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# CONSIS: COALITION NETWORK FOR SECURE INFORMATION SHARING

WlnnComm-Europe 2015, 5<sup>th</sup> Annual Tactical Radio Workshop:  
Coalition Interoperability

Erlangen, Germany, October 7<sup>th</sup> 2015

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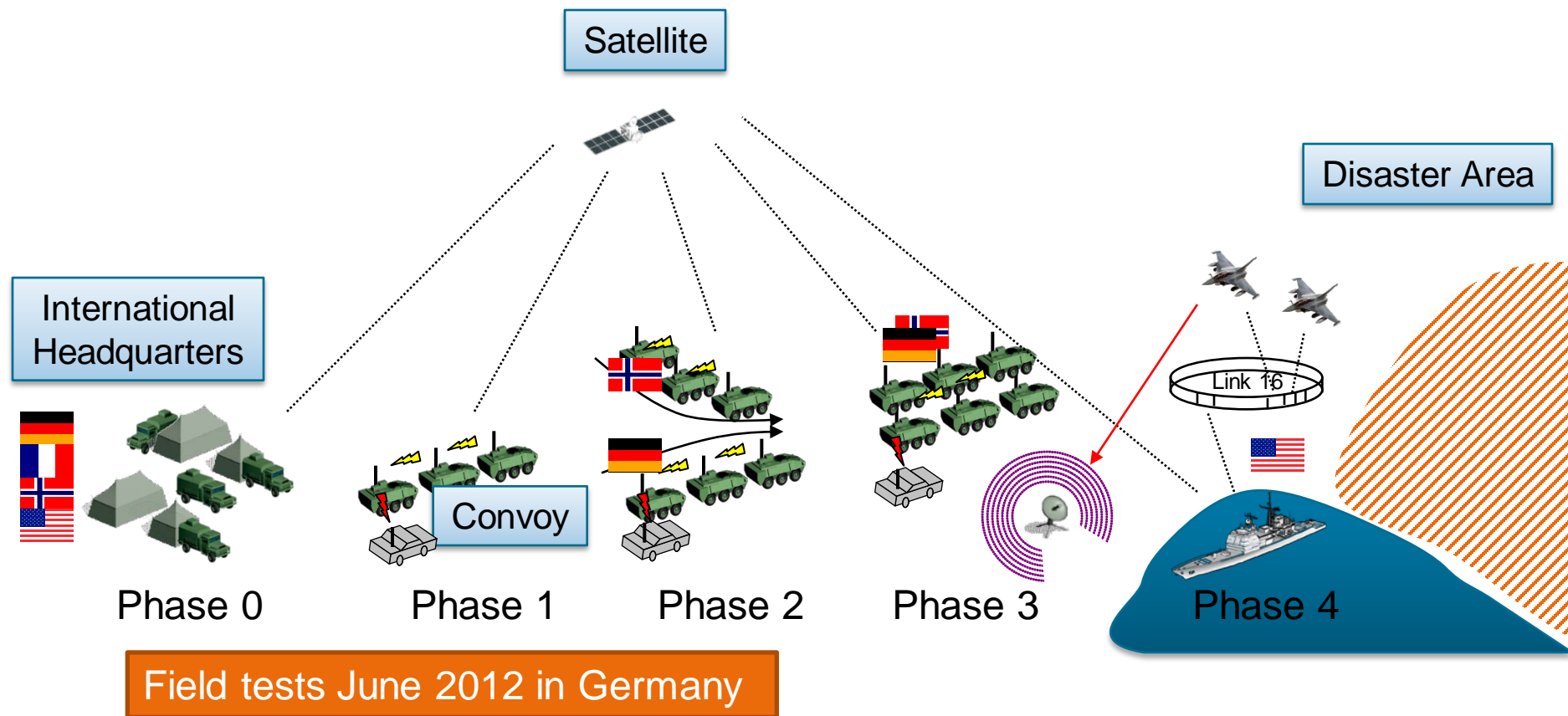
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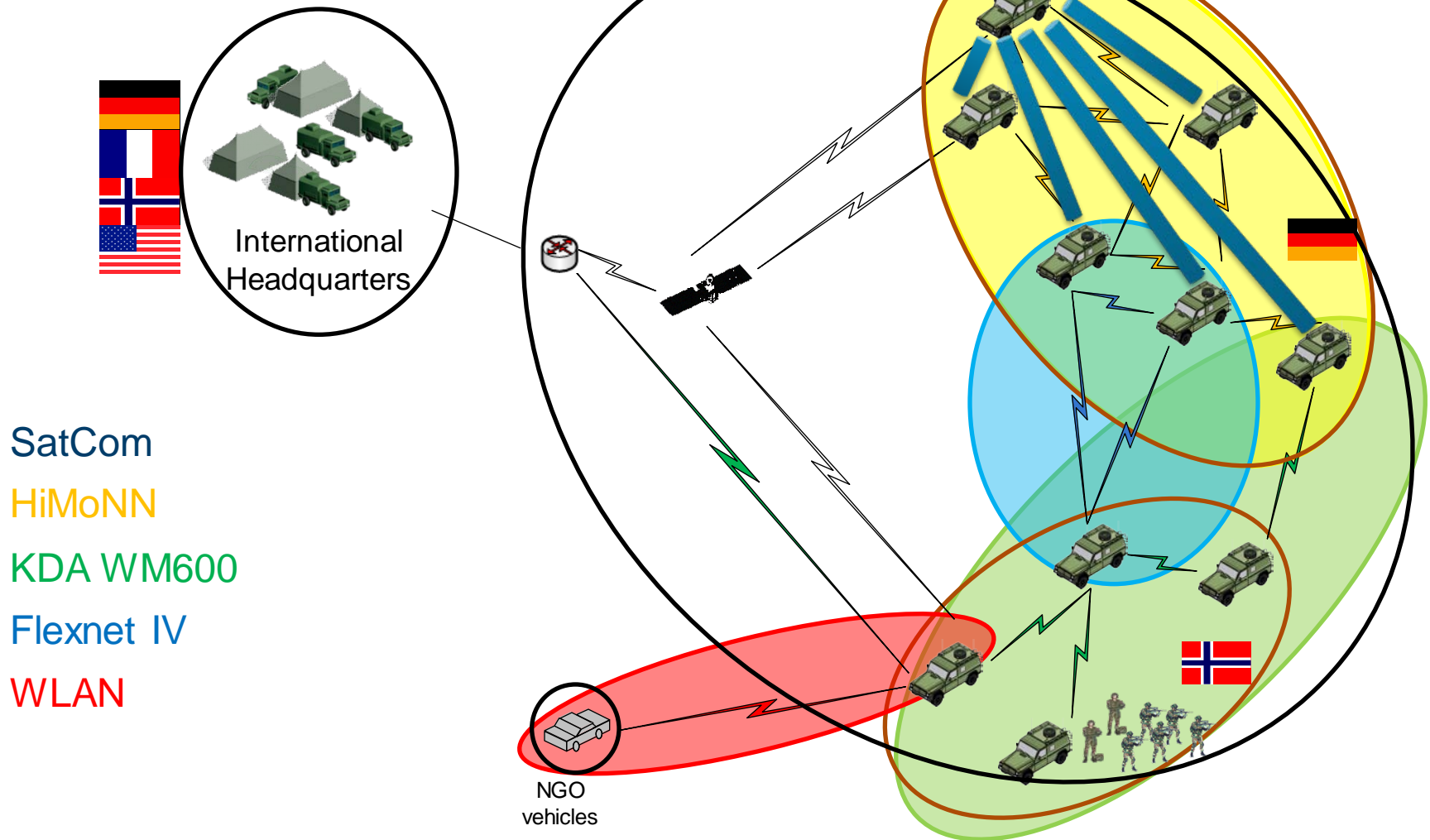
# Agenda

- CoNSIS results regarding Router to Radio interaction
- Civil Standards to cope with current integration problems
- Our DLEP & OLSRv2 implementations
- Using Future Network approaches for routing in heterogeneous ad hoc networks

