

# Some Network Coding Use Cases

Applications utilizing Network Coding

Container Logistics and Large Hadron Collider

# HIGH DENSITY SENSOR NETWORKS

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# Large Hadron Collider CERN (1)

- Some facts:
  - $10^7$  Sensoren
  - New values every 25 ns
  - Up to 400 Tbyte/sec
- The limits
  - Copper not adequate in LHC environment
  - Optical components too bulky, also using too much energy



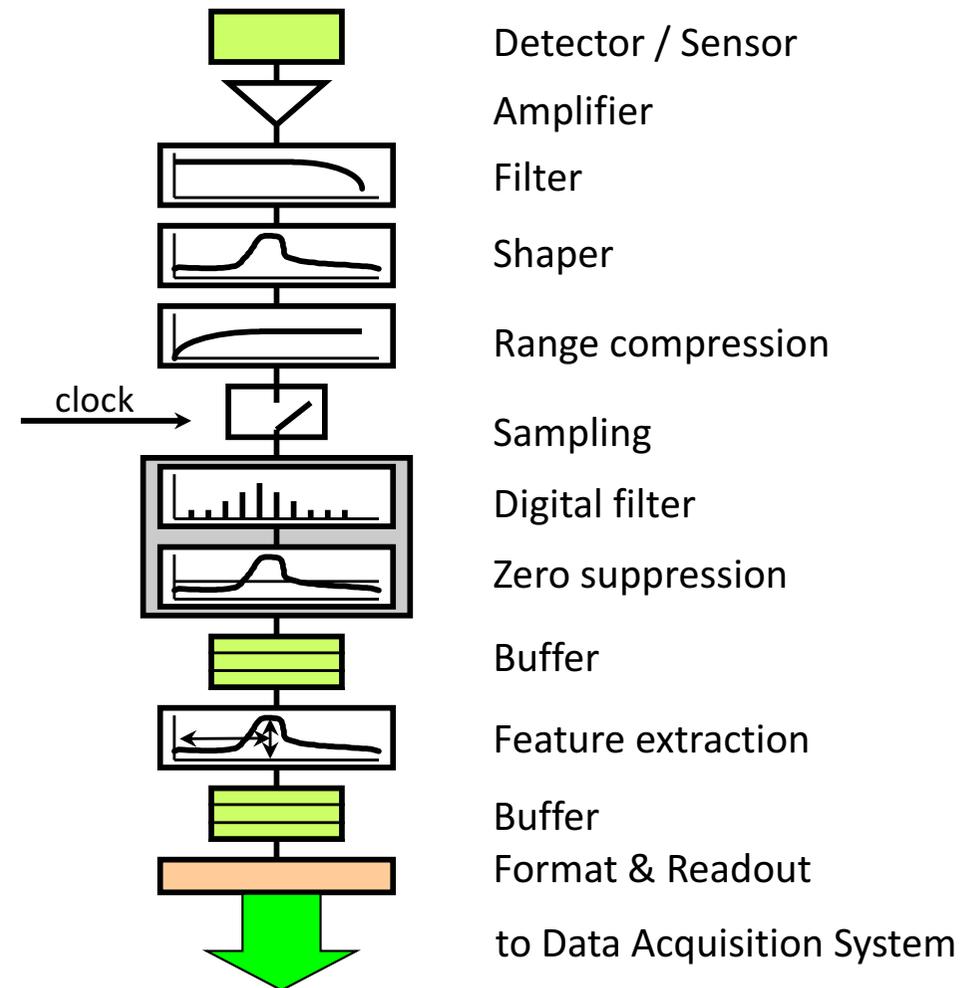
# Large Hadron Collider CERN (2)

- Possible solution: Wireless
  - WADAPT => Wireless Allowing Data And Power Transmission
  - Less wiring
  - Less distortion of experiment
  - MIMO technology utilized
  - Ideal for utilizing Network Coding
- See next slide (© CERN) for readout chain
  - Duplication for multipath transmission
  - Network Coding to provide bandwidth extension and resilience in noisy environment

# The readout chain

Niko Neufeld, real-time connectivity requirements, openlab workshop 23/03/17

- Ideally all these functions are integrated in the front-end chip
- There will be challenges with power (dissipation), in particular at high rate detectors, and, in some cases, radiation

