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Bundle Protocol Mail Convergence Layer

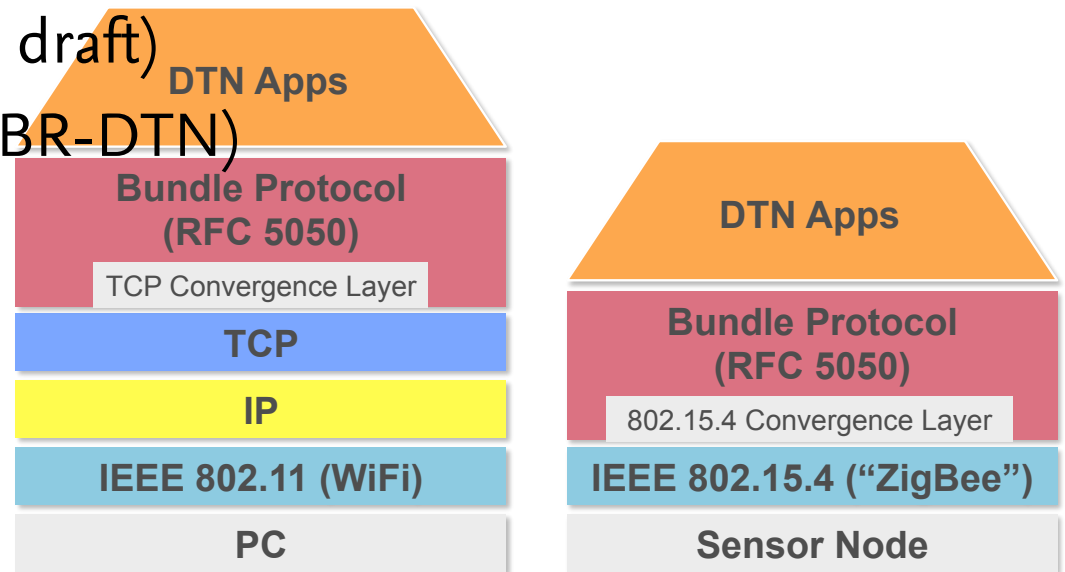
Leveraging legacy Internet infrastructure for DTNs

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CHANTS 2013, Miami

What is it?

- A Convergence Layer (CL) for RFC 5050 - Bundle Protocol (BP)
- Established CLs include
 - TCP, UDP, IEEE802.15.4, ...
- This work: SMTP/IMAP based CL
- Full specification (internet draft)
- Full implementation (for IBR-DTN)



Why another CL? Why this?

- The Internet Mail System already possesses DTN-like store-carry and forward characteristics
 - Existing work has put mail systems on top of DTN (DakNet, Bytewalla,...)
 - We turn this around: Putting BP into mails should be easy

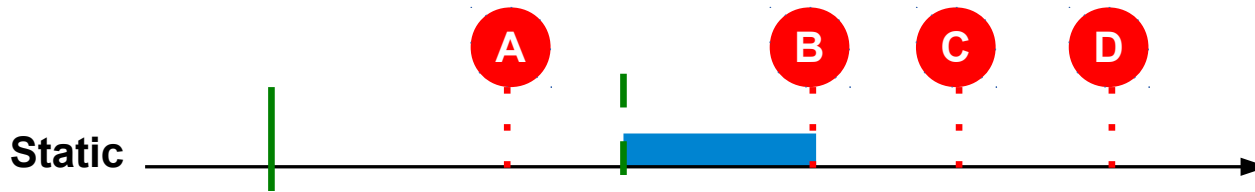
Why another CL? Why this?

- For Mobile Users
 - Opportunistic (P2P) scenarios are too energy intensive, even with energy-efficient scanning schedules to be practically usable
 - Asynchronicity might make delivery impossible or imposes extra hops
 - Always-on well-known internet based BP routers could solve the problem for situations where direct P2P communication is not possible




MailCL can solve this in a much more elegant and cost-efficient way!