# CoNSIS – The Scenario (simplified)



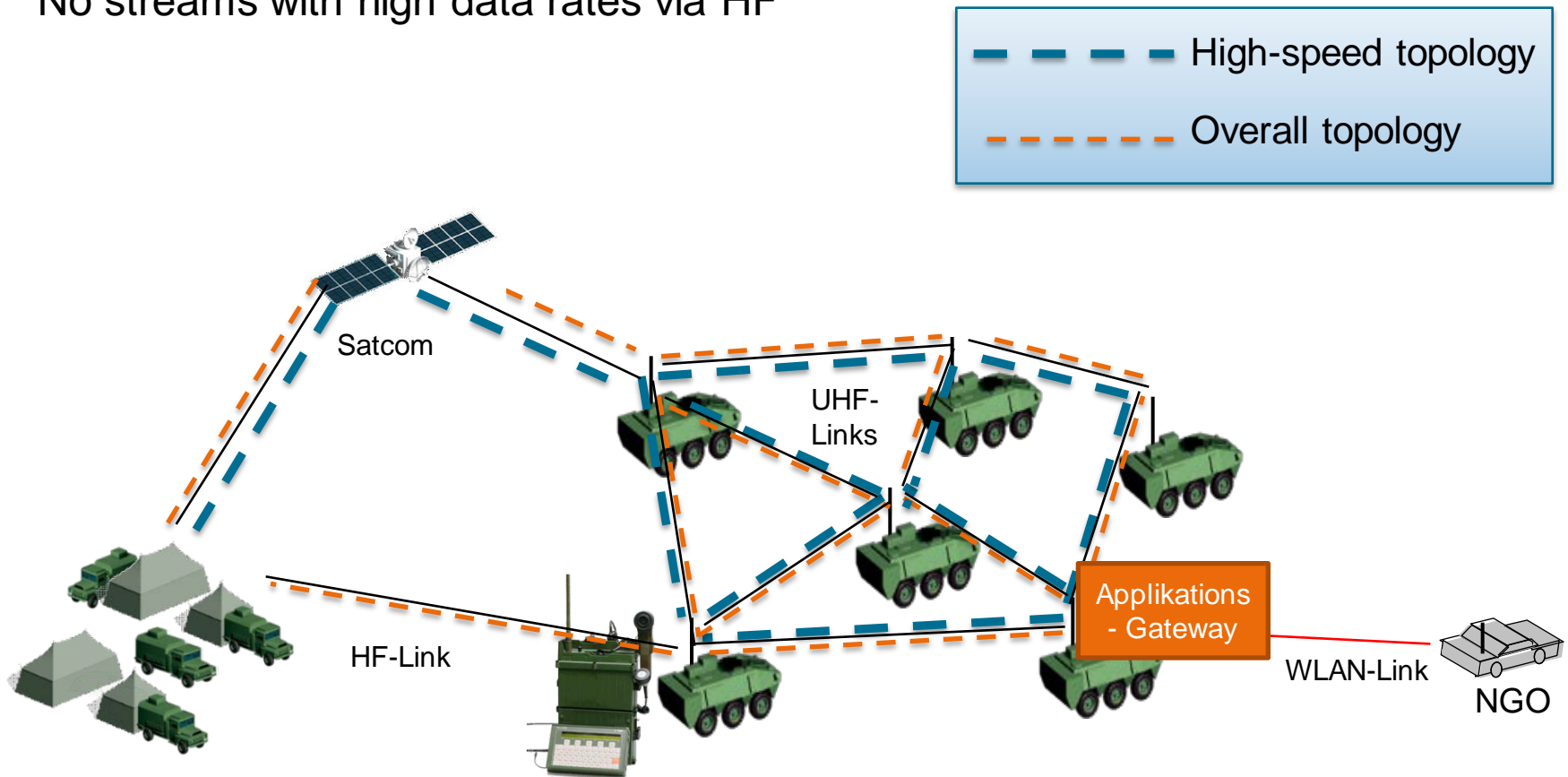
# Land Mobile Component



# Routing & QoS in heterogeneous mobile Networks

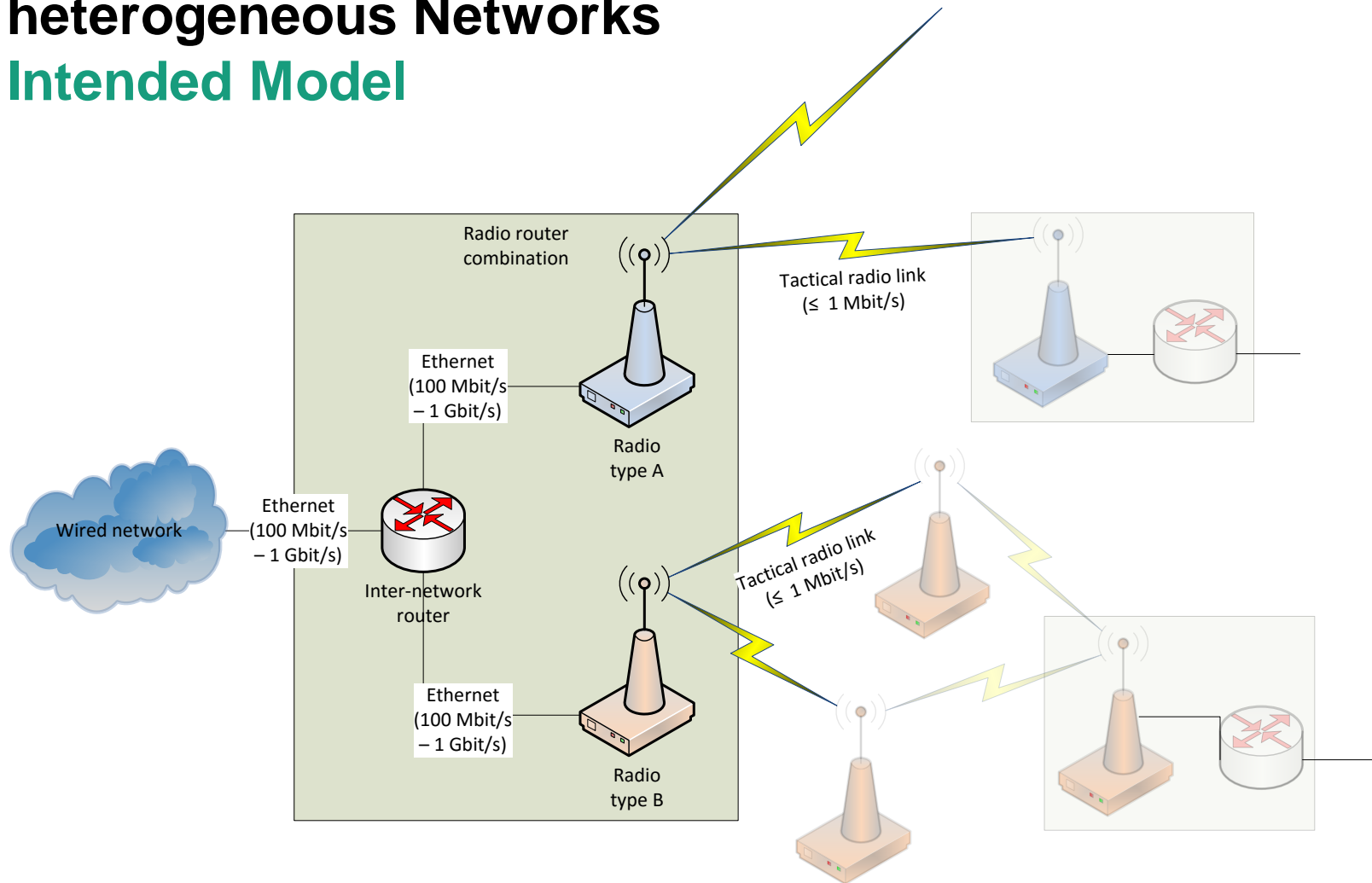
Multi Topology Routing with traffic classification  
technology /role-based

No streams with high data rates via HF



# CoNSIS – Requirements for IP-based Radios in heterogeneous Networks

## Intended Model



# CoNSIS — Requirements for IP-based Radios in heterogeneous Networks

## Link-Level

- Technological Basis
  - **Ethernet** for control- and user traffic
- Buffers in the Radio Devices
  - **Flow Control** essential for QoS
  - **Bridge-Mode** for easier integration
  - **Configurability** of buffers and queuing
- Quality of Service Support
  - **QoS-mechanisms on Layer 2** to supplement Layer 3 mechanisms
  - **Configurability** of the QoS mechanisms

