Revisiting Bundle-in-Bundle Encapsulation (BIBE)

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IETF 120 DTN WG

Current status

- Most recent specification (expired August 2020) prior to July 23 was https://datatracker.ietf.org/doc/html/draft-ietf-dtn-bibect-03
  .
- A refreshed, lightly revised draft (draft-ietf-dtn-bibect-04) was posted on July 23 and work on a more comprehensively updated draft is under way.
- Current BPv7 implementations conforming (mostly) to the expired draft: ION, DTNME, uD3TN.
- Operational demonstration of a BIBE-based “service provider” configuration on ISS is planned by Spatiam for

Motivation (1 of 2)

- In the original (2009) BIBE draft:
  - Support for content-centric networking (forwarding of cached bundles).
  - Efficient (targeted) custodial retransmission of multicast bundles.
  - Security tunneling, particularly defense against traffic analysis.
- In the resurrected (2013) BIBE draft:
  - A way of helping to disentangle routing from security. The BIBE tunnel takes the place of the “security source” and “security destination” features of the original Bundle Security Protocol specification.
- In the more recent (2019-2020) BIBE drafts:

Motivation (2 of 2)

- More recently:
  - A mechanism that can be used to build Service Provider DTN networks.
    - Customer bundles can be encapsulated in bundles that satisfy the service provider network requirements: security, QoS, time-to-live, routing constraints.
  - A mechanism that can be used for backward compatibility with BPv6.
    - Serialized BPv6 bundles acquired from a BPv6 network can be offered as ADUs for transmission as the payloads of BPv7 bundles; when delivered, those serialized bundles can be forwarded within a remote BPv6 network.

Open design questions

- Is it appropriate to use BPv7 itself as a reliable convergence-layer protocol (“custody transfer”) under BPv7?
  - Motivation: in some cases, no other reliable convergence-layer protocol is available. The acknowledgement of a bundle may occur long after the arrival of the acknowledged bundle and may travel by a very different path, arriving via a different medium. BPv7 itself may be the best way to sustain bundle acknowledgment arrival under these conditions.
  - Alternative: another disruption-tolerant convergence-layer protocol, TBD.
- Is “custody transfer” the right name for that reliability mechanism?
  - Motivation: name recognition from BPv6

How it works (1): layers

- BIBE is a BPv7 convergence-layer protocol for which the convergence-layer adapter (“BIBE endpoint”) is the Administrative Element of the node’s Application Agent.
  - All of the protocol data units of the BIBE protocol take the form of BPv7 administrative records.
- BIBE is also a BPv7 application: every BIBE protocol data unit (PDU) is presented as an Application Data Unit that becomes the payload of a bundle.
  - Similar to bundle status reports.

How it works (2): protocol data units

- The protocol comprises two types of PDU:
  - BIBE PDU, or BPDU. The record content of a BPDU is a “BPDU message” comprising:
    - Transmission ID
    - Retransmission time
    - A serialized bundle, the “encapsulated bundle”
  - Custody signal. The record content of a custody signal is a “custody message” comprising:
    - Disposition code
    - An array of disposition scope sequences, each of which comprises:
      - The first transmission ID in a consecutive series of transmission IDs of BPDUs to which this disposition code applies
      - Count of transmission IDs in that series

How it works (3): transmission

- The source node’s BPA invokes the services of a BIBE CLA to forward a given serialized bundle.
- The source BIBE CLA, acting as a BPv7 application, presents that serialized bundle to the source BPA as an application data unit.
  - The values of the parameters governing the requested bundle issuance are an implementation matter.
- The source BPA issues a new “encapsulating” bundle whose payload is the serialized bundle. It computes a route for the encapsulating bundle and forwards that bundle via CLA (LTP, TCP, etc.) as usual.

How it works (4): reception

- The encapsulating bundle is received by the destination BPA via CLA.
- The destination BPA extracts that bundle’s payload (the encapsulated serialized bundle) and delivers it to the destination application – the Administrative Element of the destination node’s Application Agent, a BIBE CLA.
- The encapsulated bundle is received by the destination BPA via that BIBE CLA (acting as a CLA rather than as a BPv7 application).
- The destination BPA then dispatches that bundle (forwards and/or delivers it) as usual.

