DTN7

An Open-Source Disruption-tolerant Networking Implementation of Bundle Protocol 7

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Artur Sterz, Mira Mezini, Bernd Freisleben
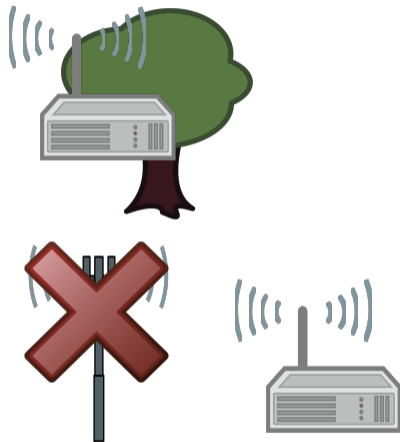
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Philipps Universität Marburg

TECHNISCHE UNIVERSITÄT DARMSTADT

Delay / Disruption-tolerant Networking (DTN)

- ▶ Situations without a reliable uplink
  - ▶ Environmental monitoring in remote areas
  - ▶ Destroyed telecommunication infrastructure
  - ▶ Internet access is blocked

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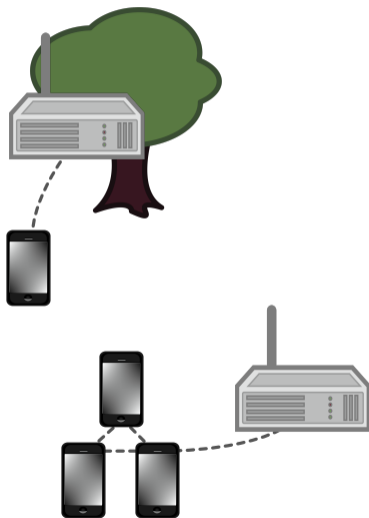   - ▶ Internet access is blocked

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▶ In DTN, data is transmitted in a store-carry-forward fashion
  ▶ Hop-by-hop transport
  ▶ Opportunistic or scheduled contacts to neighbors
  ▶ Allows large time window between two transmissions
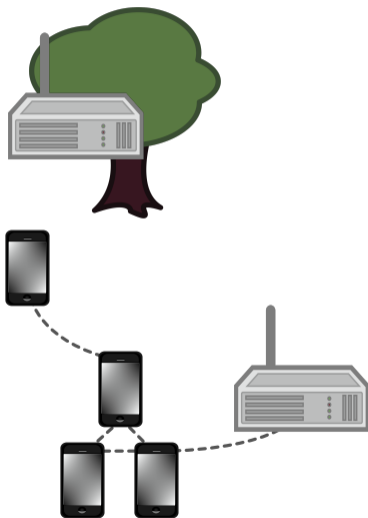
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Delay / Disruption-tolerant Networking (DTN)

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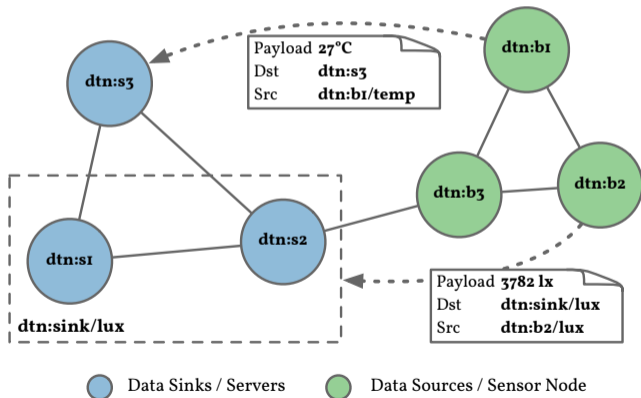# DTN7

This brings us to DTN7...

- ▶ Free and open-source DTN software
- ▶ Written in the Go programming language
- ▶ Modularized design, easy to extend
- ▶ Implementation of the recently released Bundle Protocol (BP)

Bundle Protocol Version 7 (BP)

- ▶ Describes both a DTN architecture and protocol
- ▶ Still in development, but nearly finished
- ▶ Latest draft (version 14) was released on 04.08.2019
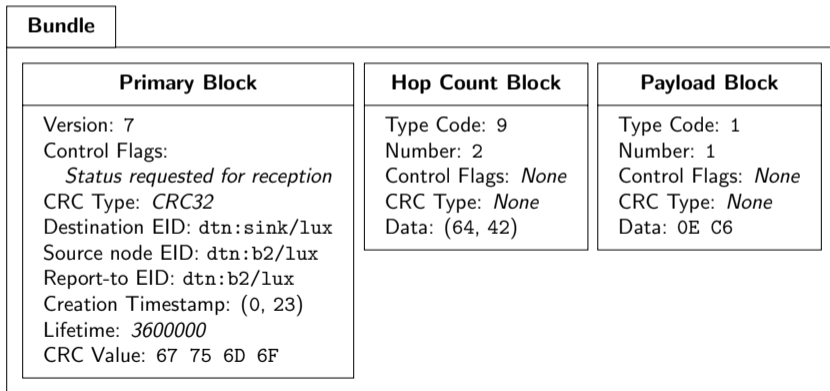- ▶ Aims to obsolete Bundle Protocol Version 6, RFC 5050