Practical Benefits




Sending a bundle from node n_0 to n_1



	A	B	C	D
Static	X	✓	✓	✓

 n_0 online
 n_1 online
 n_0 offline

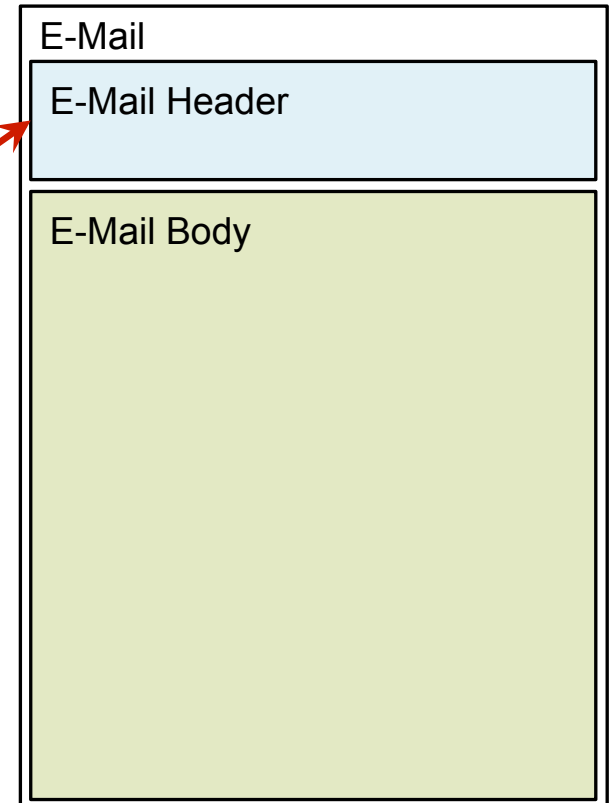
 Bundle Transmission
 Transmission Setup Time

