

Blue Force Tracker – an IP-based broadcast application

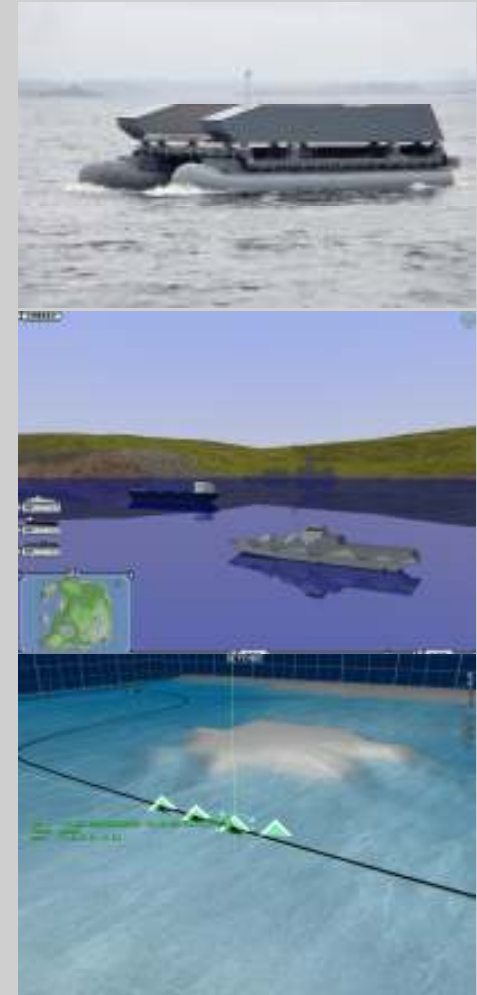
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Background

- Kockums Network Enabled Capabilities (NEC) R&D program
 - to understand network mechanisms and how they may affect naval systems
 - to understand and develop mechanisms for group control of unmanned vessels
- Co-operation with Blekinge institute of technology (BTH) based on the Open Computational Systems (OCS) model:
 - Service oriented layered architectures (2001)
 - Self synchronisation / info-fusion (2002)
 - Multiple organisations / network exploration (2004)
 - Vessel command / group management (2005)
- In-house development and field tests
 - the Distributed Blue Force Tracker (2006-2007)
 - The Piraya USV system (2007 – 2009)