Nodes and Endpoints

- ▶ Nodes are identified by an Endpoint ID (URI), e.g., `dtn:node`
- ▶ A node might be addressed by multiple Endpoint IDs
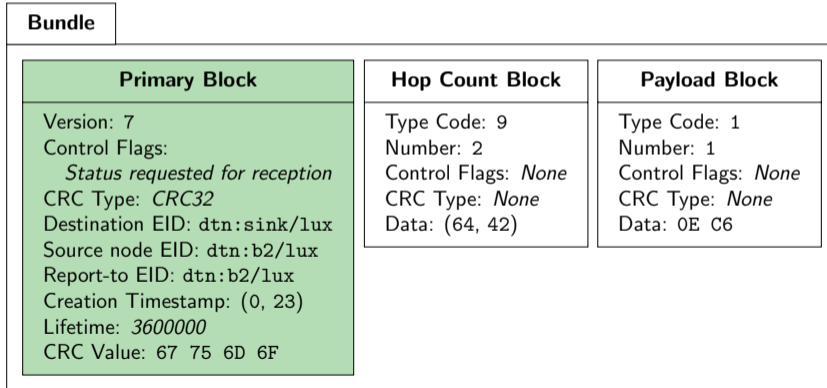- ▶ An Endpoint ID might represent multiple nodes

○ Data Sinks / Servers   ○ Data Sources / Sensor Node

Bundles and Blocks

- ▶ BP packets are called Bundles
- ▶ A Bundle is a sequence of Blocks
- ▶ Binary represented in CBOR, RFC 7049

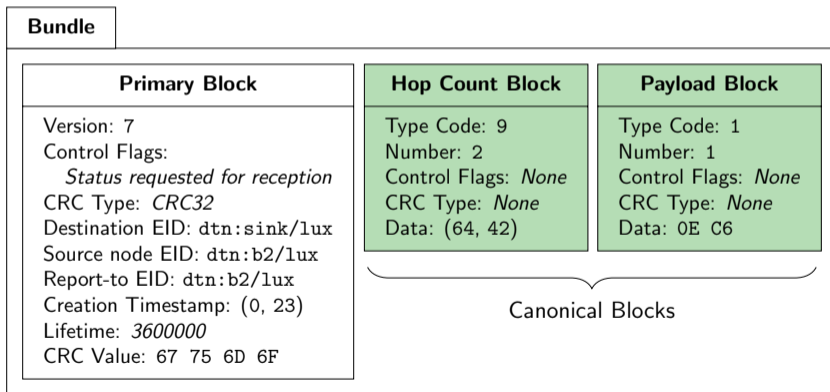| **Bundle**		
Primary Block	**Hop Count Block**	**Payload Block**
Version: 7 Control Flags: *Status requested for reception* CRC Type: *CRC32* Destination EID: `dtn:sink/lux` Source node EID: `dtn:b2/lux` Report-to EID: `dtn:b2/lux` Creation Timestamp: (0, 23) Lifetime: *3600000* CRC Value: 67 75 6D 6F	Type Code: 9 Number: 2 Control Flags: *None* CRC Type: *None* Data: (64, 42)	Type Code: 1 Number: 1 Control Flags: *None* CRC Type: *None* Data: 0E C6

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Bundle

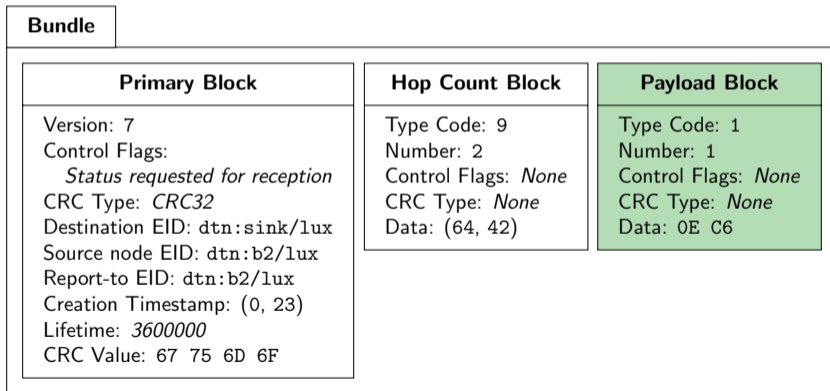| **Primary Block**	**Hop Count Block**	**Payload Block**
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Destination EID: `dtn:sink/lux`	Data: (64, 42)	Data: 0E C6
Source node EID: `dtn:b2/lux`		
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Creation Timestamp: (0, 23)		
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Canonical Blocks