How it works (5): custody transfer

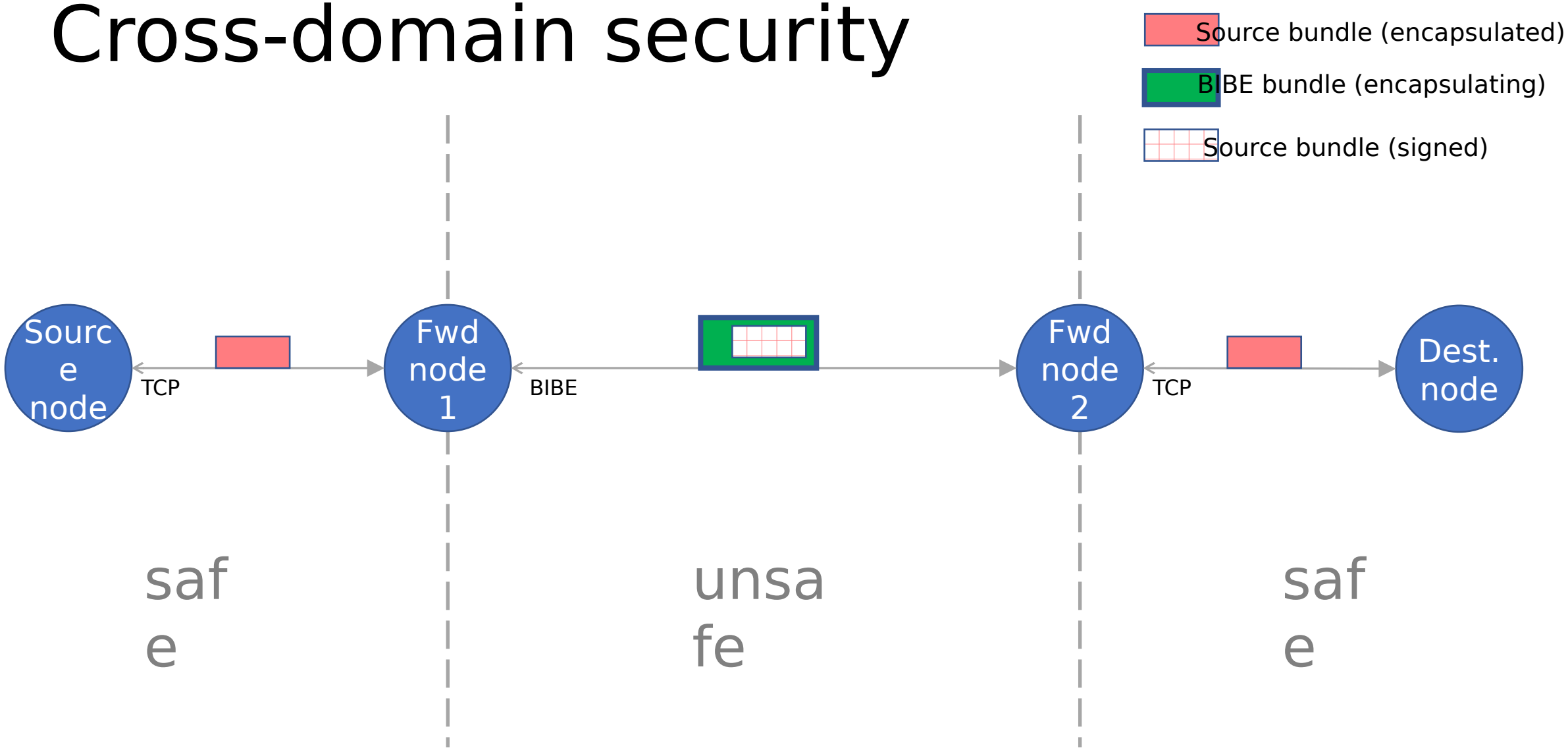
- Content of the BPDU administrative record comprises:
  - Transmission ID (zero if custody transfer is not requested).
  - Expected time of acknowledgment (zero if custody transfer is not requested).
  - Encapsulated bundle.
- Acknowledgment of the encapsulating bundle is aggregated into a new administrative record sent in a responding bundle.
  - Custody transfer disposition code (“custody accepted” or reason for refusal).
  - Sequences of consecutive transmission IDs of received bundles.
- If acknowledgement is not received by the expected time, transmission of the encapsulating bundle is assumed to have failed; the encapsulating bundle is re-forwarded by the source BPA.

