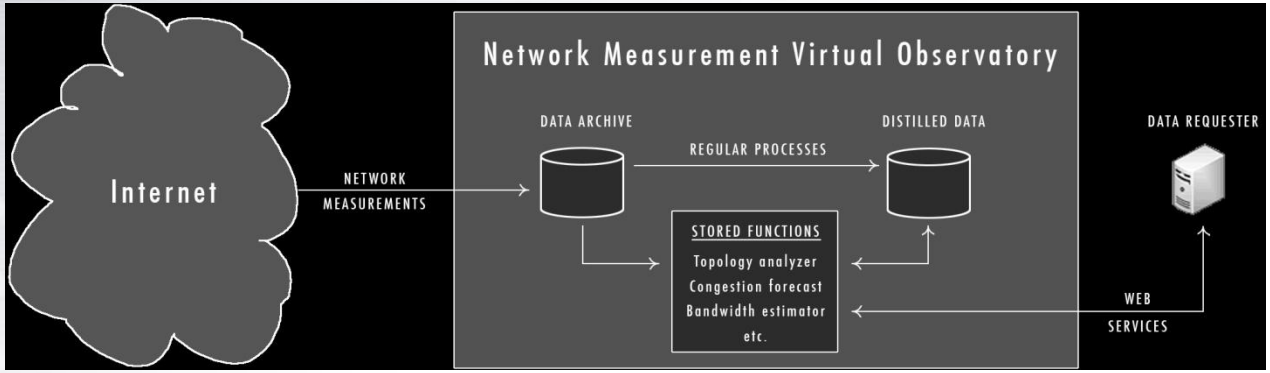


Publishing measurement data

- Why is it important to store and publish measurement data?
  - Reproducibility of experiments
  - Cross validation using different data sources
  - Joint analysis of different types of data
  - Proofing new concepts
- Our solution
  - The concept of Virtual Observatory is well known in other scientific areas
    - Astronomy, biology, etc.
  - Integration with the measurement infrastructure
  - **Network Measurement Virtual Observatory (nmVO)**

Network Measurement Virtual Observatory

- What does the etomic-nmVO provide?
  - store & share raw data
    - joint analysis of different types of measurement data
    - reanalysis (with new evaluation methods)
    - reference data (historical comparison)
  - share analysis tools
    - server side processing simplifies client applications
    - no need to transfer bulk data packages: online processing
    - storing the evaluated data as well as the raw data and measurement parameters



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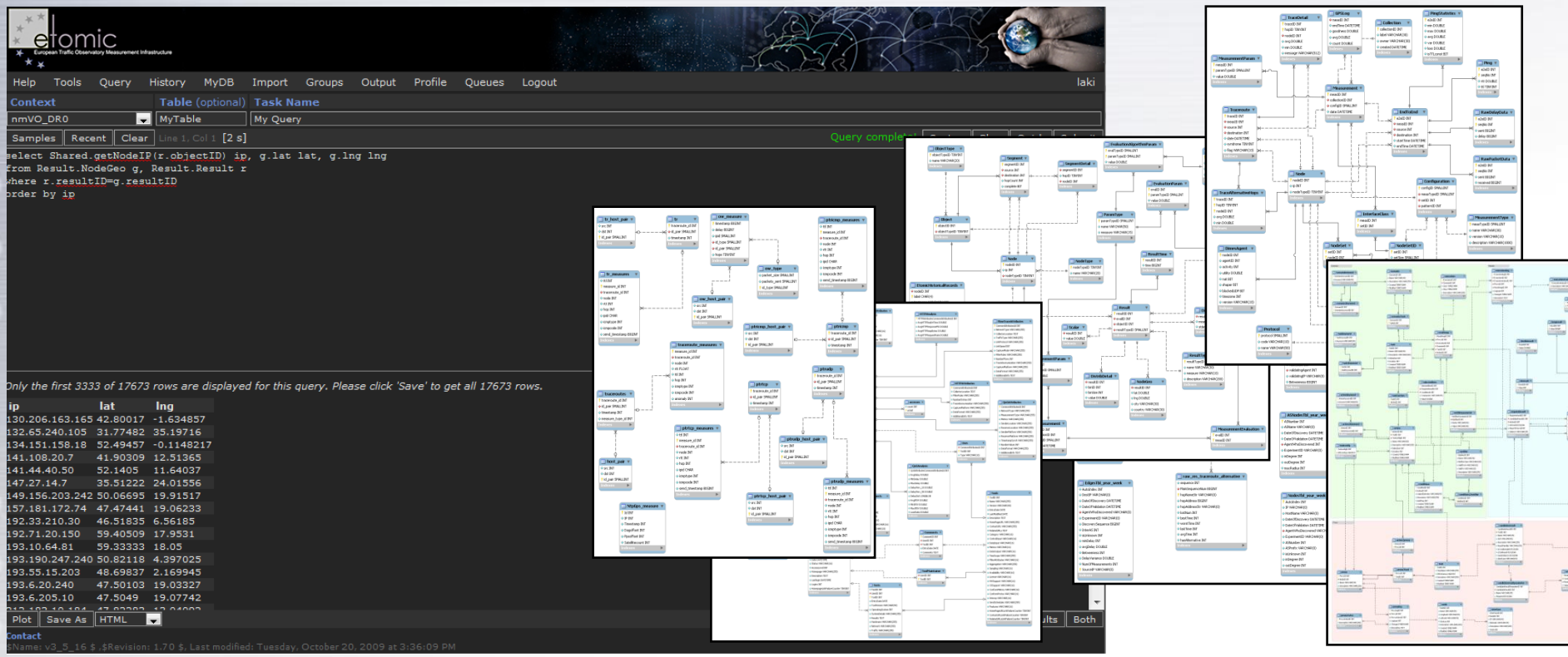
Casjobs User Interface for accessing data

