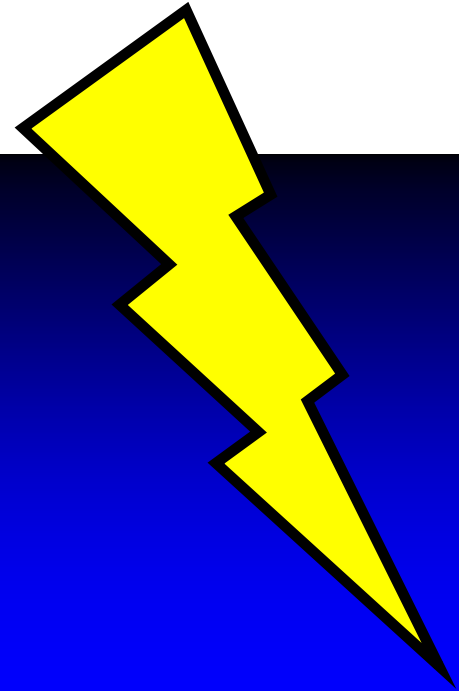# Reliability

further points for discussion
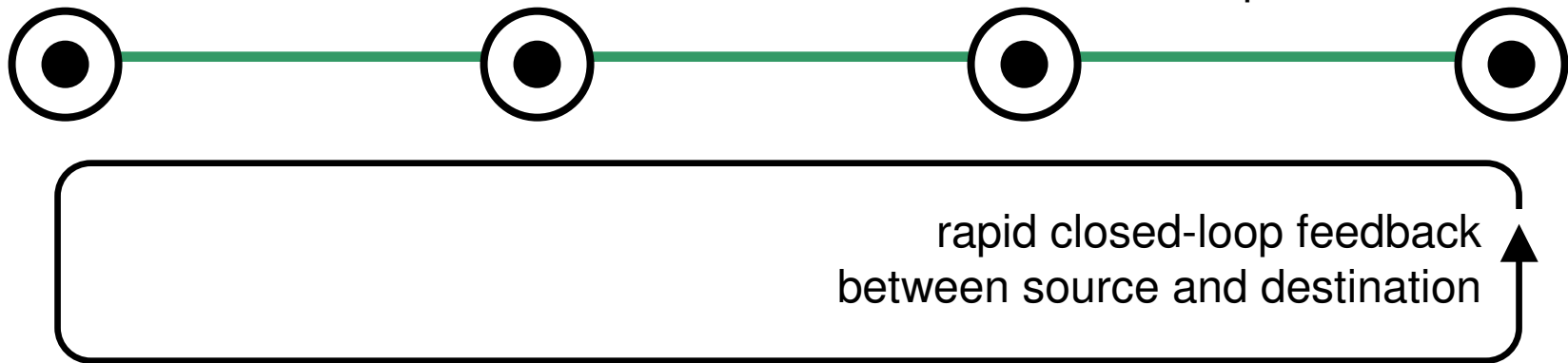
draft-irtf-dtnrg-bundle-checksum
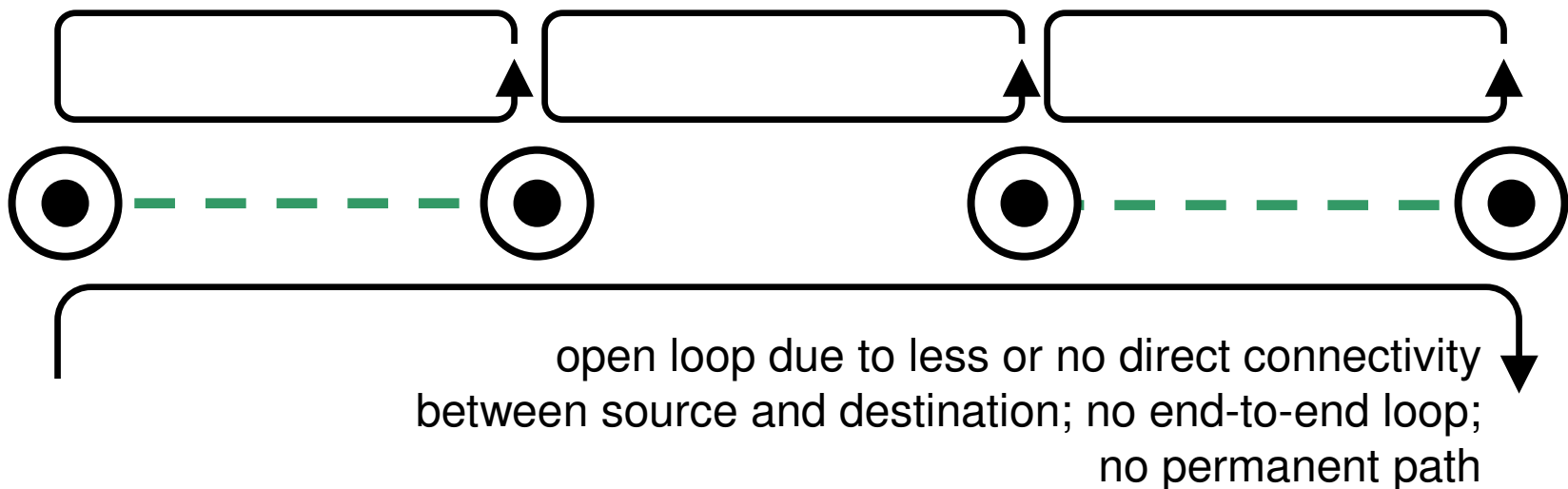Lloyd Wood, Wesley M. Eddy and Will Ivancic
Cisco Systems, Verizon/NASA, NASA Glenn.