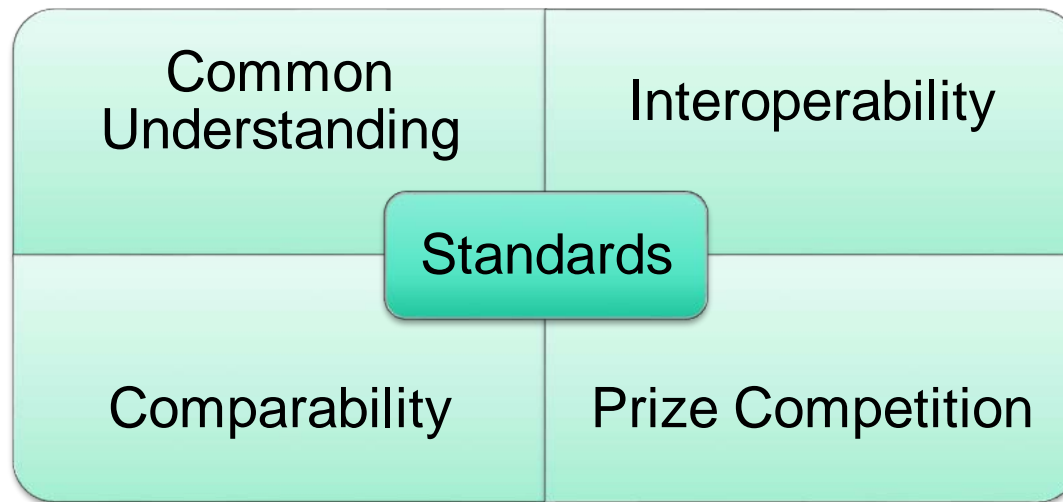
# CoNSIS — Requirements for IP-based Radios in heterogeneous Networks

## Routing-Level

- **Topology Control and Routing Metrics**
  - **Controlled and Monitored** by router
  - **Relevant parameters:** current data rate per neighbor; neighbor discovery; link error rates; capacity status of queues; ...
  - **Raw data for routing metrics** must be available (not only abstract link quality)
    - **Dynamic Link Exchange Protocol** for local delivery of metric data
- **Radio Device Internal Routing**
  - **Layer 3 Routing** to be deactivated
  - **Export of detailed topology information** as alternative

More details:  
[www.consinfo.info](http://www.consinfo.info)  
“Radio Device Requirements”

# Standardization



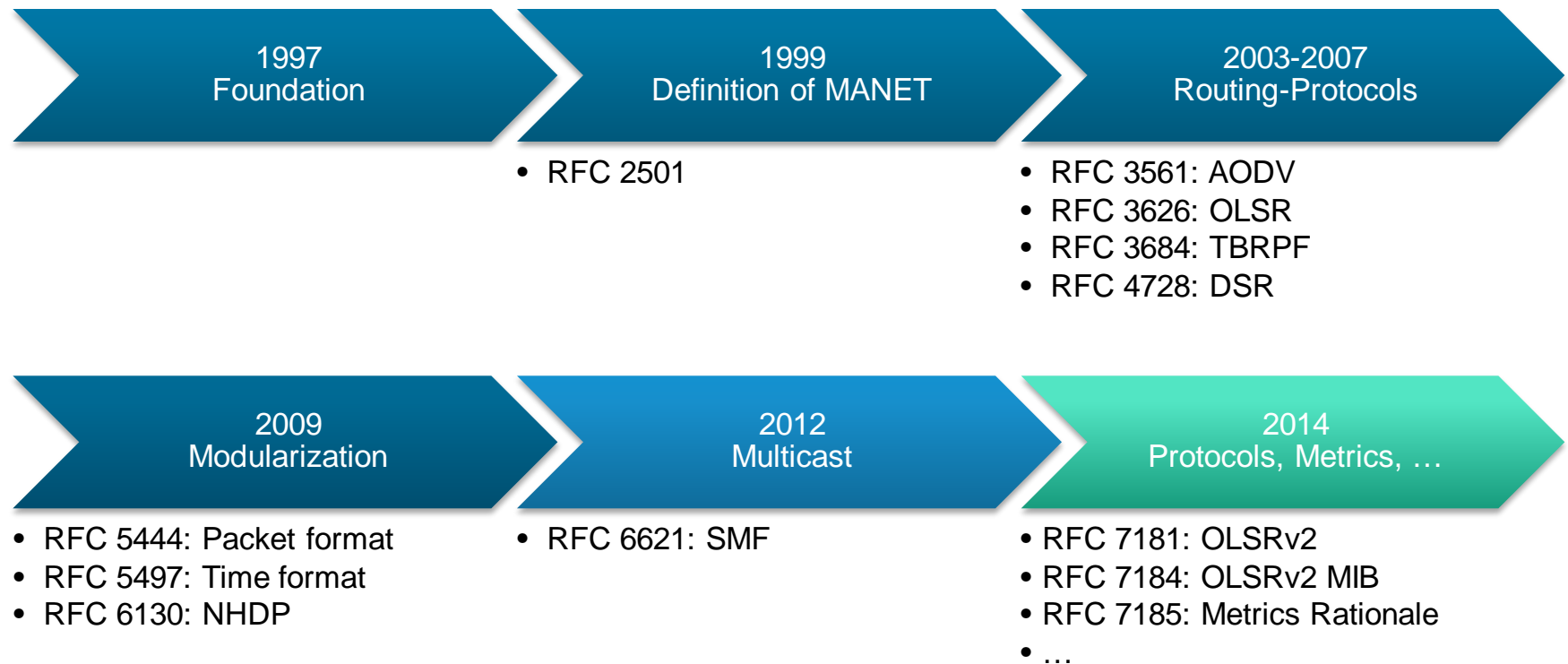
- Interoperability in Joint- & Combined-Missions
- Avoiding vendor-lock-in effects
- Simplifications in the areas tendering, assessment, comparison

# Standardization

## IETF MANET WG



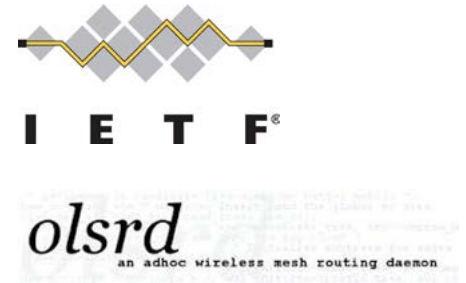
### History of the IETF MANET WG



# Routing Protocols for MANETs

## Advancement of OLSRv2

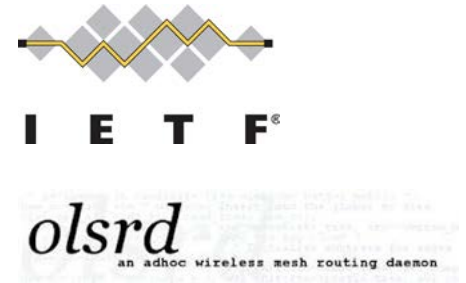
- New MANET protocols: modular instead of monolithic
- Modular protocol family
  1. Packet format
  2. Neighborhood discovery
  3. Routing
    1. Multi-Topology Routing
  4. Cryptographic Signatures



# Routing Protocols for MANETs

## Advancement of OLSRv2

- Extensibility
  - New messages
  - New information in existing messages
  - New routing protocols from existing components
- Support for link metrics
  - Generic in terms of metrics
  - Metrics in separate specifications
    - Directional Airtime Metric



# Packet Sequence Number based directional airtime metric for OLSRv2 (draft-ietf-manet-olsrv2-dat-metric-06 Fraunhofer FKIE)

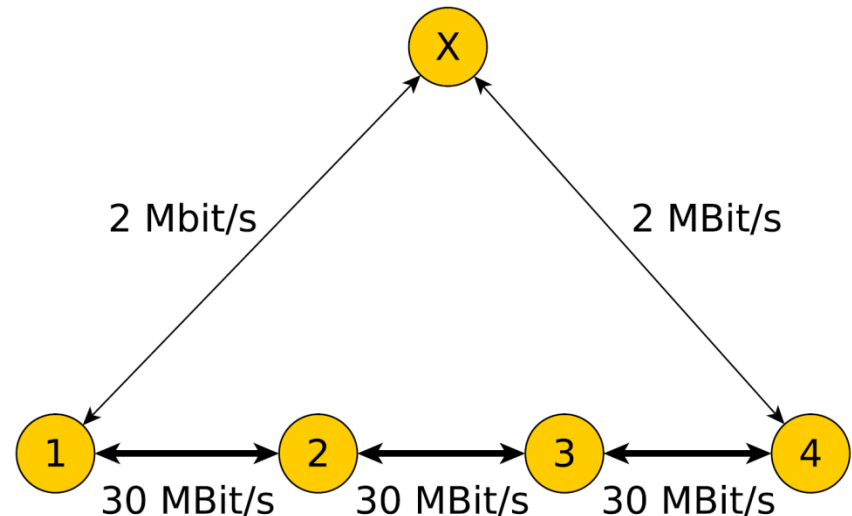


## Routing Metrics:

- Hopcount – Insufficient with Radio Links
- Expected Transmission Count (ETX)
- Expected Transmission Time (ETT)
- ...