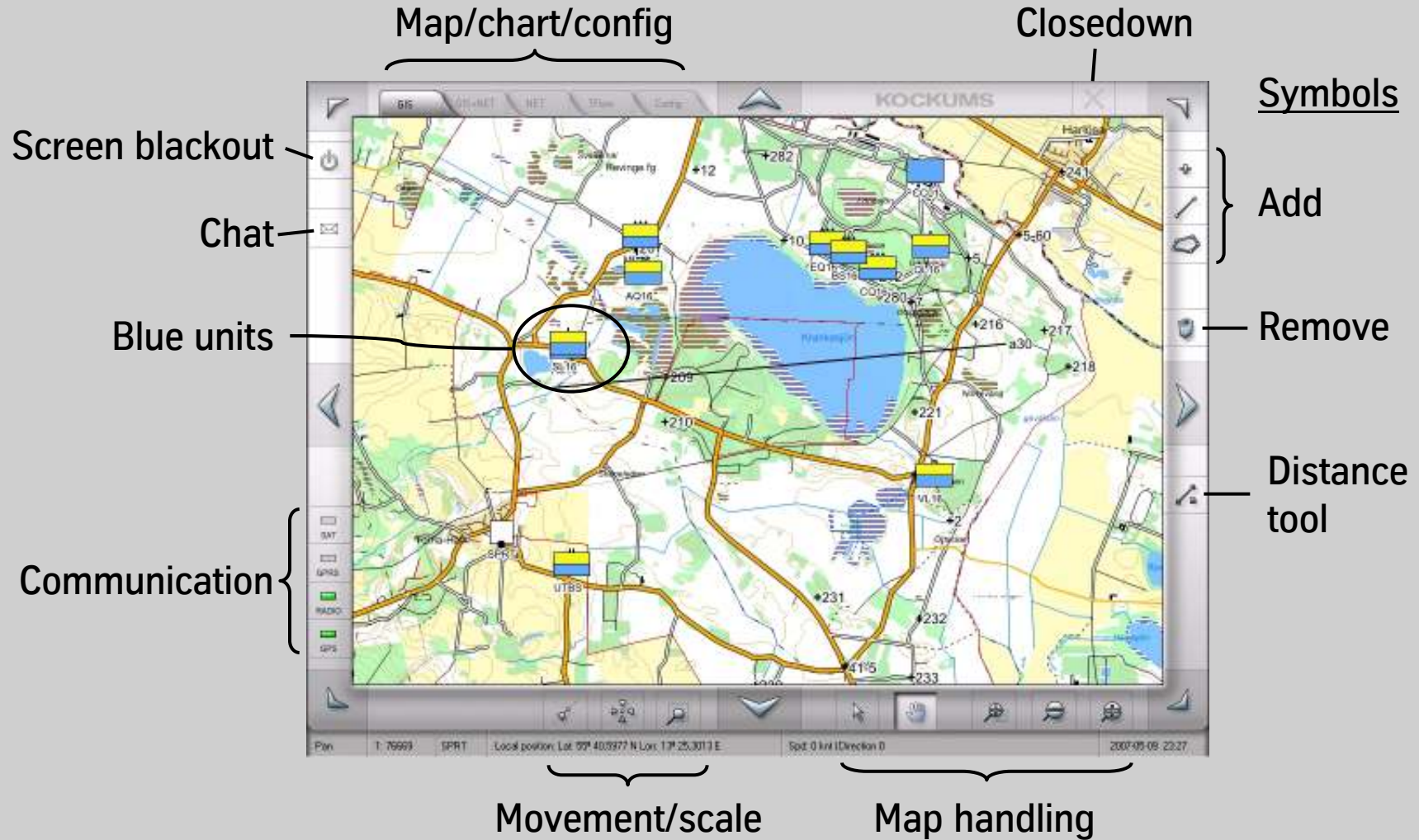


The Distributed Blue Force Tracking (DBFT) framework

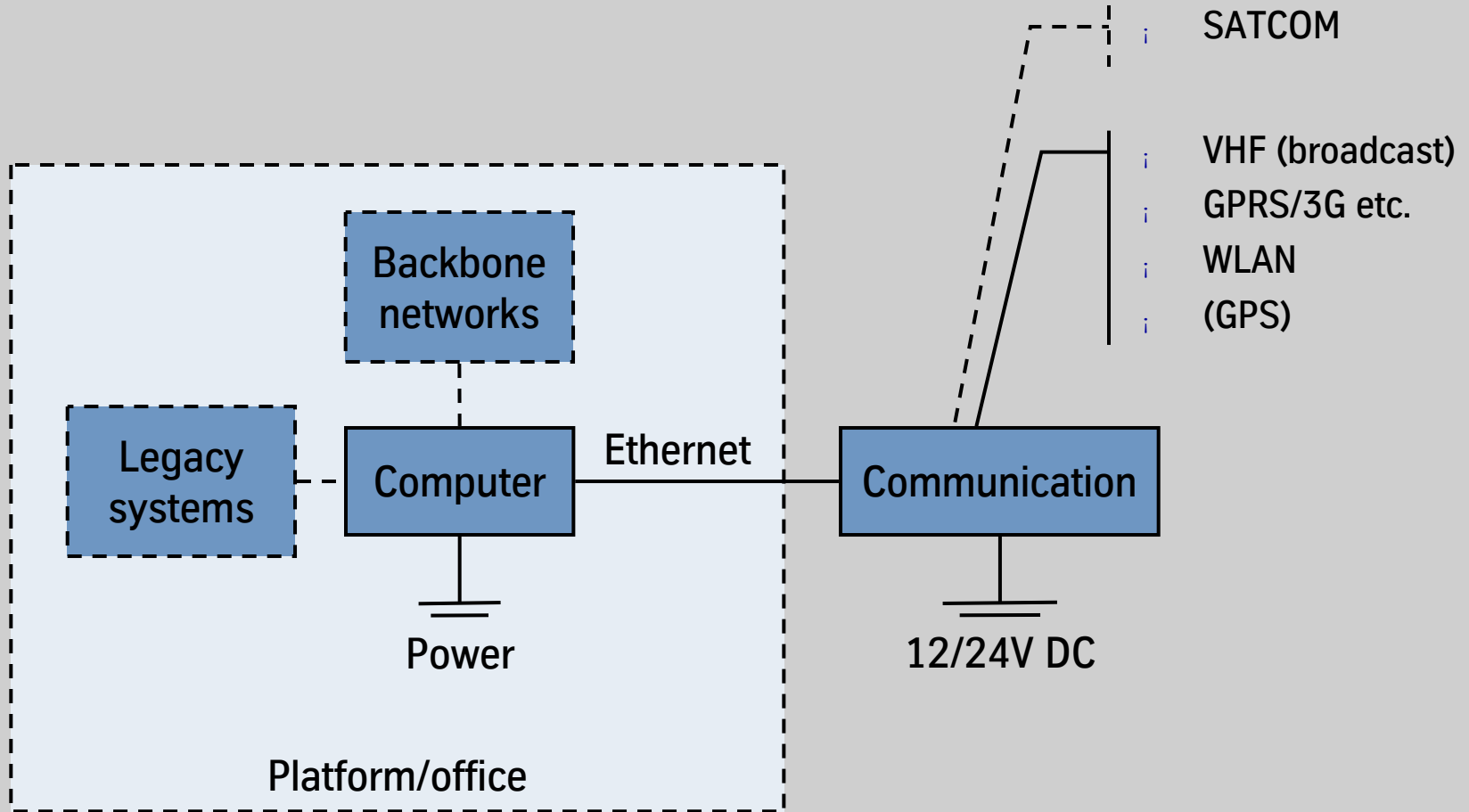
- Where am I? Where are my buddies? And a few more functions. Users say: Add no more!
- Tested with the training command at the Södra Skånska Regimentet P7
- Installs in non-combat vehicles. Unclassified system
- Commercial off-the-shelf hardware
- Peer-based design. All nodes are equal members. No node is critical to the network
- Ad-hoc and emergent behaviour. Nodes are entering and leaving the network at any time
- Routing is automated. Available channels are used
- Easy to use makes easy to learn. Intuitive <= 30min