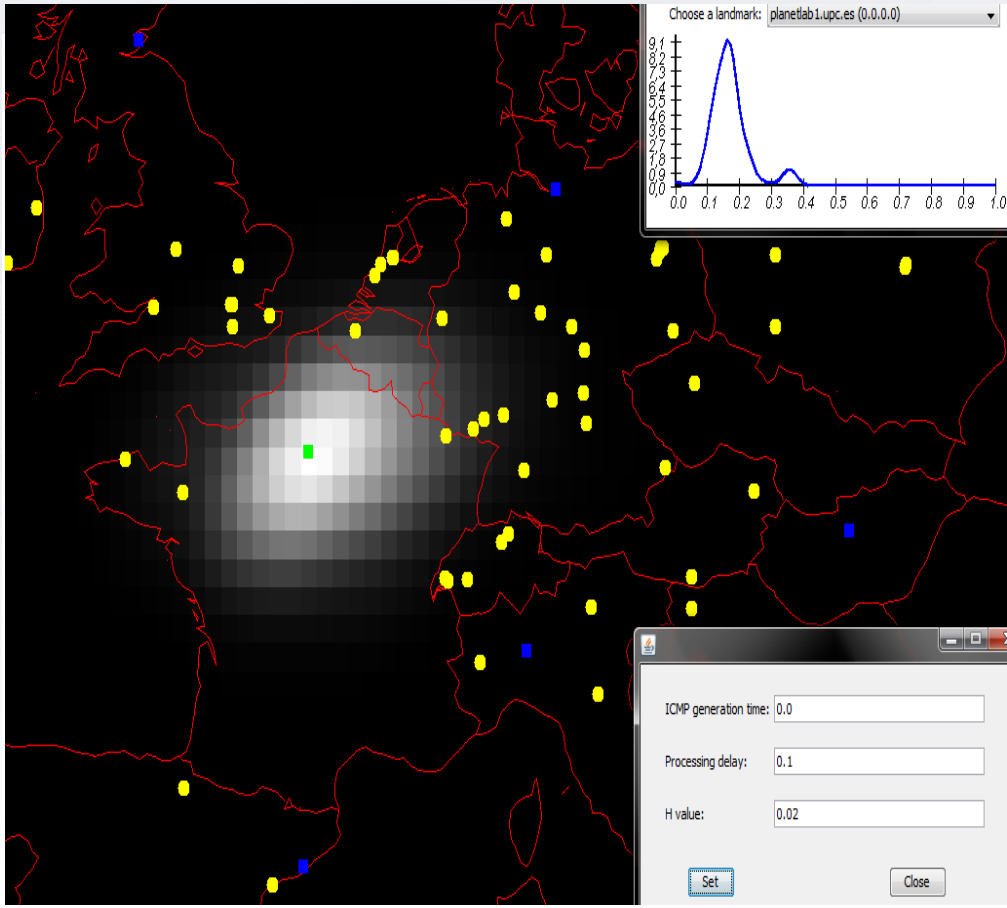
The **N**etwork **M**easurement **V**irtual **O**bservatory is available at

http://www.etomic.org/database



Some experimental use cases

- one way delay (60nanosec resolution)
- tracking topology changes
- available bandwidth meter
- transport protocol testing
- queuing delay tomography
- geolocation experiments
- …