Directional Airtime Metric measures the incoming loss rate and integrates the incoming link speed into the metric cost.

Draft in IETF Last Call!

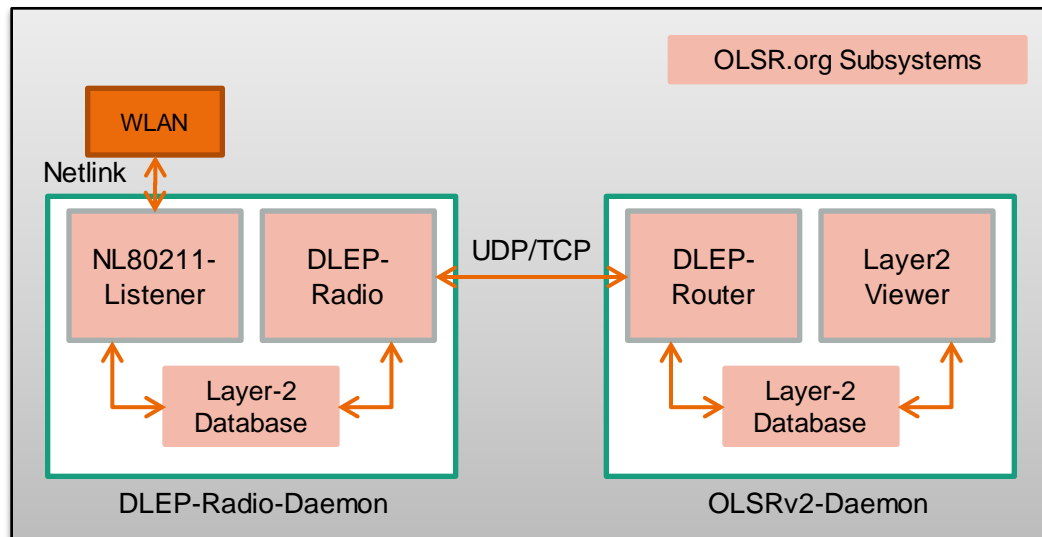
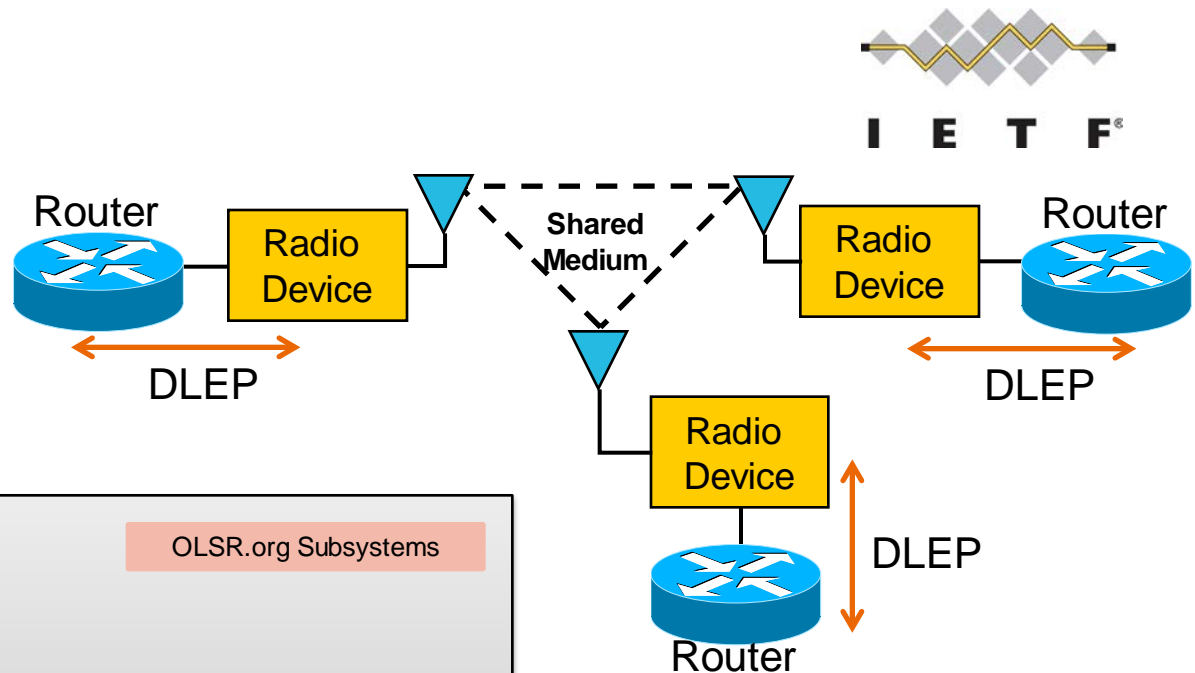


# Link Quality and Flow Control

## External Radio Devices

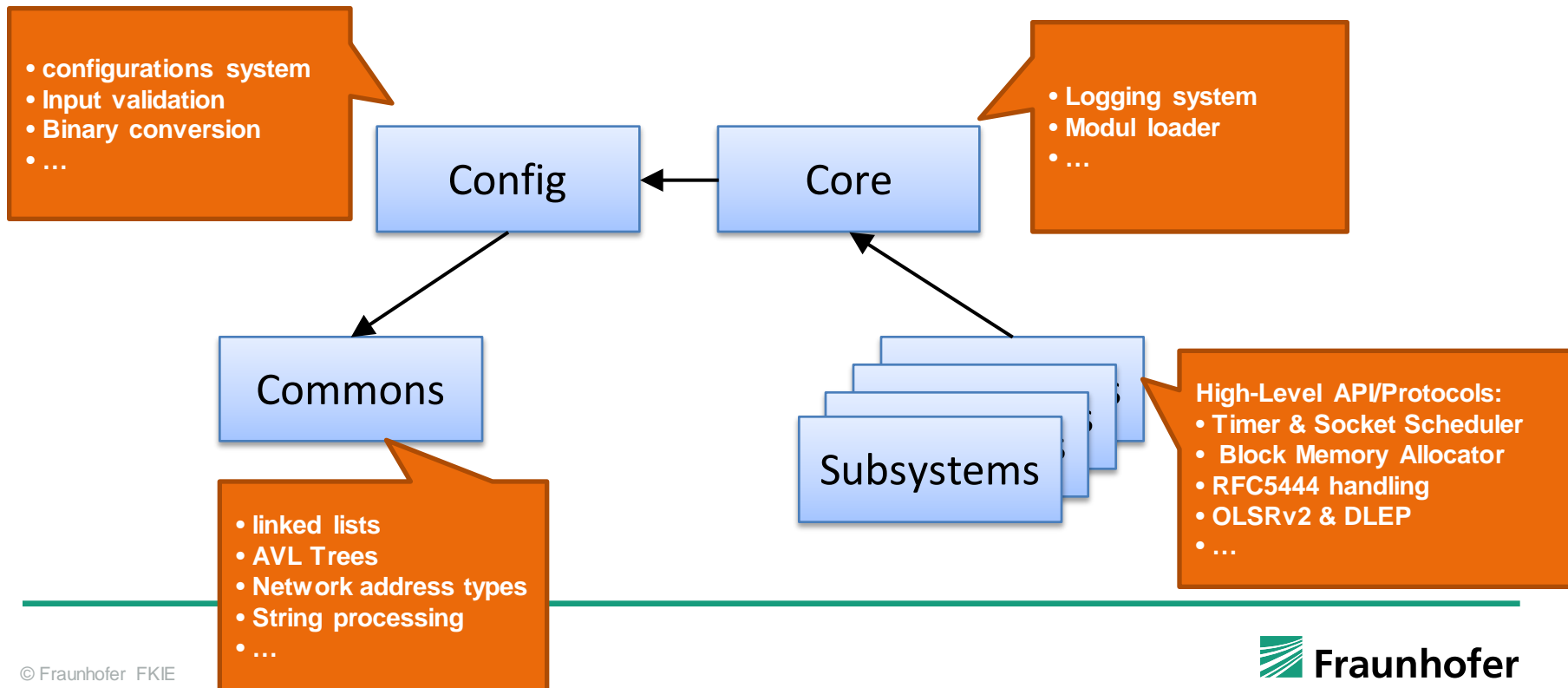
Approach:

- New R2R protocol
- No communication over the air



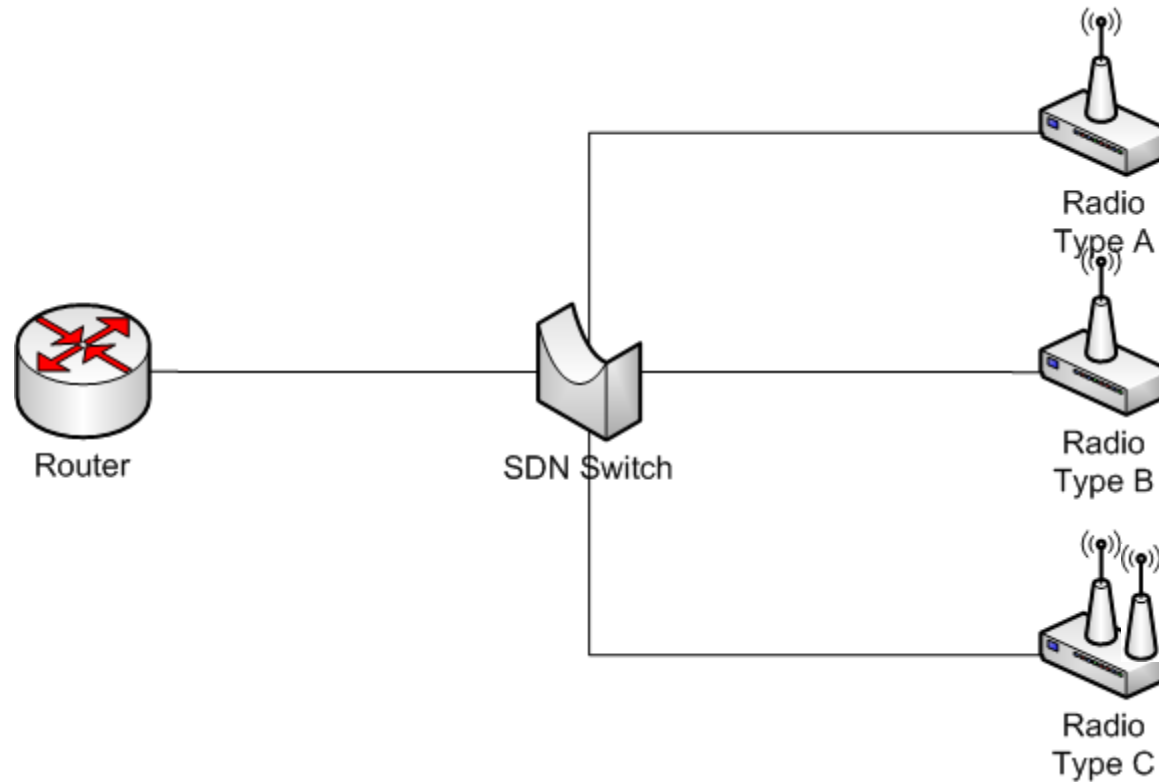
# The OLSR.org OLSRv2 Implementation

- olsrd2 (OLSR.org) – C99 implementation also for Embedded Systems
- OS-abstraction layer – Linux, Preparations for BSD, win32 , ns-3, ...
- 3 shared base libraries and lots of high level Subsystems
- BSD – License Modes



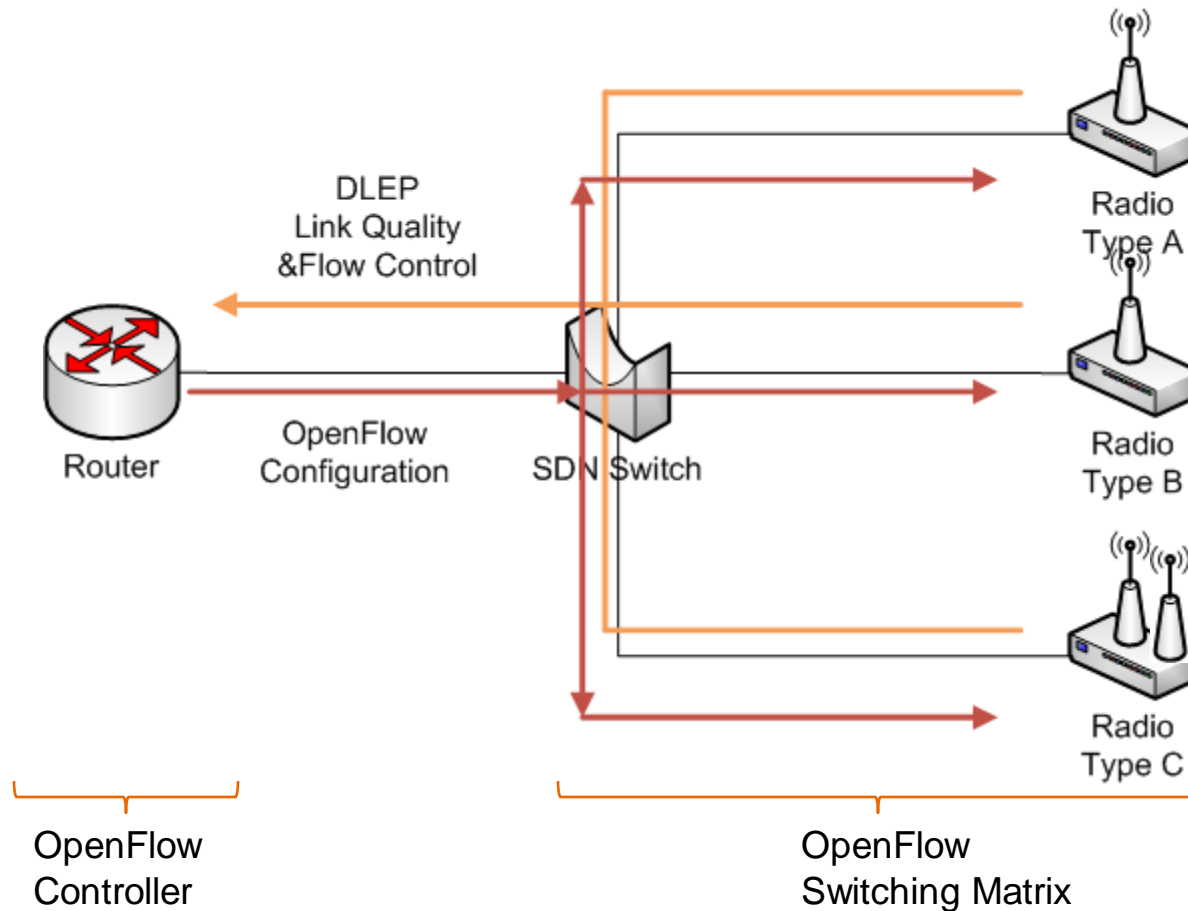
# Using Future Networks Approaches for Routing in heterogeneous Ad hoc Networks