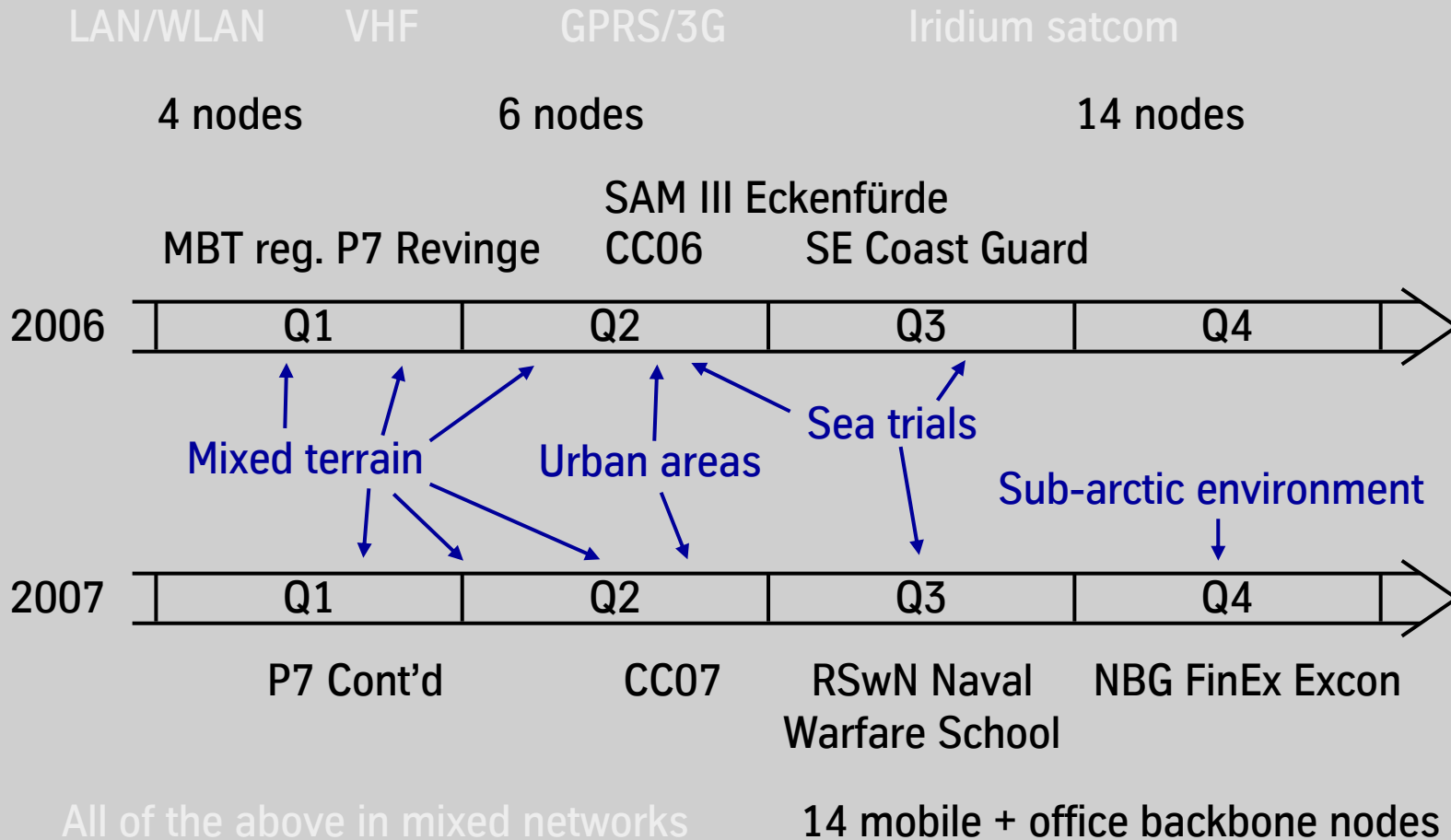
DBFT touch screen user interface



DBFT integration with legacy systems and/or preferred networks



DBFT development and test activities 2006-2007



Field test: NBG FinEx Jokkmokk/Vuollerim w0745