Terrestrial fixed Internet   little need for resends between or checking at nodes when resends can easily and quickly be done end-to-end over the whole path instead

rapid closed-loop feedback between source and destination

Delay-tolerant network   more reliance on separate closed loops between each pair of nodes with local checking for *e.g.* custody transfer and to increase throughput

open loop due to less or no direct connectivity between source and destination; no end-to-end loop; no permanent path

Bundling compared to IPv6

- IPv6 packets don't get fragmented and reassembled in the network. **Bundles do.**

- IPv6 runs in a tight, closed, end-to-end control loop. **Bundles don't. Open loop between applications.**

- IPv6 can leave all its checking to the endhosts and applications, thanks to closed control loops and fast resends. **Bundling can't.**

- **DTN networks must take a different approach to reliability.**

Control loops: security and custody transfer #1

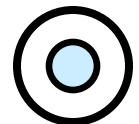**source**   **destination**
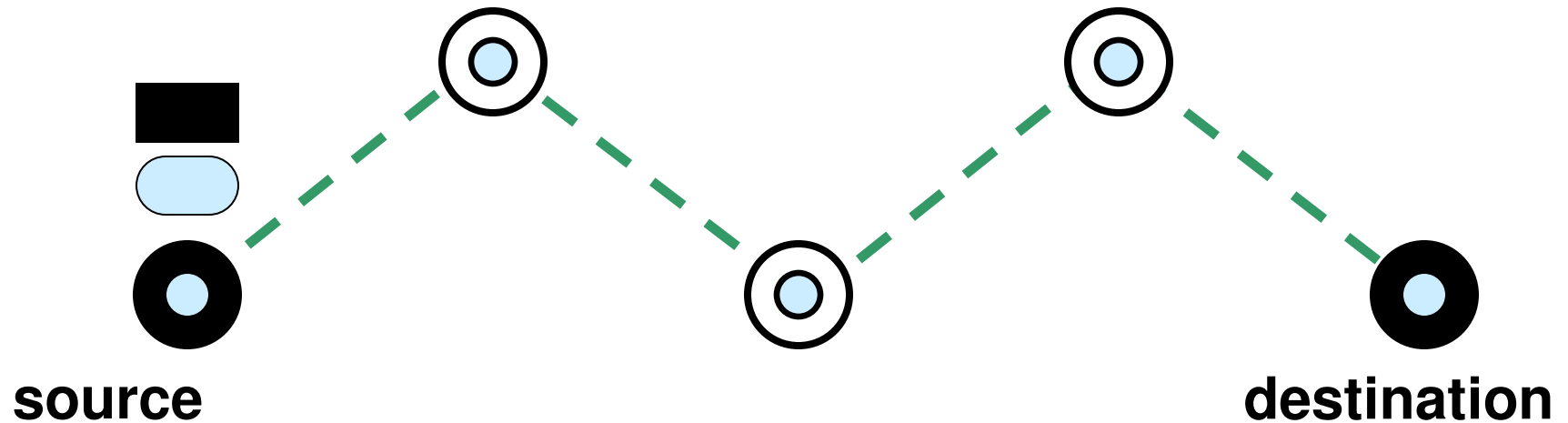
secure PIB	as in bundle security drafts
insecure ciphersuite	as in draft-irtf-dtnrg-bundle-checksum