## Heterogeneous Radio Infrastructure



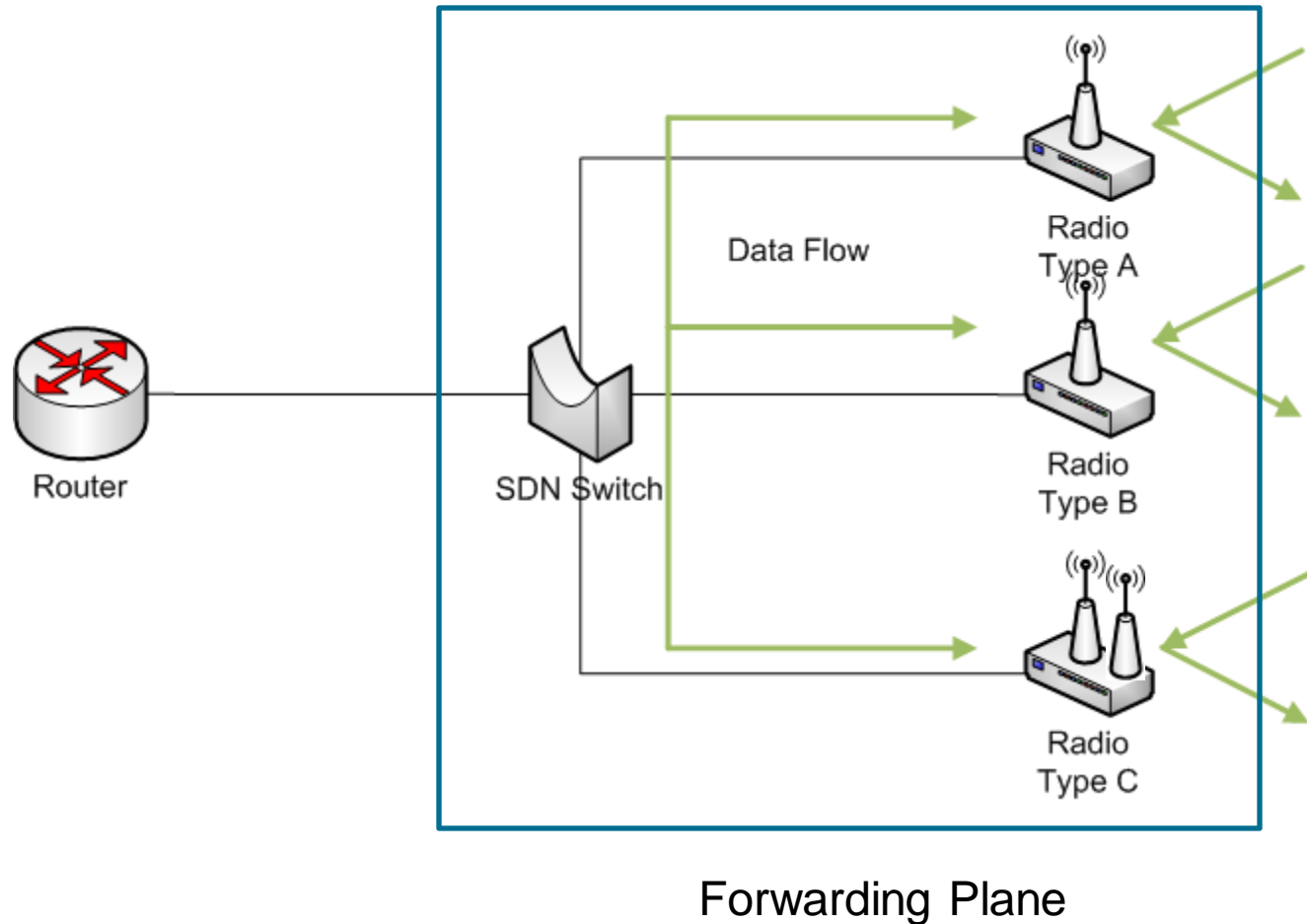
# Using Future Networks Approaches for Routing in heterogeneous Ad hoc Networks