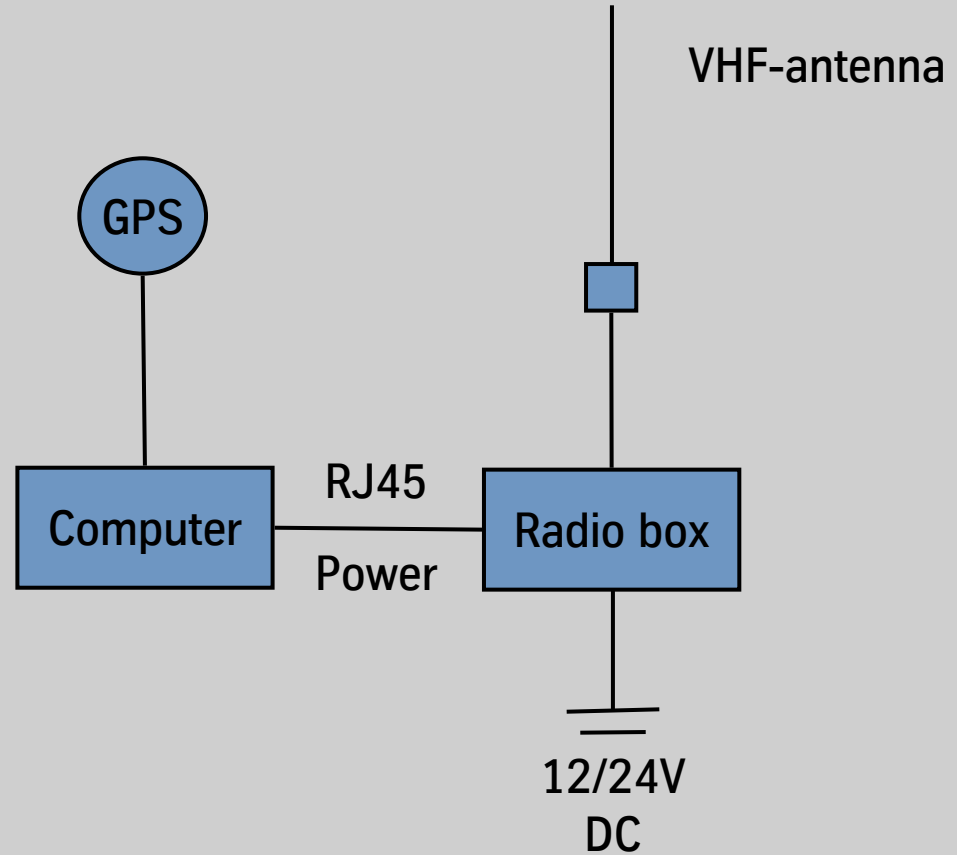


These are the same places

We are here!



DBFT stand alone node

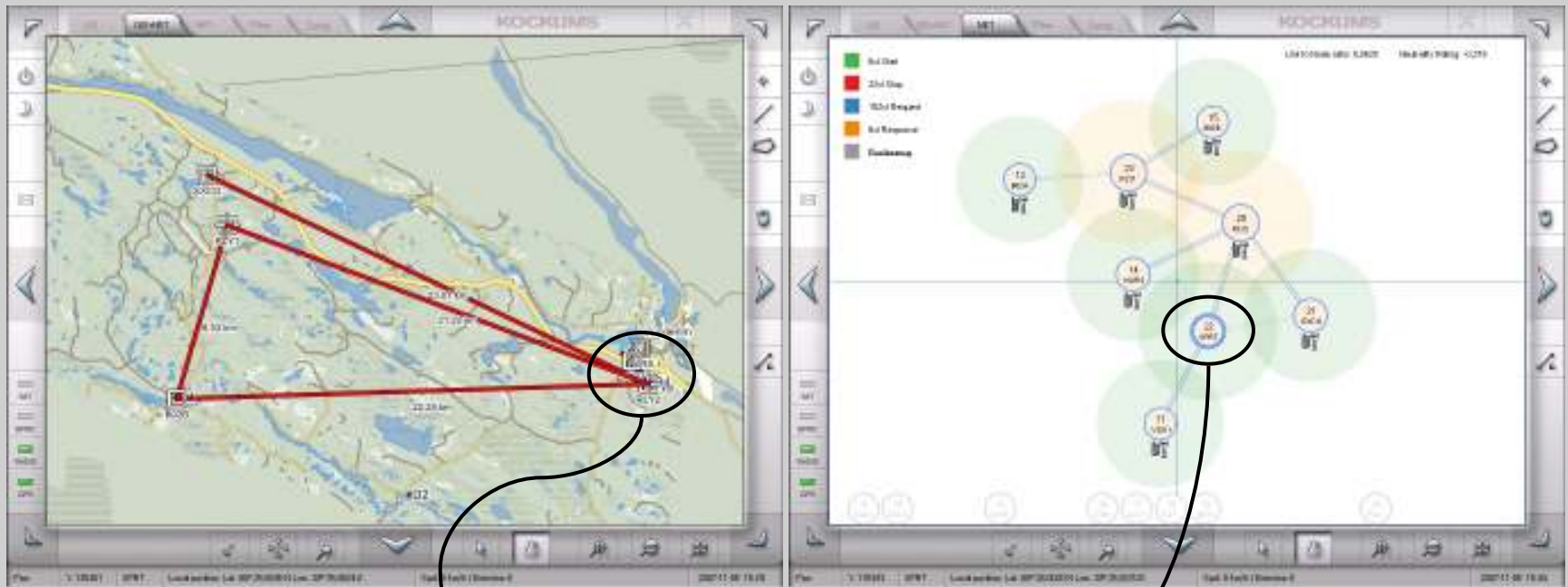


Installations: Support (SPRT), relay node 2 (RLY2) and Vuollerim 1 (VOU1)