 Successful Transmission
 Partial Transmission
 Failed Transmission

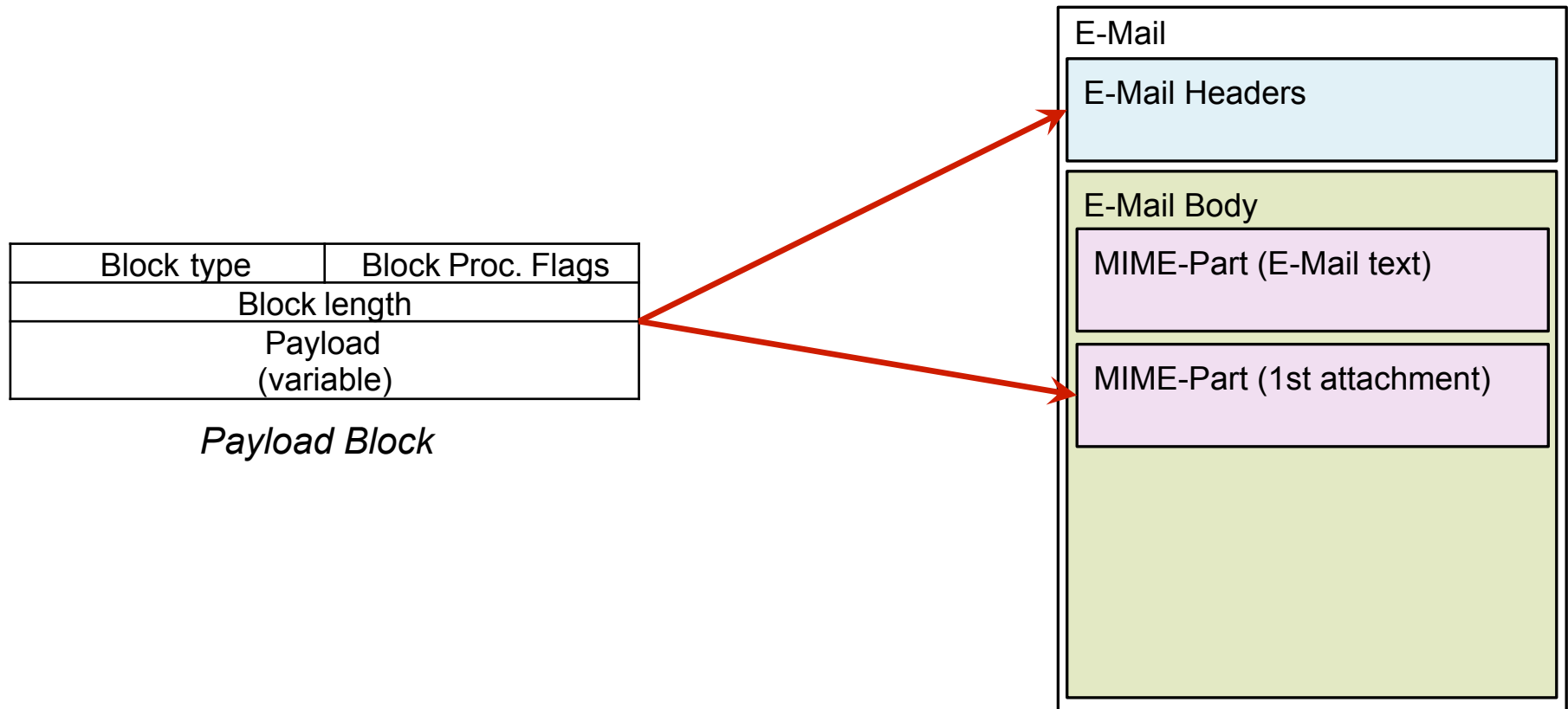
Encoding

Version	Proc. Flags
Block length	
Destination scheme offset	Destination SSP offset
Source scheme offset	Source SSP offset
Report-to scheme offset	Report-to SSP offset
Custodian scheme offset	Custodian SSP offset
Creation Timestamp time	
Creation Timestamp sequence number	
Lifetime	
Dictionary length	
Dictionary byte array (variable)	
Optional: Fragment offset	
Optional: Total application data unit length	

Primary Block



Encoding

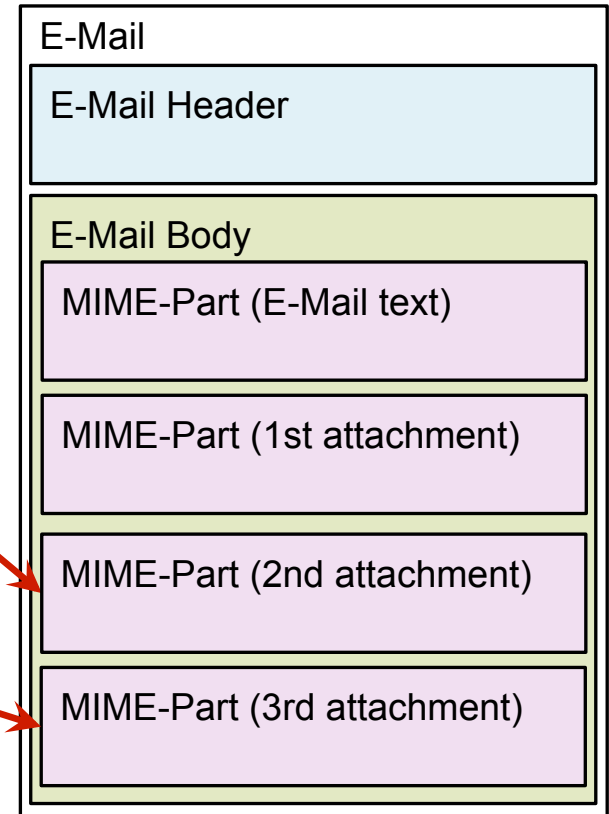


Encoding

Block type	Block Proc. Flags
EID Reference Count	
Ref scheme 1	Ref ssp 1
Ref scheme 2	Ref ssp 2
Block length	
Payload (variable)	