shared or private keys ⬤

shared keys only ◎

Control loops: security and custody transfer #2
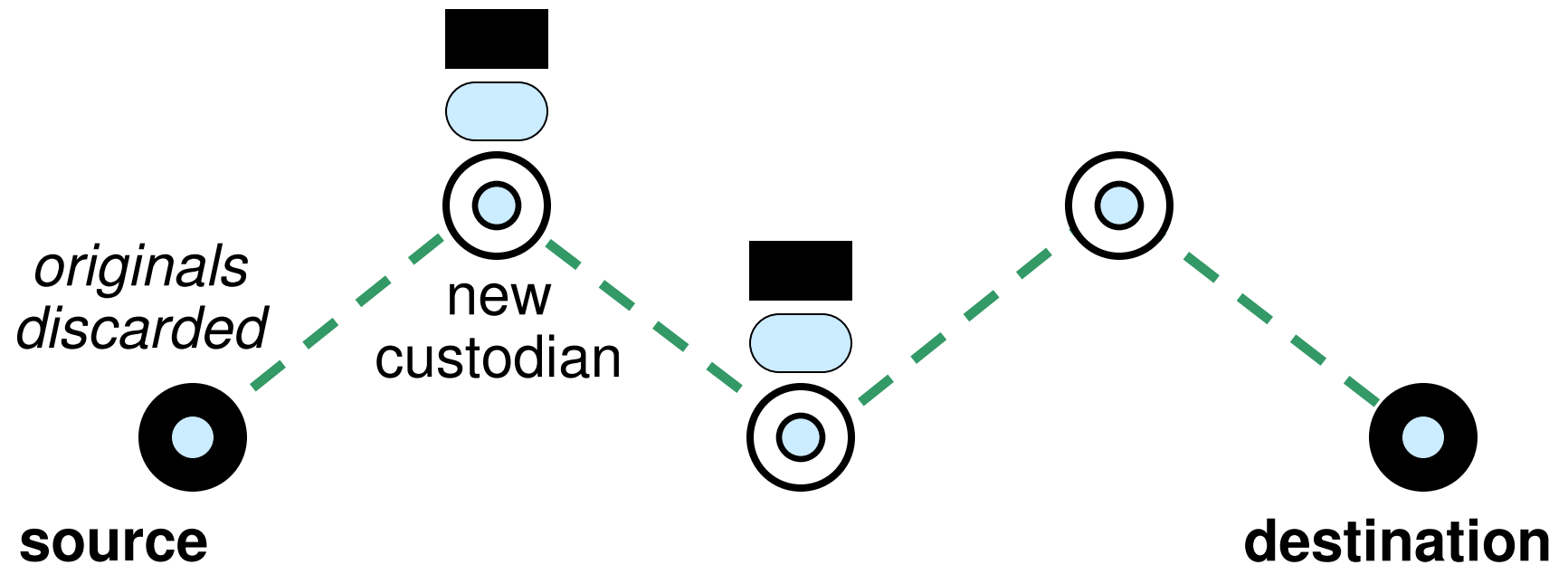