## Standardized Control Plane

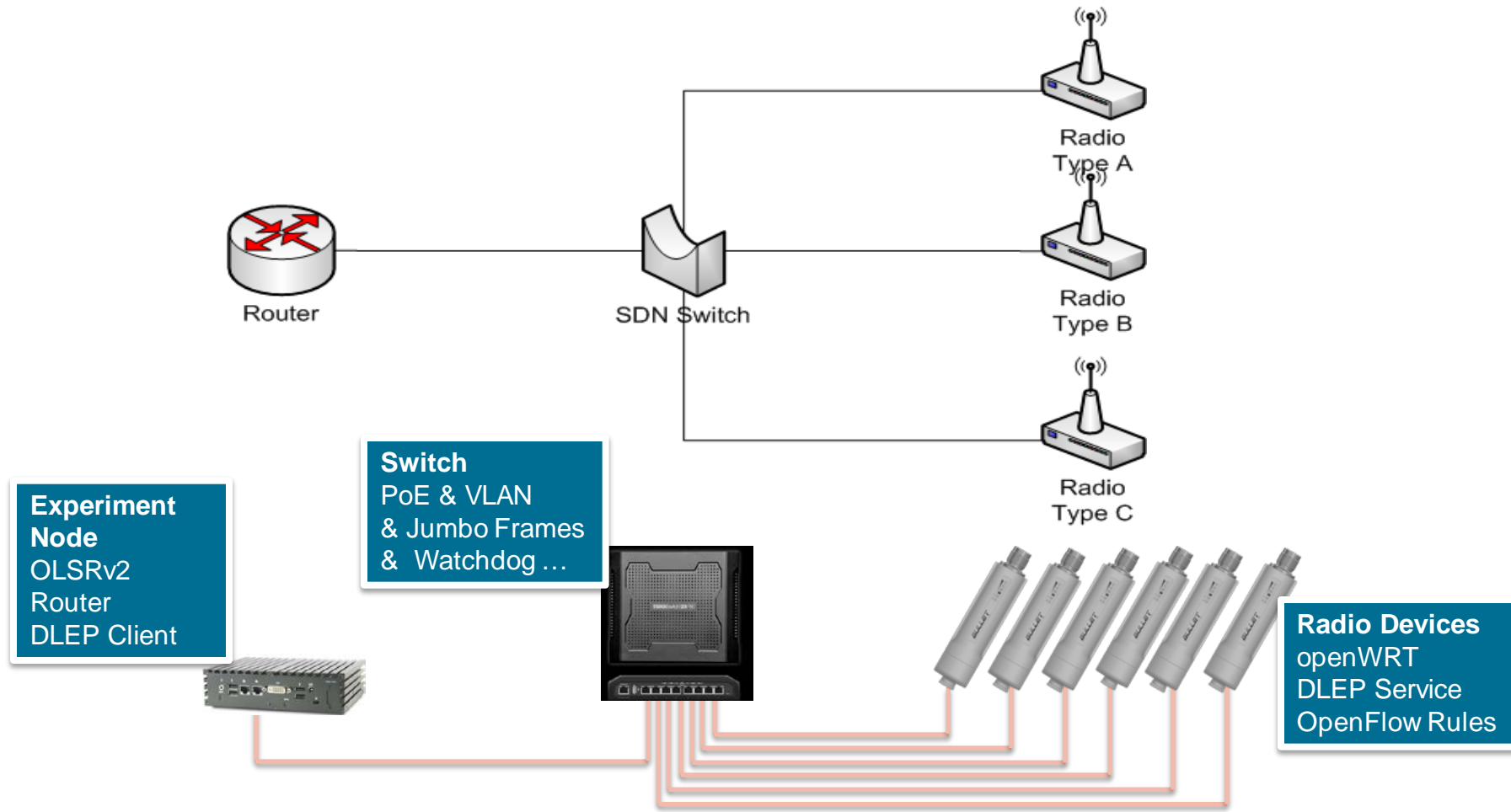


# Using Future Networks Approaches for Routing in heterogeneous Ad hoc Networks

## Forwarding Plane Offloading Router

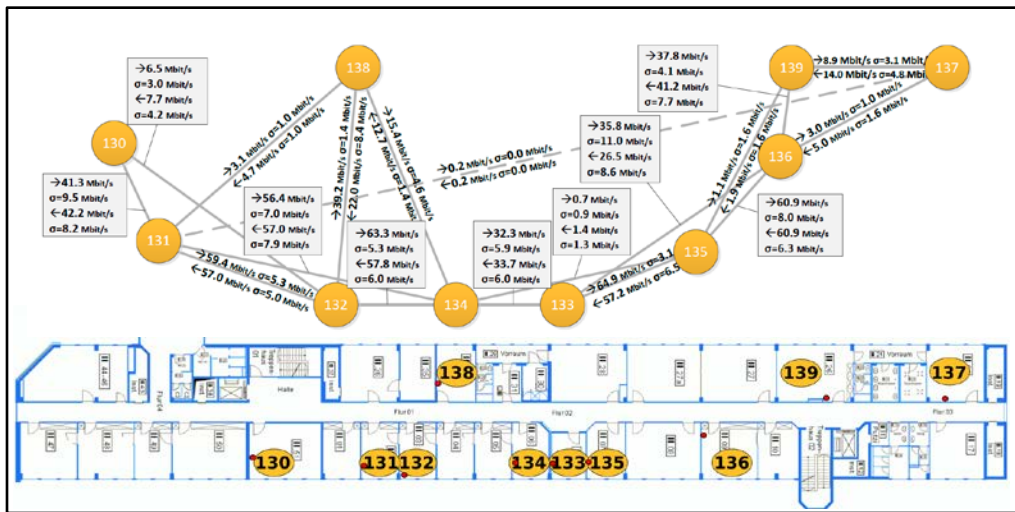


# Using Future Networks Approaches for Routing in heterogeneous Ad hoc Networks



# DLEP-based Testbed at Fraunhofer FKIE

- FKIE testbed extensions - two floors, 100m approx.
- 26 locations in a dense indoor deployment, each with:
  - Radio devices with 12dbi 5Ghz antenna
  - Experiment devices (e.g. running OLSRv2 with DAT metric)
- OLSRd / OLSRd2 backbone network