Block type	Block Proc. Flags
EID Reference Count	
Ref scheme 1	Ref ssp 1
Ref scheme 2	Ref ssp 2
Block length	
Payload (variable)	

Extension Blocks



Example

```
Return-path: <sender@server>
Envelope-to: recv@server
Delivery-date: Wed, 23 Jan 2013 19:44:25 +0100
From: sender@server
To: recv@server
Subject: Bundle for mail://sender@server
Bundle-EMailCL-Version: 1
Bundle-Flags: 144
Bundle-Destination: dtn://some/eid
Bundle-Source: dtn://second/eid
Bundle-Report-To: dtn:none
Bundle-Custodian: dtn:none
Bundle-Creation-Time: 412281870
Bundle-Sequence-Number: 1
Bundle-Lifetime: 3600
Bundle-Payload-Flags: 8
Bundle-Payload-Block-Length: 35
Bundle-Payload-Data-Name: payload.data
Content-Type: multipart/mixed;
  boundary="=_f-20r0xUuORzjAo2CVz1bGFWJK1irHf4t+jNIoYURaTVkAY6"
```

This is a multi-part message in MIME format. Your mail reader does not understand MIME message format.

```
---_f-20r0xUuORzjAo2CVz1bGFWJK1irHf4t+jNIoYURaTVkAY6
```

```
---_f-20r0xUuORzjAo2CVz1bGFWJK1irHf4t+jNIoYURaTVkAY6
```

```
Content-Type: application/octet-stream
```

```
Content-Transfer-Encoding: base64
```

```
Content-Disposition: attachment; filename=payload.data
```

```
VGhvcn91Z2ggcmVhZGVyIGFjaGllZmVtZW50IHVubG9ja2VkIQ==
```

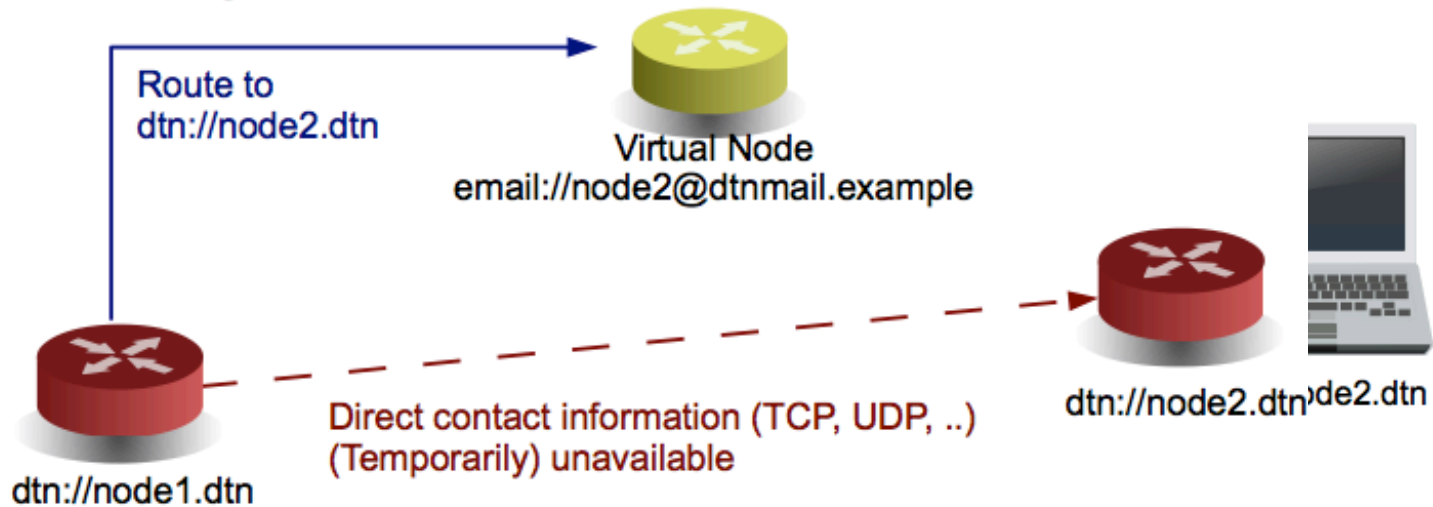
```
---_f-20r0xUuORzjAo2CVz1bGFWJK1irHf4t+jNIoYURaTVkAY6--
```