Example: Real time views of routed VHF network

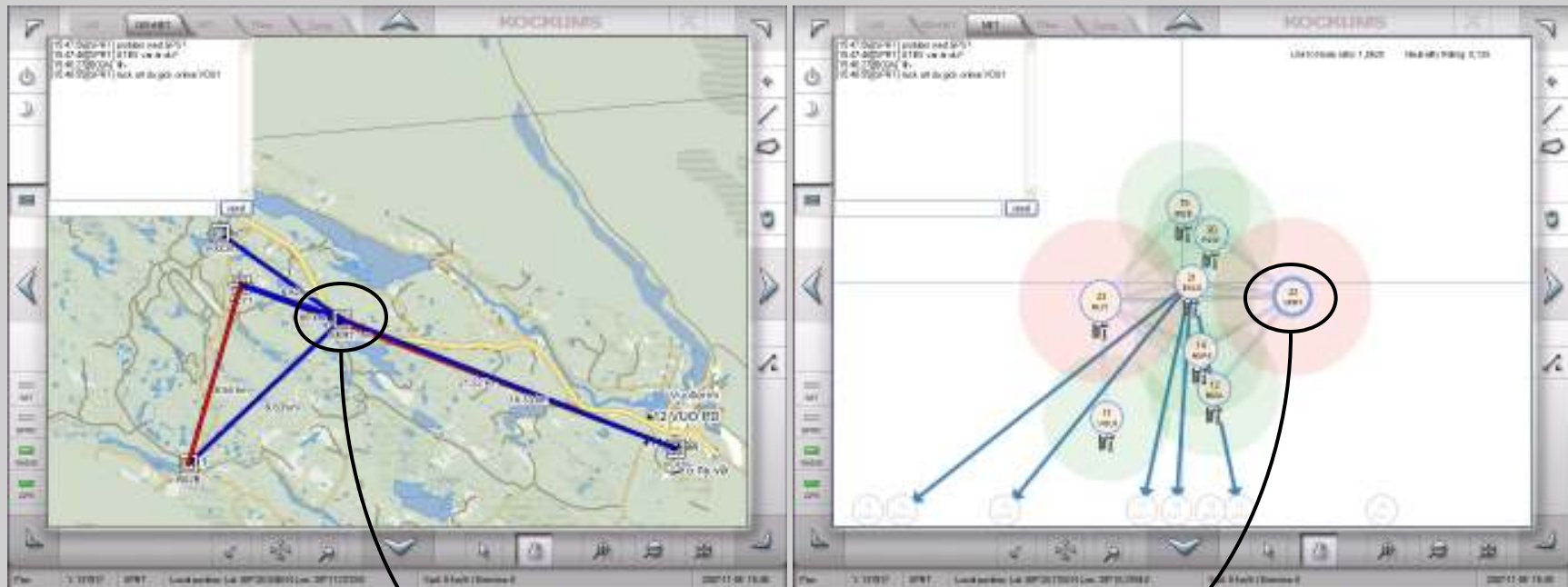
The paths of incoming messages can be monitored in the field