custody transfer receipts

source

destination

secure PIB

insecure ciphersuite

shared or private keys

shared keys only

Control loops: security and custody transfer #3

originals discarded

new custodian

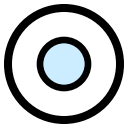**source**

destination

secure PIB

insecure ciphersuite

shared or private keys

shared keys only

Control loops: security and custody transfer #4

originals discarded

new custodian

memory corruption of bundles
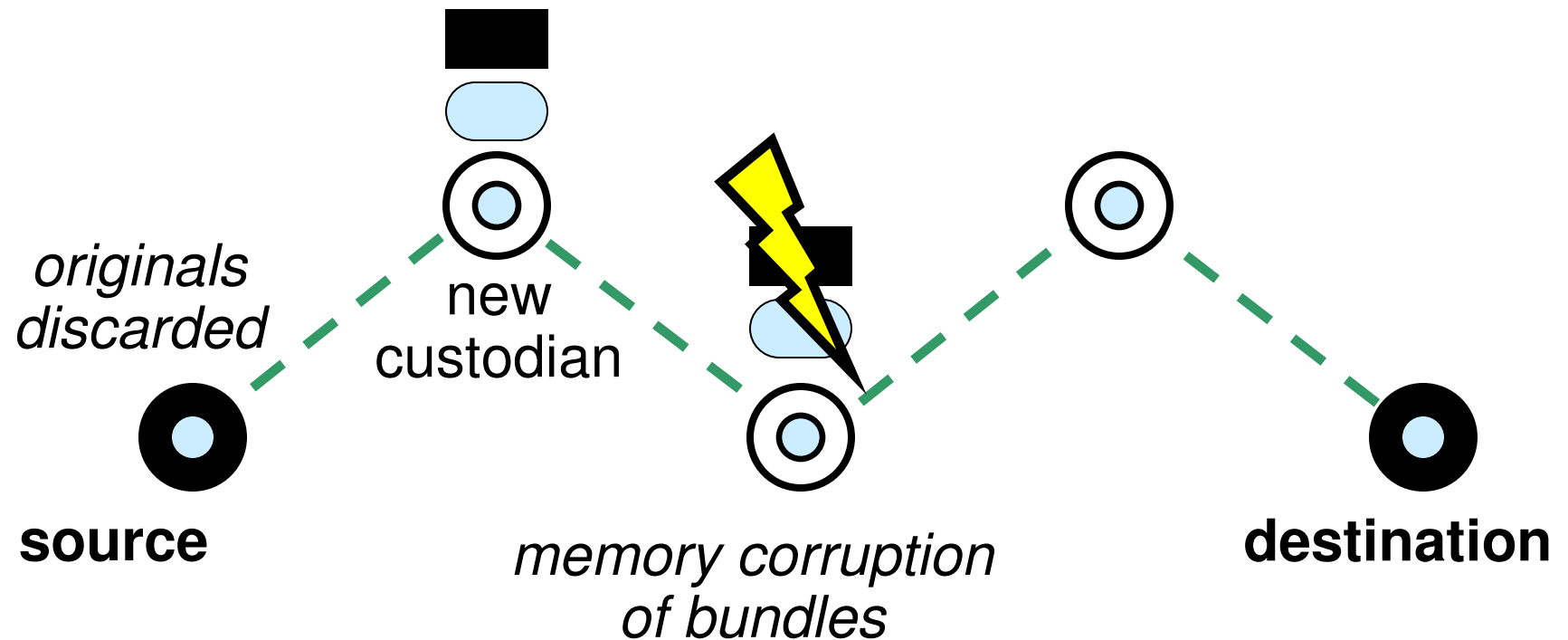
source

destination

secure PIB

insecure ciphersuite

shared or private keys

shared keys only

Control loops: security and custody transfer #5

no way of verifying content.
presumed good and sent on.

resend
requested

source

fails insecure
ciphersuite check
before sending

destination

secure PIB

insecure ciphersuite

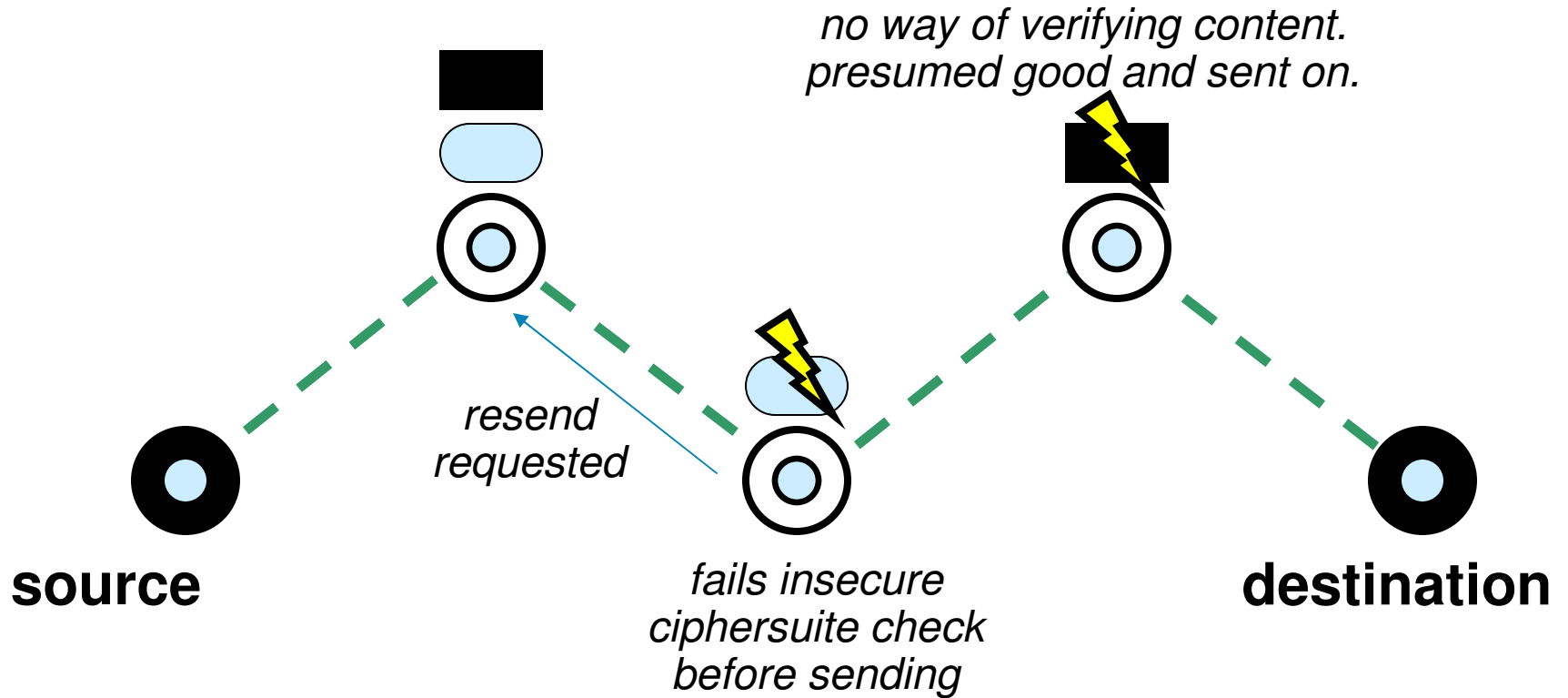shared or private keys

shared keys only

Control loops: security and custody transfer #6

PIB fails check;
discarded

discarded; re-requested.