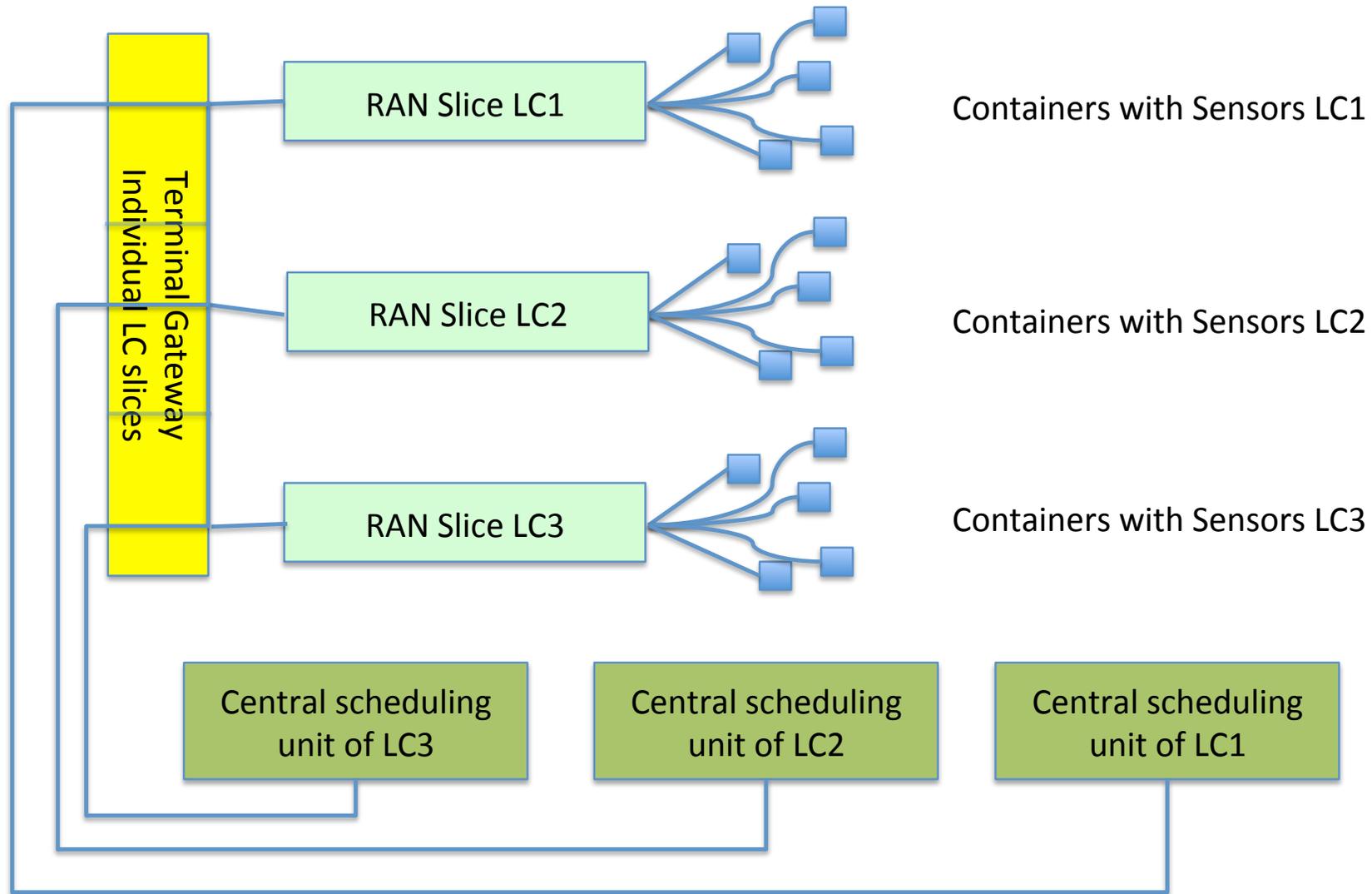


# Container Logistics (1)

- Containers equipped with multiple small transmitters permanently transmitting
  - Container ID
  - GPS coordinates
- On the move:
  - Multipath transmission to e.g. LTE infrastructure, i.e. NC utilized
  - Comparable to railway application or V2X
- Stationary:
  - Last entry transmitted to location database stays valid
- See next slide for a container terminal with different logistics companies (LC1 to LC3)