Cost: how much overhead does it add?

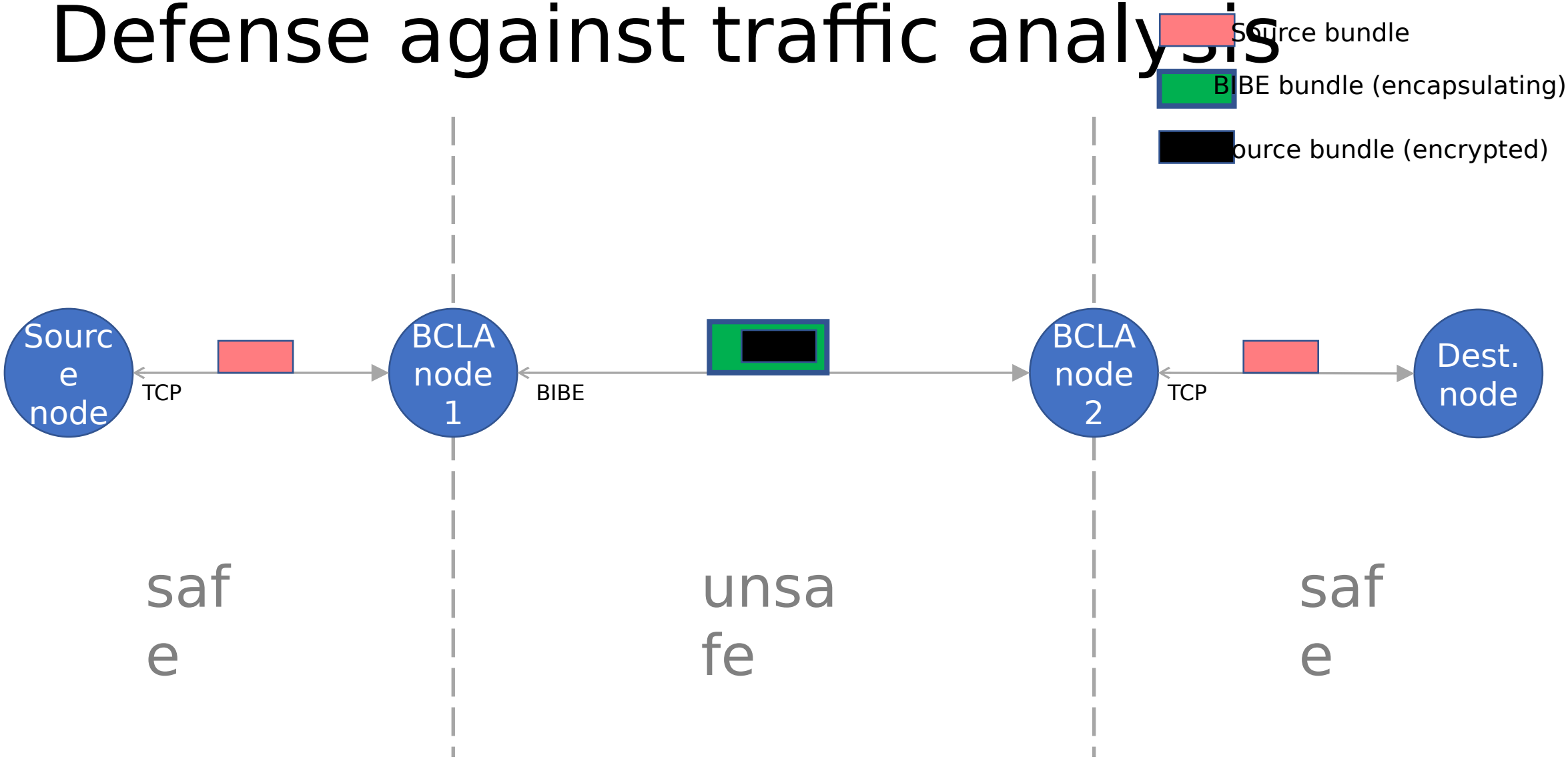
- Elements of the encapsulating bundle:
  - Primary block
  - Possibly some sort of QoS extension block
  - A block integrity block whose targets are the primary and QoS blocks
  - Possibly a block confidentiality block whose target is the payload block
  - Payload block
    - Payload block header
    - Payload block-type-specific data
      - Administrative record header
      - Administrative record content
        - Transmission ID
        - Retransmission time