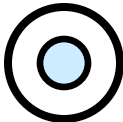**source**

destination

secure PIB

insecure ciphersuite

shared or private keys

shared keys only

Control loops: security and custody transfer #7

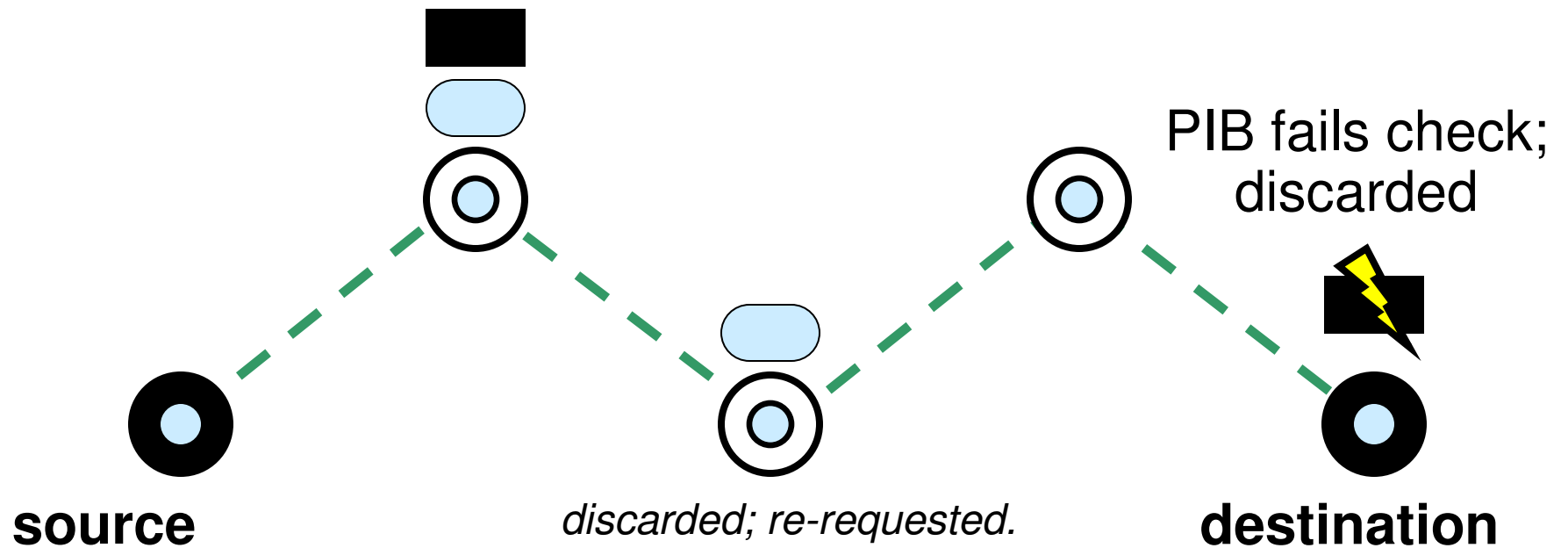

source

rerequest
secure
bundle

destination

secure PIB

insecure
ciphersuite
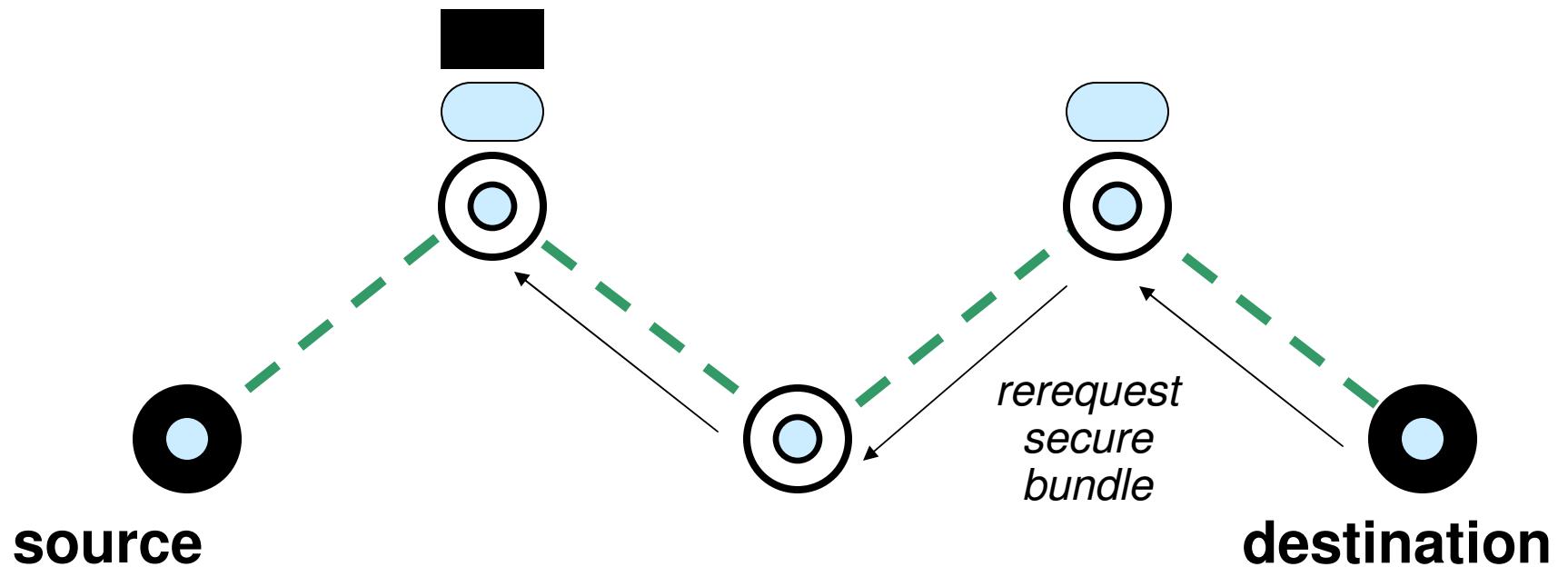
shared or private keys

shared keys only

Control loops: security and custody transfer #8

source

destination