The observation node is here

Example: Real time views of routed VHF network, 15 min later

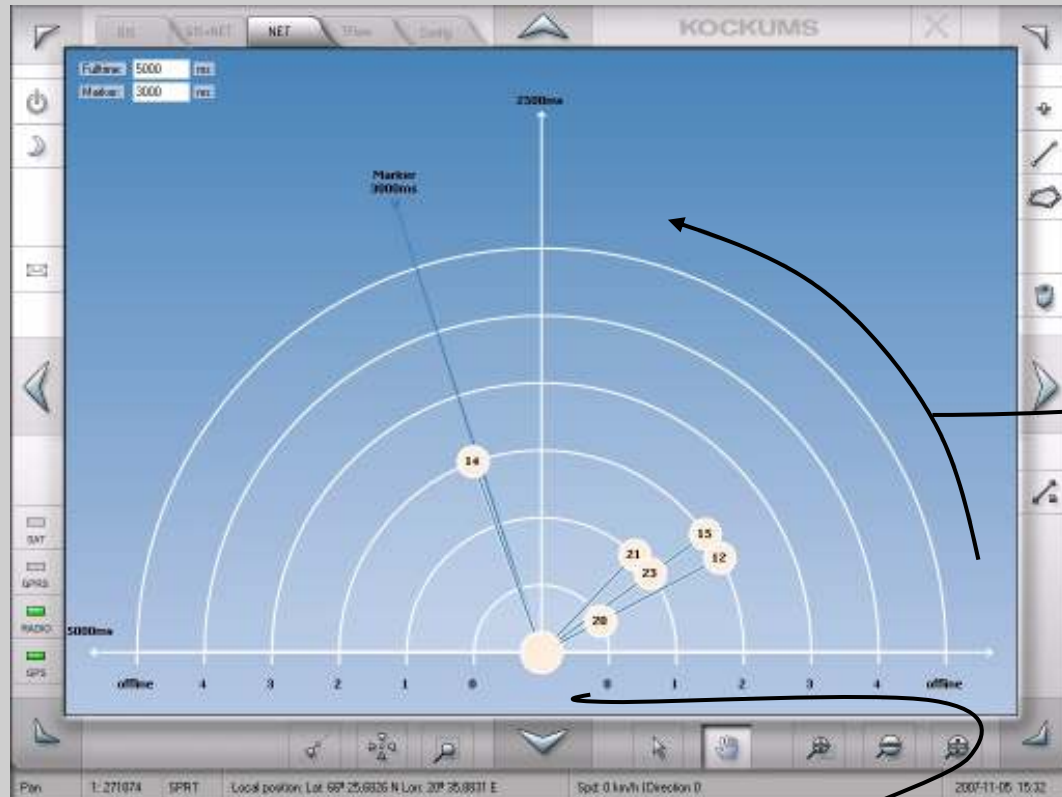
As the node is moving, the network reconfigures itself