The etomic system

Onelab-2:

26 partners
in 13 countries

ETOMIC:

ca. 40 ETOMs and
20 APE boxes
on more than 20
different sites

ETOMIC

www.etomic.org

ANME

www.onelab.eu
www.etomic.org

Thank you for your attention!

SEVENTH FRAMEWORK PROGRAMME

Visit and register:

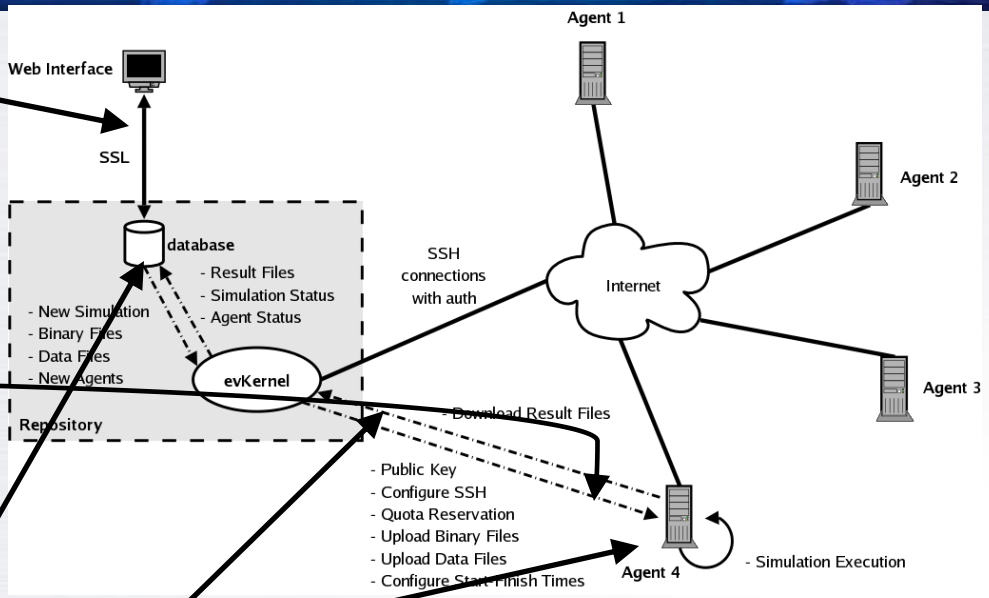
www.etomic.org

E-mail: laki@etomic.org

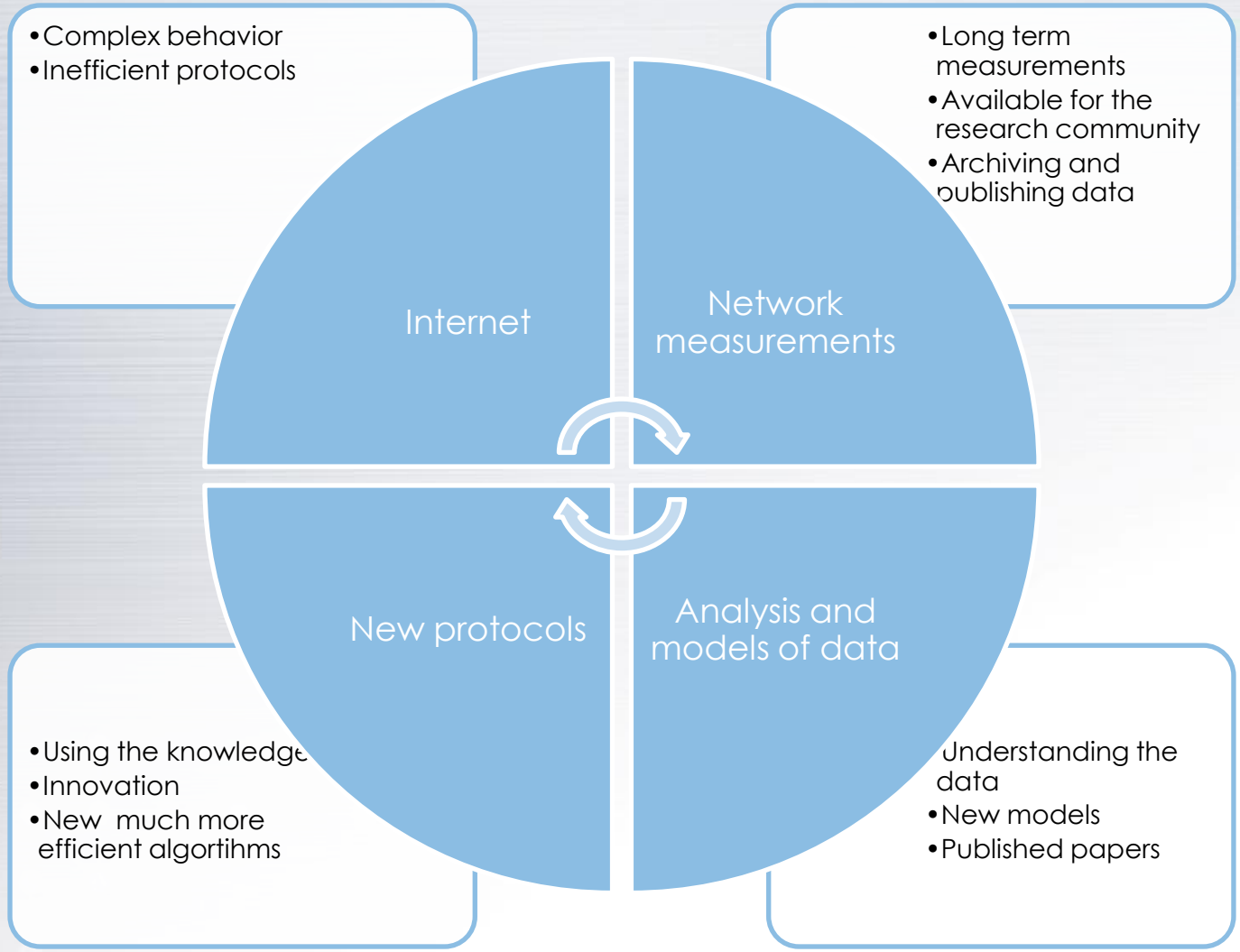
OneLab FUTURE INTERNET TEST BEDS
MOMENT
NKTH National Office for Research and Technology
ERICSSON TAKING YOU FORWARD
CNDA

Performing an experiment

- Setting up an experiment
  - Uploading scripts, data files
  - Selecting measurement agents
  - Reserving one or more timeslots
- Initializing phase
  - Reserving the selected measurement agents
  - Uploading measurement scripts and other files needed for the experiment
- Execution phase
  - Running the uploaded scripts with the preconfigured settings on the etomic nodes
- Data collection phase
  - Downloading and storing the resulting data files in the CMS database



Lifecycle of network measurements



Measurement boxes

	ETOM w DAG	ETOM w ARGOS	APE	PlanetLab
platform	Intel server PC	HP server PC	Blackfin board	various server PC

Open Repository

Periodic measurements

- Available continuous measurements: One Way Delay
  - One Way Delay
  - Traceroute
  - ntp-gps
  - Traceroute new
  - ParisTraceroute ICMP
  - ParisTraceroute UDP
  - ParisTraceroute TCP
- Measurement description:

These are one way delay measurer odes in ETOMIC system.
The measurements are done with vare timestamps and GPS synchronization.
Series of probe packets are sent se

The data file has one line for each sample. The first line is a description.
Each line has several columns separated by one blank space each.

First two lines example:

#src dst timestamp delay hops ipid packet_size packets_sent
130.206.163.166 130.206.163.166 341251741984249 147760 1 1 46 300
Each column meaning:

src:	IP address of the source node.
dst:	IP address of the destination mode.
timestamp:	when the packet was sent. The format is in nanoseconds since 1st of January of 1970.
delay:	one way delay measurement in nanoseconds.
hops:	number of hops that this packet went through.
ipid:	identifier of IP header for this packet (from 1 to the number of packets in the series packets_sent).
packet_size:	packet size in bytes.
packets_sent:	total number of packet sent in this series.

Access