Insecure bundle that can be checked in-transit has arrived faster.

secure PIB

insecure ciphersuite

shared or private keys

shared keys only

Tradeoffs

PIB secure bundle

opaque to intermediate nodes; longer control loops
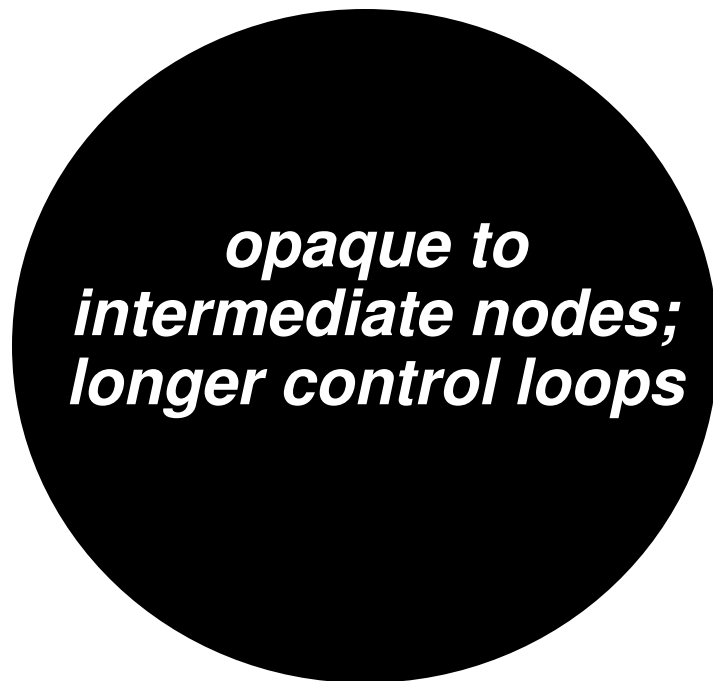
insecure payload using INSECURE ciphersuite

can be verified at each intermediate node, leading to faster resends and tighter control loops
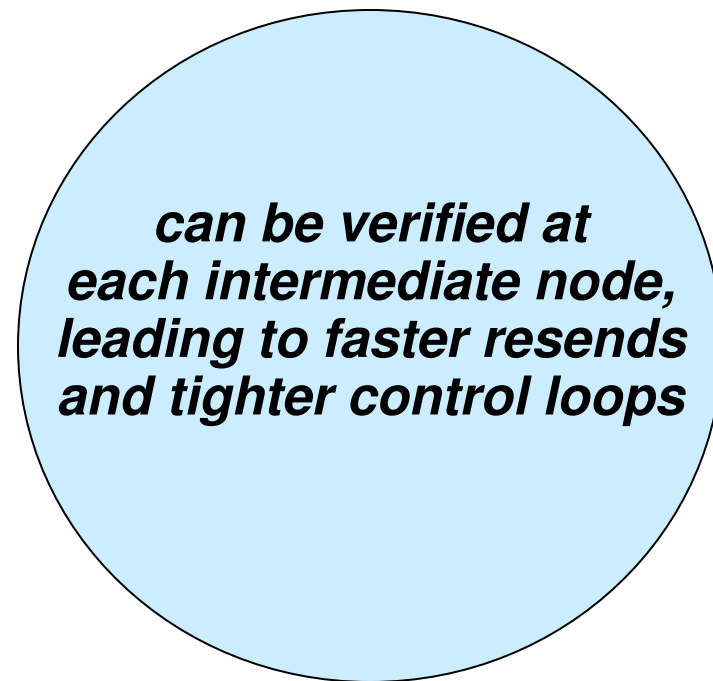
can also be used by applications implementing their own e2esecurity