For full technical specifications of the protocol consult the draft

<http://tools.ietf.org/html/draft-gernert-dtnrg-mailcl-01>

Design Issues for Implementations

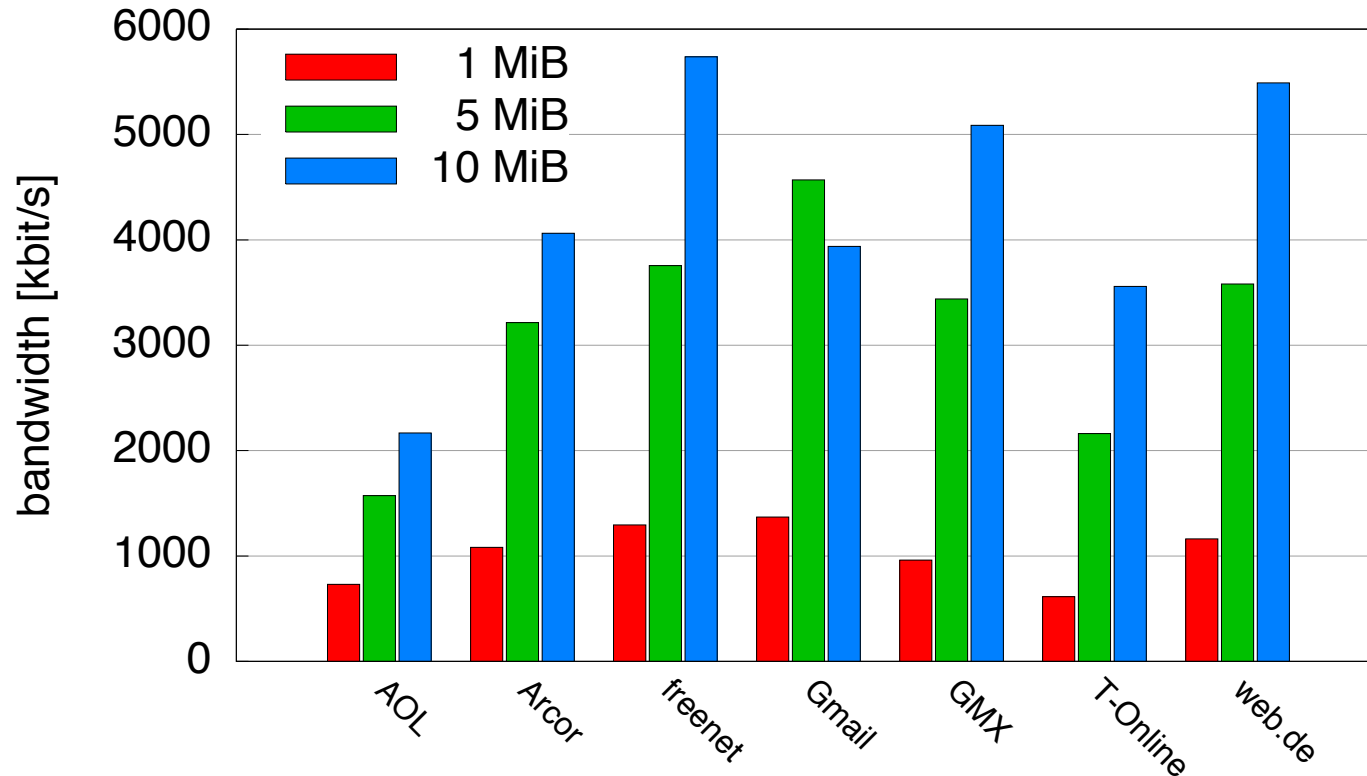
Ph IBR-DTN View



In IBR-DTN we choose the concept of a virtual node, because

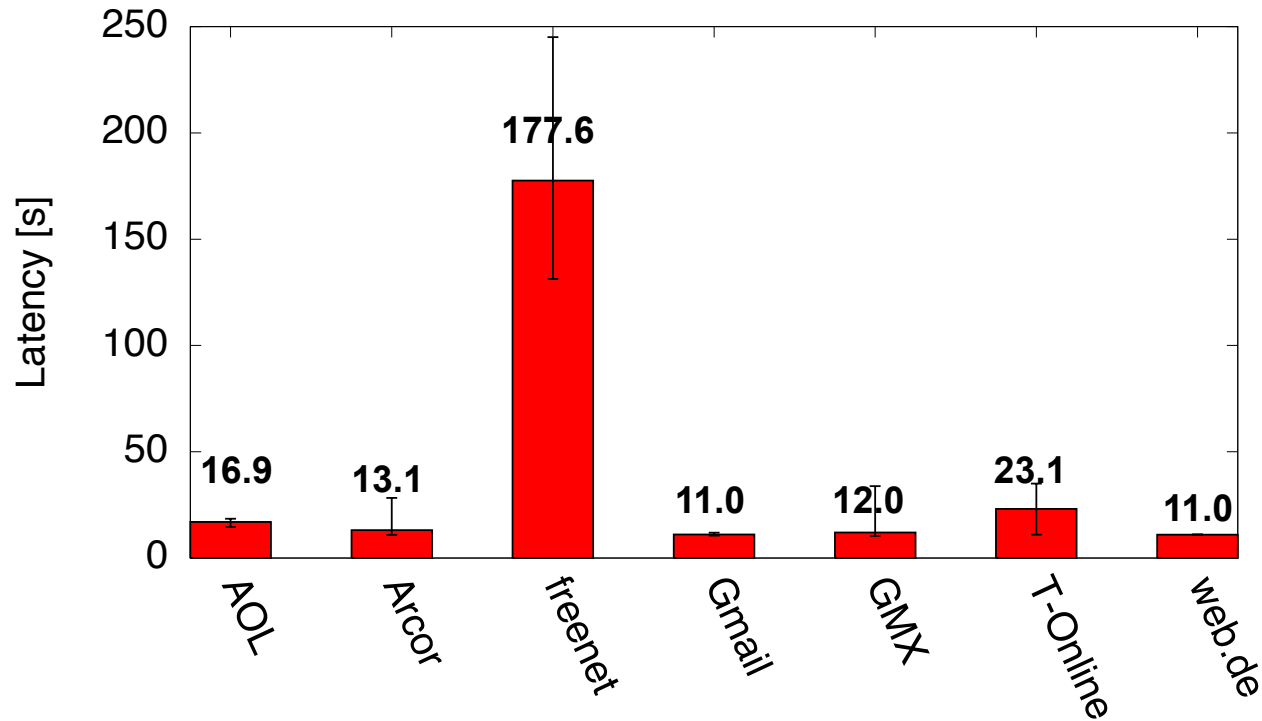
- a bundle send to a mail address will be considered *forwarded* but not *delivered*
- if a direct contact is possible later, the sender/forwarder will still have a copy and would deliver it

Bandwidth



Sending bundles from our own mailserver to various freemail providers

Latencies



Latency when pinging a node using different freemail providers

Conclusions

- Presented a Mail Convergence Layer for BP networks using SMTP and IMAP
- Mailservers can act as light-weight always-on BP routers, alleviating the need to deploy additional hardware
- Use standard mail providers for free and leverage the resources of the internet mail system for DTN apps
- Full specifications and implementation for IBR-DTN available

<https://github.com/ibrdtn/ibrdtn>

<http://tools.ietf.org/html/draft-gernert-dtnrg-mailcl-01>

Thank you! Questions?

Working Principle