# Container Logistics (2)



Railway and Vehicles

# ON THE MOVE

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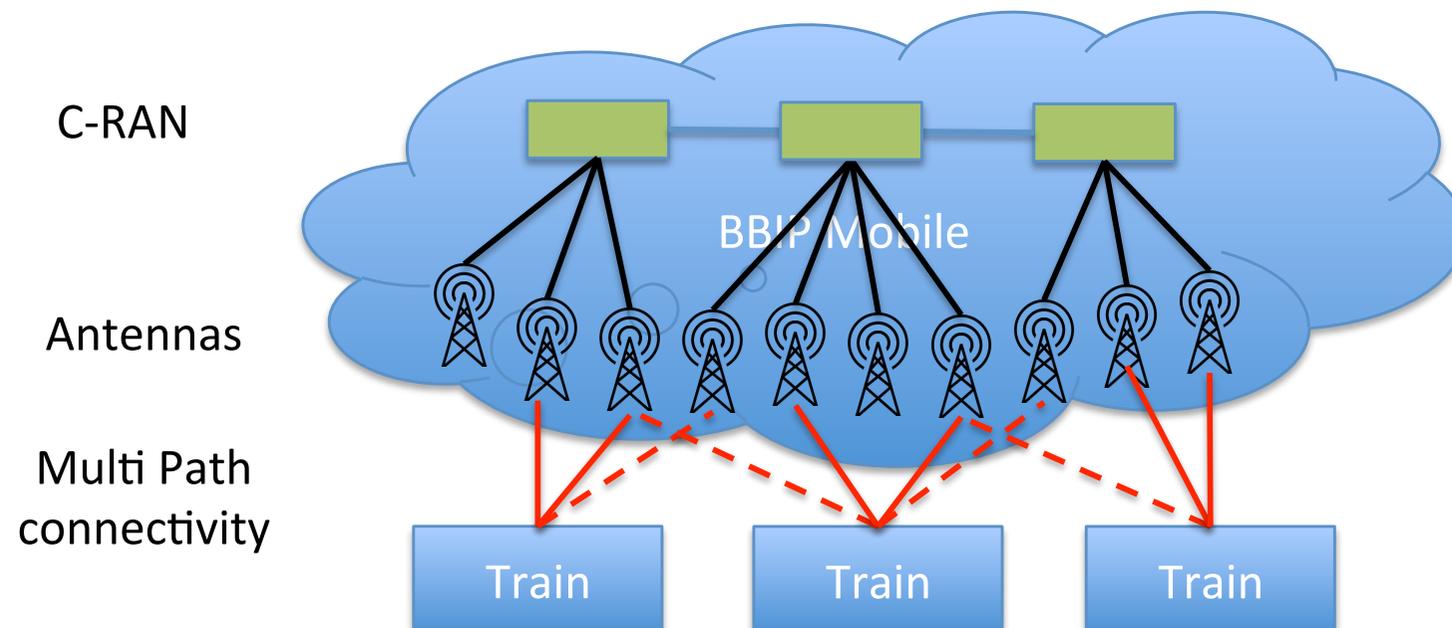
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# On the Move

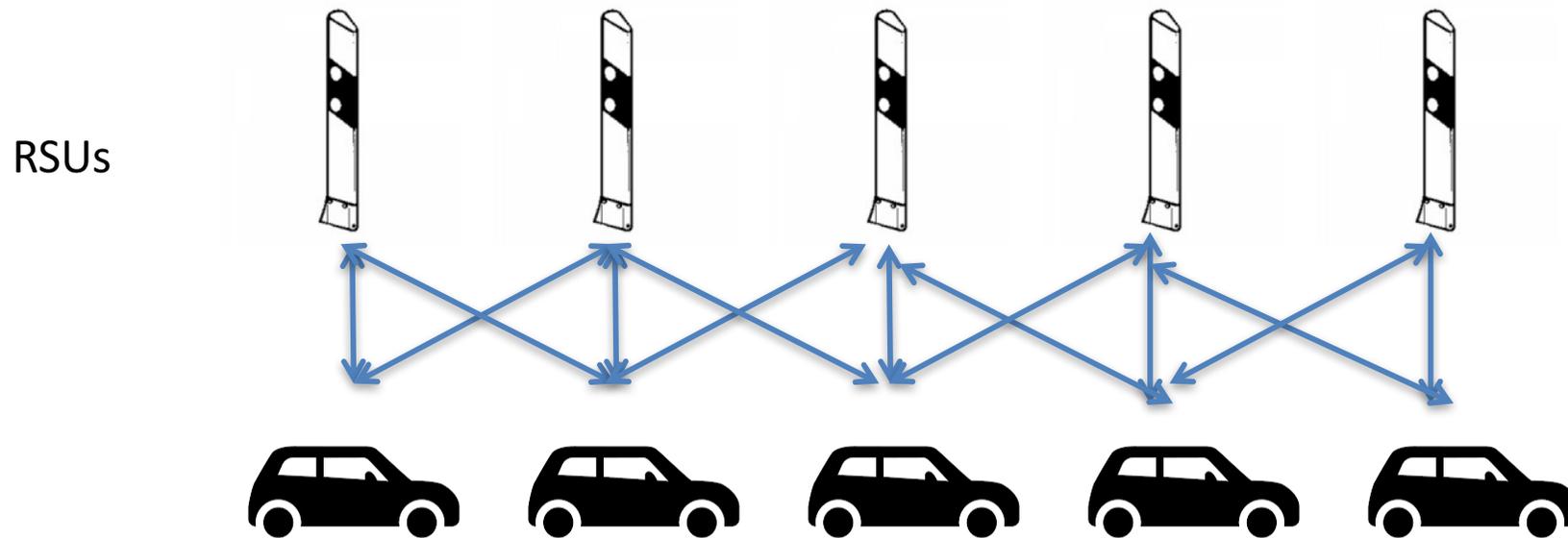
- Both railways and cars are moving along access points to transfer infrastructure
  - High speed of train or car
  - Multiple carriers
  - Handover to be organized
  - Resilience and security required
  - Heterogeneous access and backbone technologies possible
  - Multipath to be organized
  - End to end (not peer to peer) Network Coding applicable