Best of both worlds – end-to-end

wrapping e2e reliability checksum which can be checked at each nodes

secure end-to-end payload

allows for fast resends if errors are detected
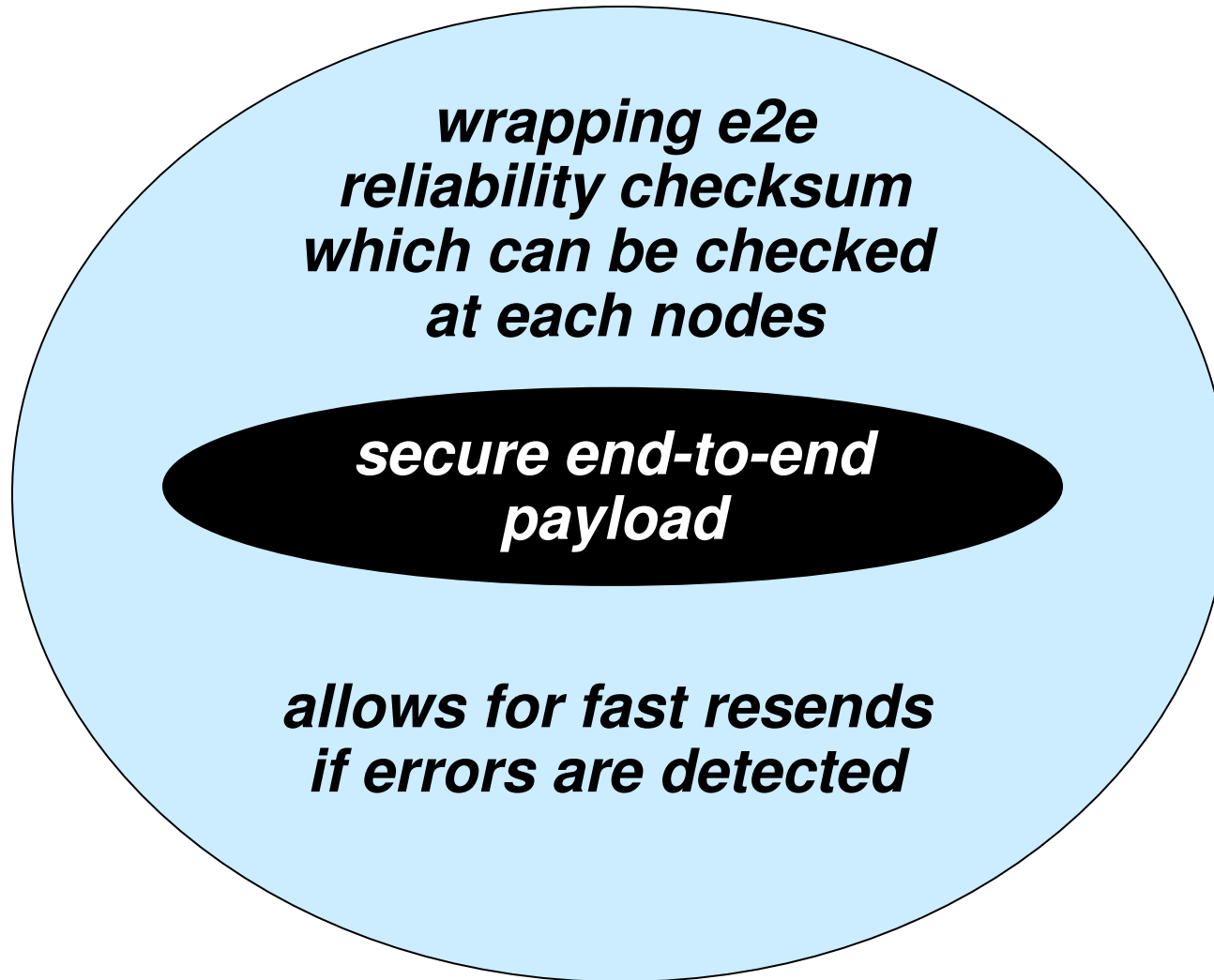
push an e2e reliability checksum on after the secure PIB is used.

How should a convergence layer support reliability?