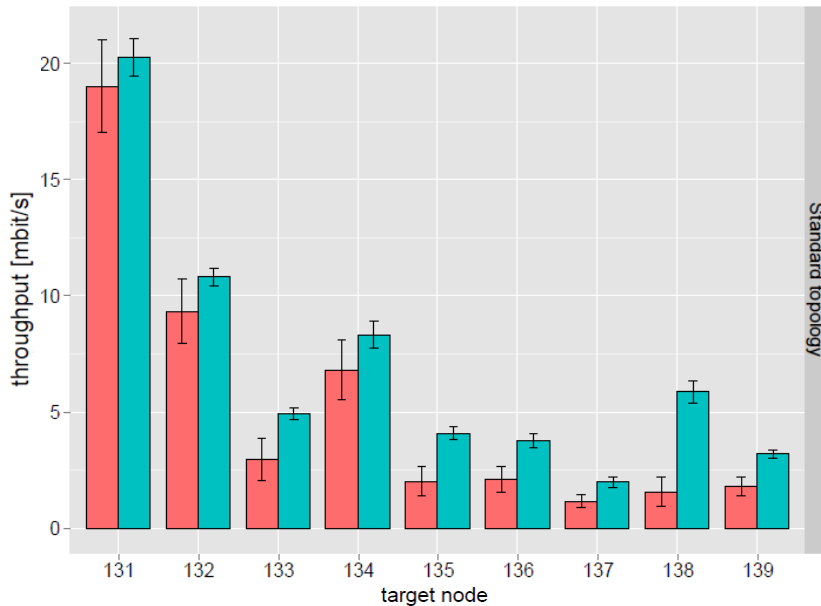


# OLSRv2 with DLEP – Testbed Results

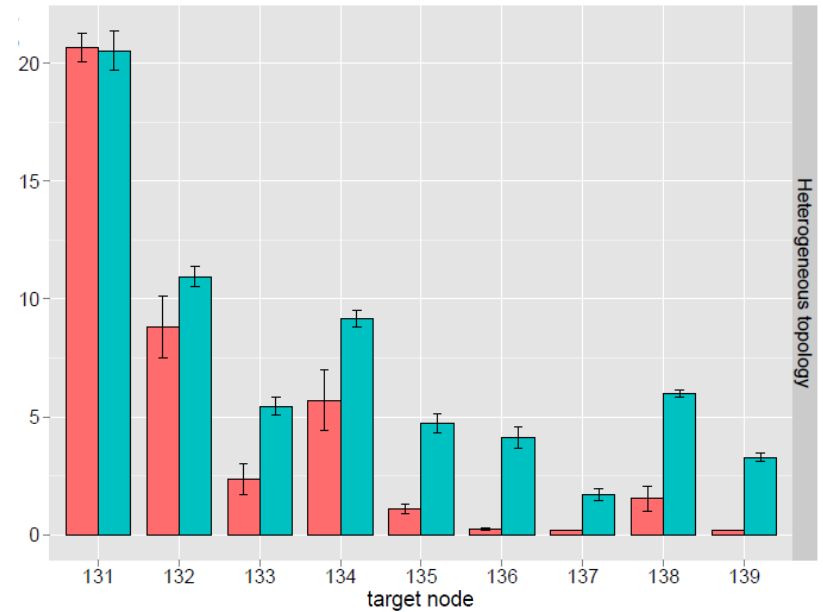
Experiment: TCP throughput measurements

- From node 130 to node X
- 20 replications
- 0.95 confidence level

Without long range link

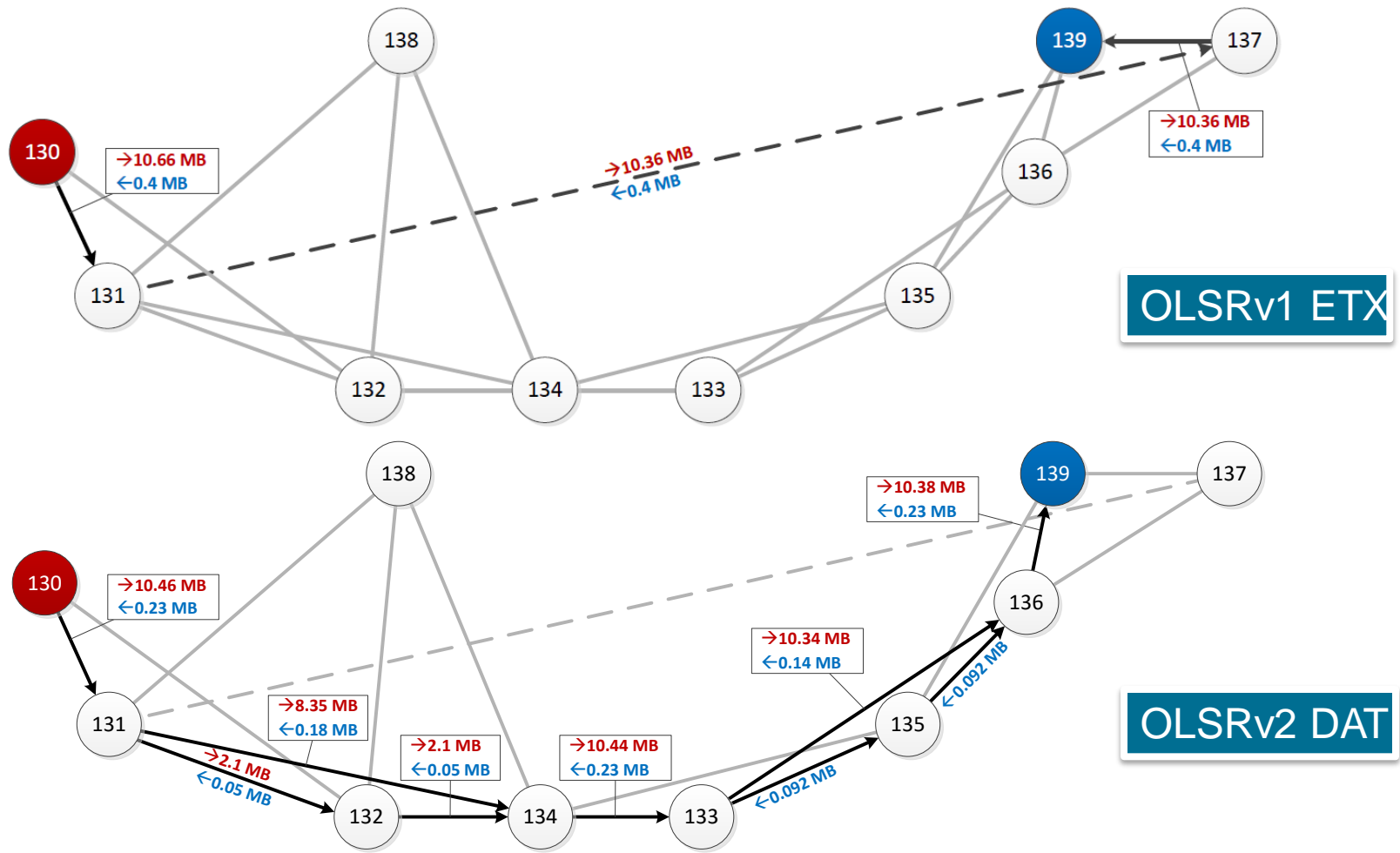


With 200 kbit/s long range link



OLSRv1  
OLSRv2

# Difference of OLSRv1 ETX and OLSRv2 DAT Strategies



# Routing Protocols for MANETs

## Emulation with NS-3

### ■ Real-time emulation in NS-3:

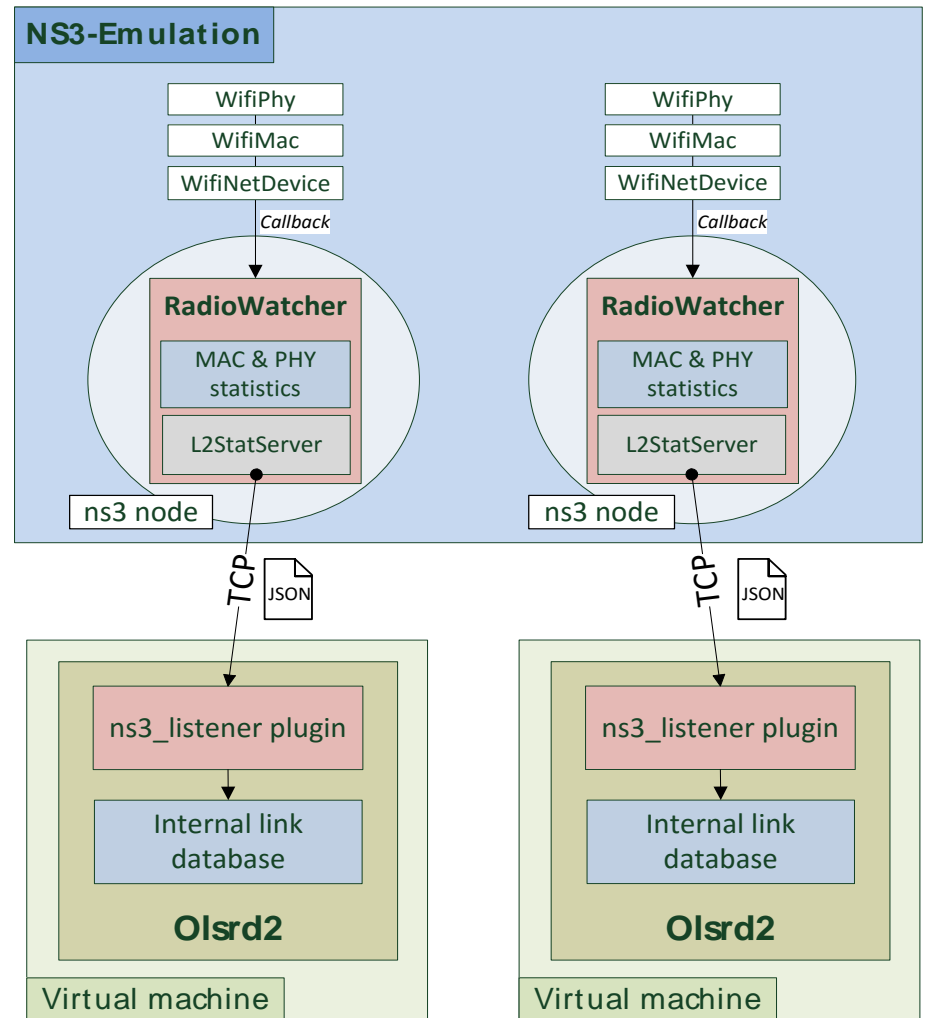
- Radio devices
- Wireless medium
- Topology

### ■ Real execution on virtual machines:

- OLSRv2 (olsrd2)
- User applications

### ■ RadioWatcher:

- Collects MAC and PHY statistics in emulation
- Provision to olsrd2 by periodical reports over TCP connection and olsrd2-Plugin

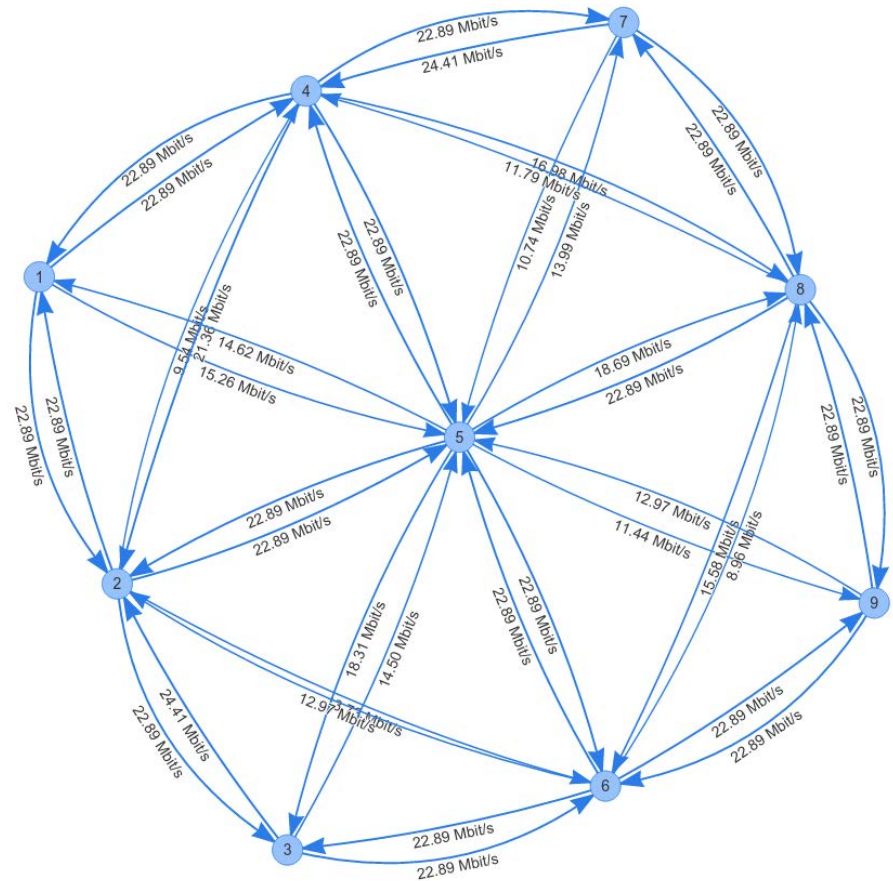


# Routing Protocols for MANETs

## Emulation with NS-3

### Advantages:

- Emulation allows for an easy change of topology, link characteristics, and number of nodes in experiments
- Usage of real olsrd2 avoids re-implementation within emulator
- Real execution of applications and their transmitted data enables direct assessment of the impact of scenario characteristics on the application performance



# Conclusions & Future Work

- Practical experiences from CoNSIS fieldtests (details see [www.consis.info](http://www.consis.info))
- Work on standards at the IETF MANET group
- Implementation of OLSRv2 as extensible routing protocol
- Demonstrator with DLEP and SDN approach
- Testbed based evaluation

## Related Future Topics in CoNSIS II

- OLSRv2 & Link Metrics
  - Military extensions (EMCON, synergies with security, special radio types, ...)
  - Encrypted Control Traffic
- Radio to router communication
  - SDN approach for configuration of the radios by OLSRv2

# Questions ?



... thank you for your attention.