The observation node is here

Example: Online analysis of message latency in the routed VHF network

Real time visualisation of "age" of messages that flow into one node

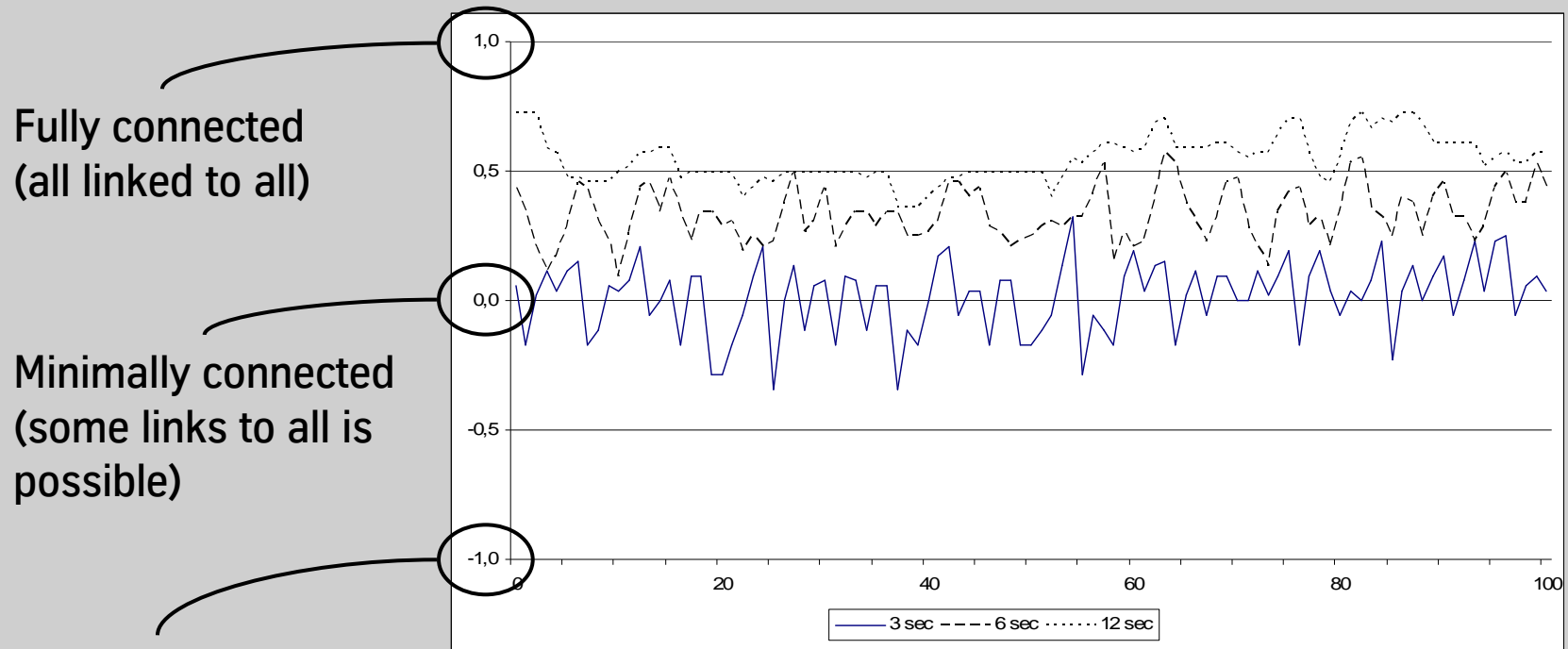


Older messages,
Increasing angle

More linked, farther out

Example: Offline analysis of data latency in the routed VHF network

Directed Normalised Neutrality Rating (DNNR) in the full network (8 nodes)



Fully connected
(all linked to all)

Minimally connected
(some links to all is possible)

No connections
(no links at all)

...given that we accept data this old

To be continued...

R&D program Distributed Naval Forces Concepts



- i Goal: Investigate network forces operational capabilities
 - i Recombination of heterogeneous elements for adaptive multiscale forces
 - i Dispersion of assets – obscuring existence and interaction patterns
 - i Persistent missions – changing assets while maintaining operations

- i Means: Group control for autonomous USV's to support sub-littoral operations
 - i The Piraya experimental USV platform
 - i The autonomous vehicle control tool (AVC)

- i Sample of tasks:
 - i Environment monitoring. NBC sensory tasks
 - i Communication relay stations
 - i Logistic support and supply unit
 - i Target practice. Ordnance delivery



The Piraya tactical unmanned surface vessel (TUSV) system



- ┆ Platform for TUSV control tech./meth. development
 - ┆ Deep-V hull, 4.1 x 1.3 m composite structure
 - ┆ Payload: 100 kg. Tot. displacement <400 kg
 - ┆ Propulsion: 20 hp four stroke outboarder
 - ┆ Top speed: 20 knots. Range: 60 M
 - ┆ Robust construction. Small logistics footprint

- ┆ Autonomous Vessel Control tool (AVC)
 - ┆ High level multi-vessel coordination
 - ┆ Mission definition and distribution
 - ┆ Resource allocation and status monitoring



Piraya TUSV conceptual overview



Autopilots for navigation

Autonomous Vessel Control

VHF/WLAN-based groups

Pi11

Pi12

Pi13

Pi14

R/C control for manouvering and safety

R/C 11

R/C 12

R/C 13

R/C 14



Tactical Network Topologies (TNT) field experimentation program



- Cooperation with RSwn Naval Warfare Centre,
- Lead by Naval Postgraduate School; twice a year
- Riverine and Maritime Interdiction Operations (MIO)
- Current scenario
 - Collaboration for handling of maritime sourced nuclear radiation threat
 - Port Administration of New York New Jersey and LLNL

Summary and future works

- i Peer-based broadcast systems can be used as routed networks, in combination with other IP based means for communication
- i We are developing our understanding of temporal phenomena in such asynchronous networks. These are pivotal for control applications.
- i Continued cooperation with
 - i the RSwN Warfare Centre and Amphibious Forces
 - i the Tactical Network Topologies Program (US NPS)
- i Development of and experimentation with the Piraya and related systems
- i Continued development of network concepts and experimental methodologies



Thank you for your attention!

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