Bundle Protocol				

Direct convergence layer adapter	TCP Transmission Control Protocol (widely used, but some deployment differences)	**direct over UDP** (not yet agreed)	*Saratoga*	Licklider (LTP)
		UDP User Datagram Protocol		CCSDS protocols for custom space links
	IP Internet Protocol			
Data-link: Ethernet, Frame Relay etc.				
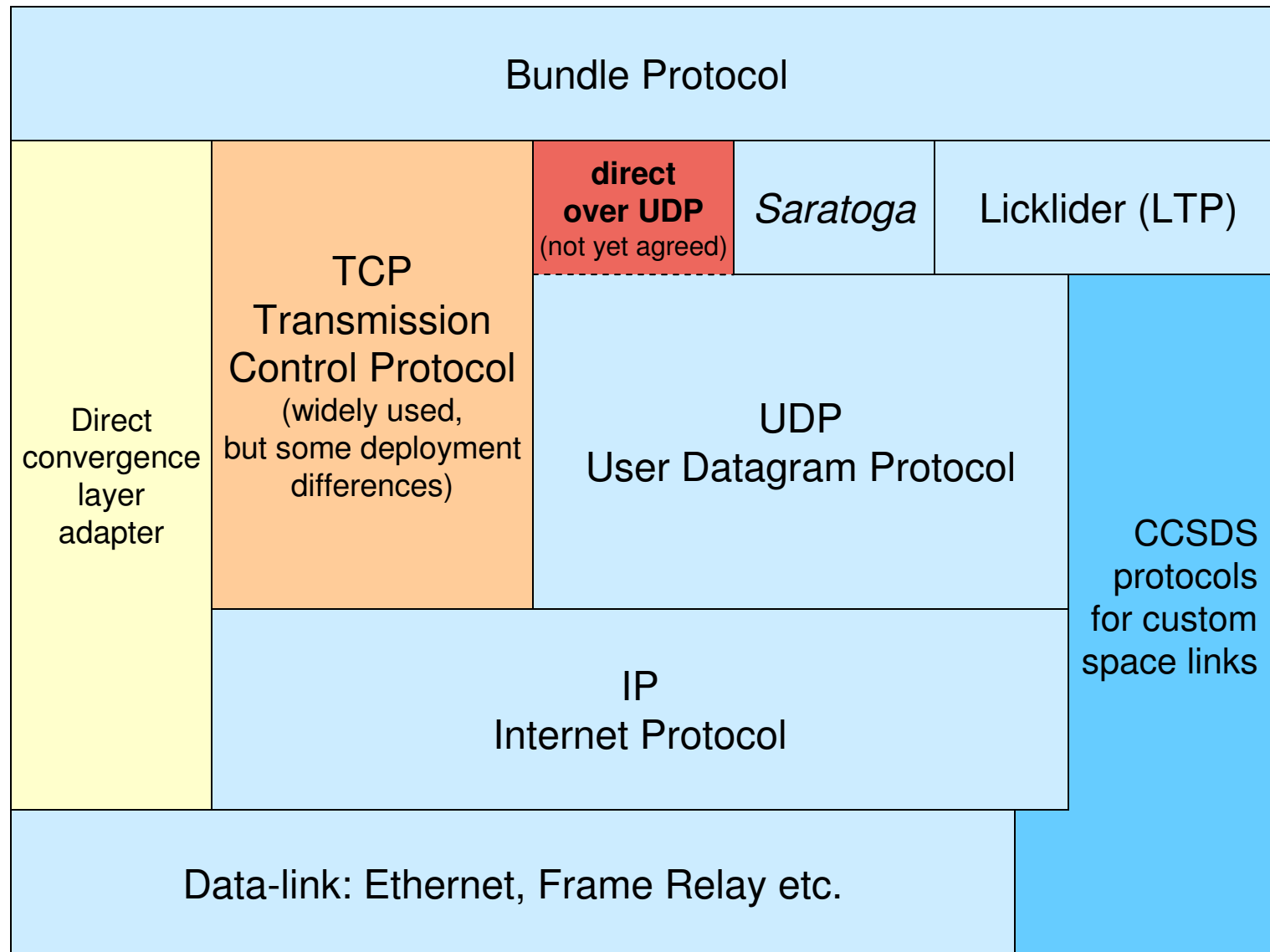
Most Bundle Protocol use is over IP. What reliability should direct-over-UDP offer?

We have experienced reliability problems when testing the Bundle Protocol in space….

- Not checking bundles for errors before forwarding can increase resend times and overall network utilization.

- Errors are only noticed afterwards by the user, rather than being caught early in the network.

150MB image transferred from UK-DMC satellite using Bundle Protocol over *Saratoga* with proactive fragmentation, 25 August 2008.

TIME Magazine best inventions of the year **#9 Orbital Internet**, 10 November 2008 issue.

draft-irtf-dtnrg-bundle-checksum

More discussion is needed.
thankyou.