Bundles and Blocks

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Source node EID: dtn:b2/lux		
Report-to EID: dtn:b2/lux		
Creation Timestamp: (0, 23)		
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Bundle Exchange

- Convergence Layer
  - Transport technology for Bundles between nodes
  - Implemented: MTCP, TCP
  - Possible: Bluetooth, LoRa, Email, QR code, Pigeon, . . .
- Routing
  - Selection of neighbors for Bundle delivery
  - Implemented: DTLSR, Spray and Wait, Epidemic Routing

Other DTN7 Components

- ▶ Store for Bundles that are waiting for delivery
- ▶ RESTful API to dispatch and fetch Bundles
- ▶ Peer Discovery to detect nearby nodes

DTN7 Programs

- ▶ dtnd: DTN daemon
- ▶ dtncat: command line tool

```
# Sending a Bundle
$ dtncat send http://localhost:8080/ dtn:sink/lux <<< "3782 lx"

# Retrieving a received Bundle
$ dtncat fetch http://localhost:8080/
```

DTN7 Architecture
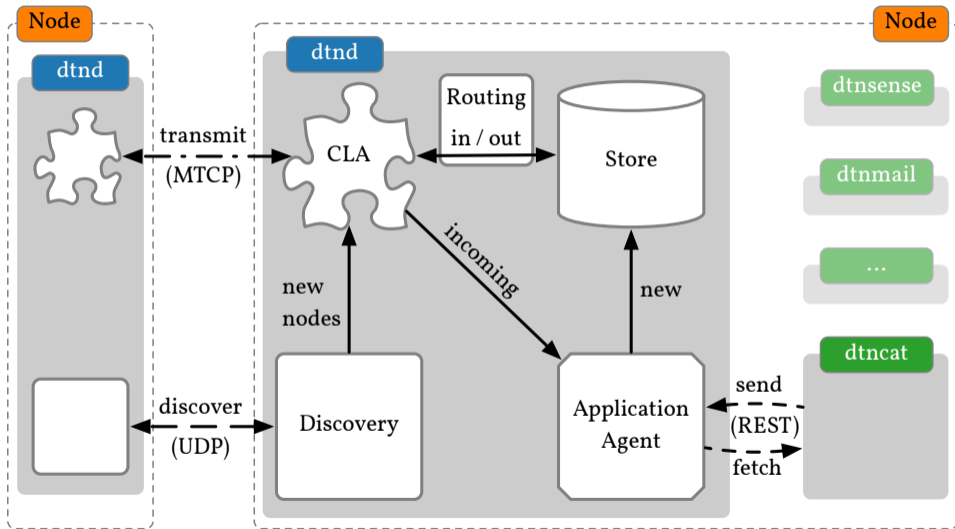
Evaluation

- Up to 64 nodes emulated in the Common Open Research Emulator (CORE)
- Nodes are connected pairwise in a chain topology
- Simulated IEEE 802.11g network, 54 MBit/s

CORE
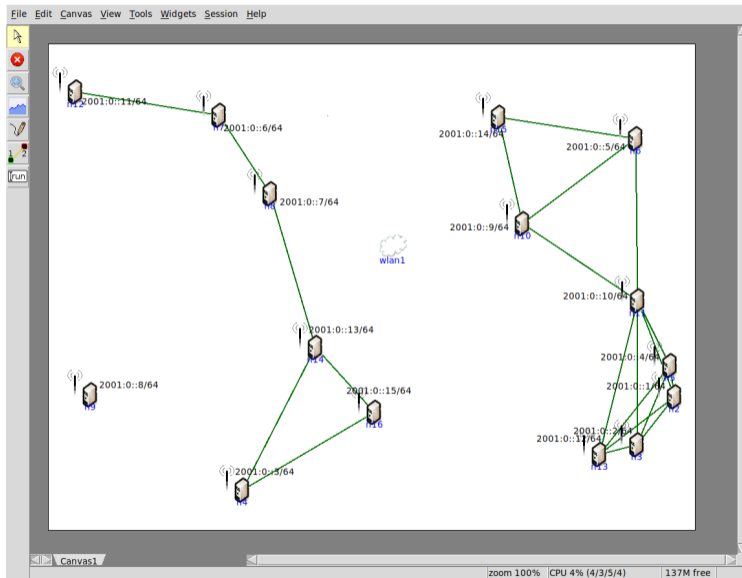
Evaluation

- Payload Size
  - 64 KiB: compressed image
  - 1 MiB: small image / short audio recording
  - 5 MiB: smartphone image / audio recording
  - 25 MiB: longer audio recording / short video
  - 50 MiB: HD video
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- DTN Software
  - DTN7
  - Forban
  - IBR-DTN
  - Serval