# On the move - Railway



# On the move – Car



Volume Data Replication

# PEER TO PEER NC FOR VOLUME DATA

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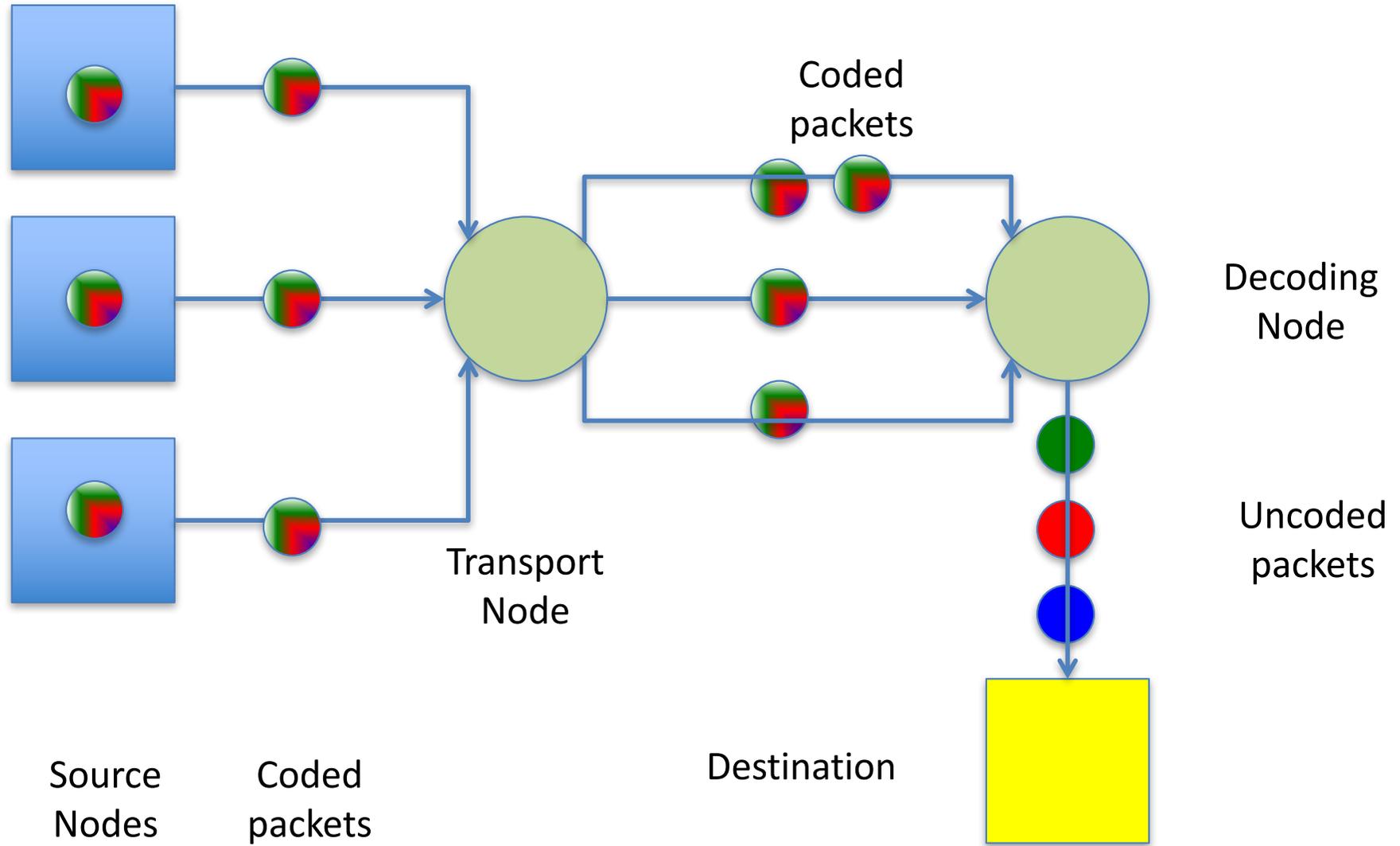


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# Volume Data Replication

- Peer to peer NC to improve transfer from replicated datasets
- Could be fine for volume data like e.g. climate research data
- However:
  - No budget
  - Storage technology not improving fast enough to get along with low budget

# RLNC for Storage



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**THANK YOU**

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