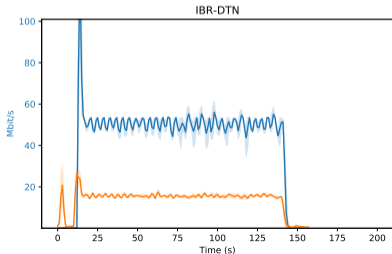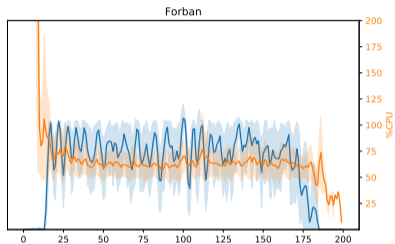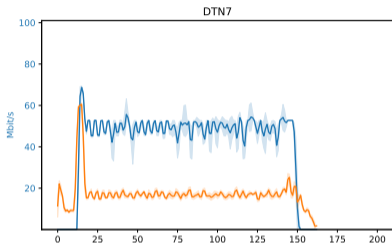# Transmission Time: Two Nodes
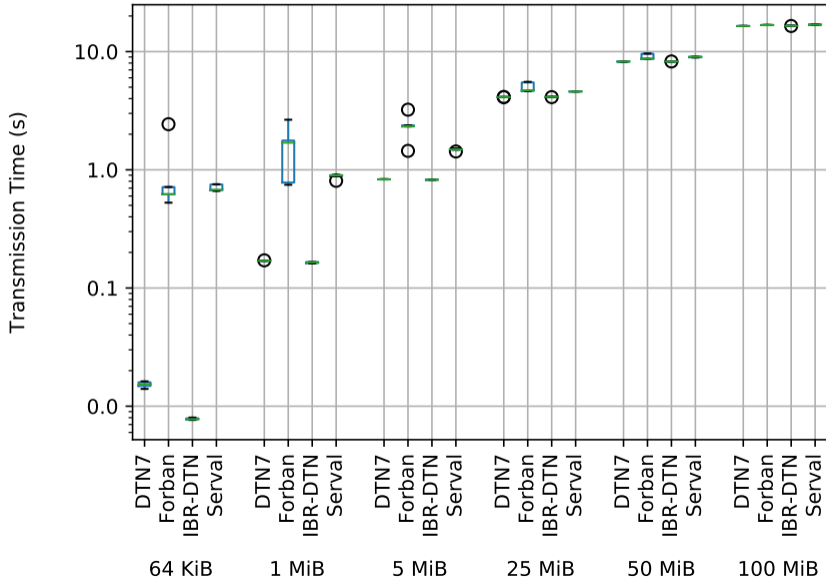
Transmission Time: 64 Nodes
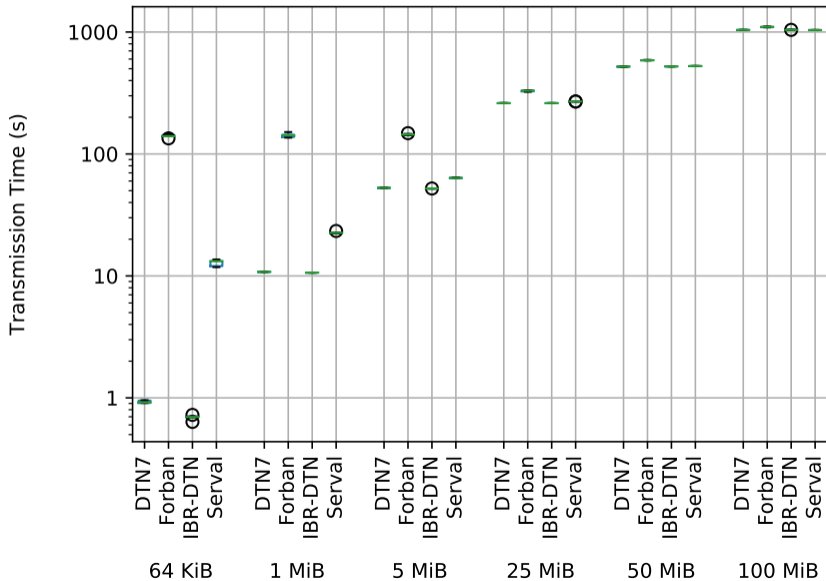
CPU and Network Usage: 32 Nodes, 25 MiB

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https://dtn7.github.io/