Benefit: potential applications

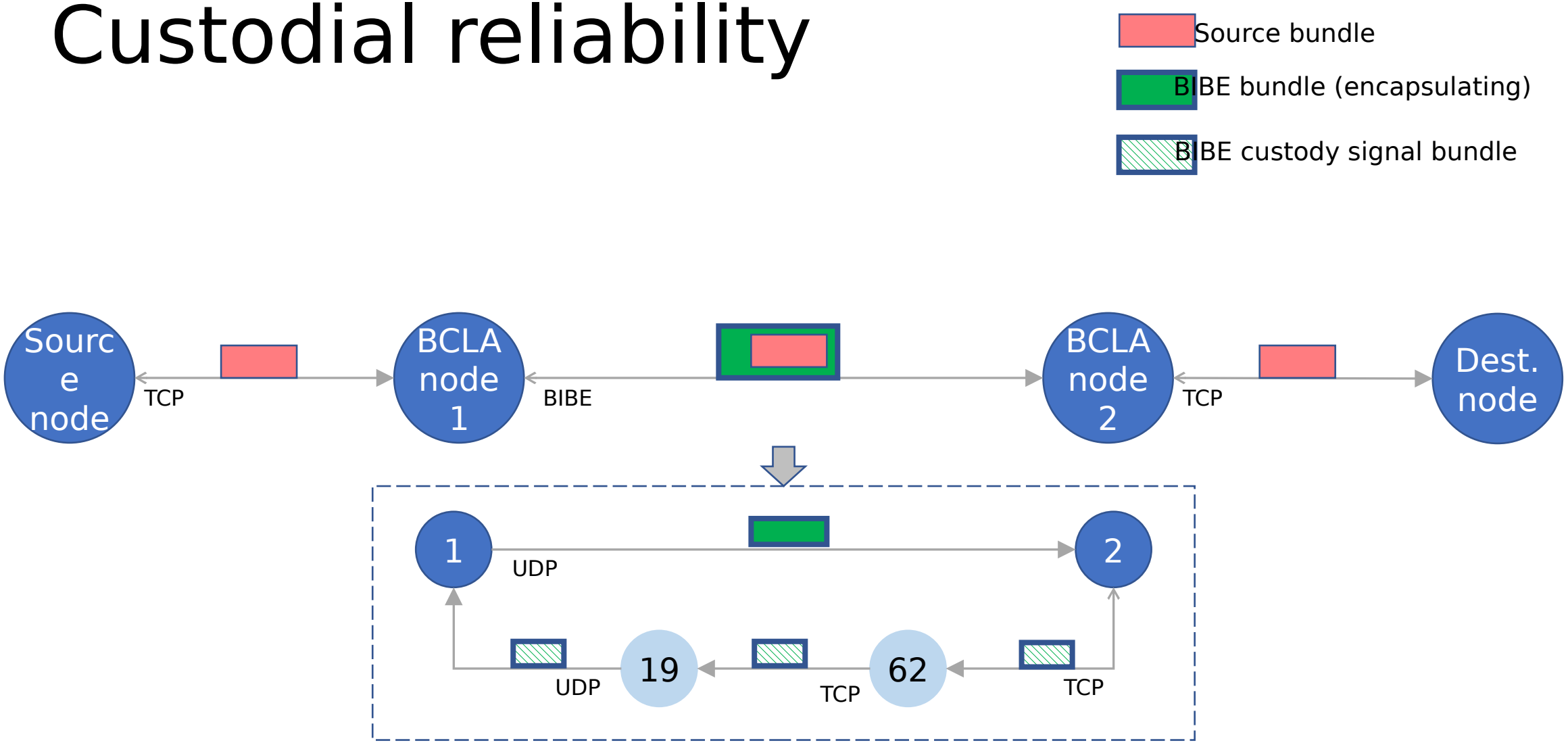
Cross-domain security



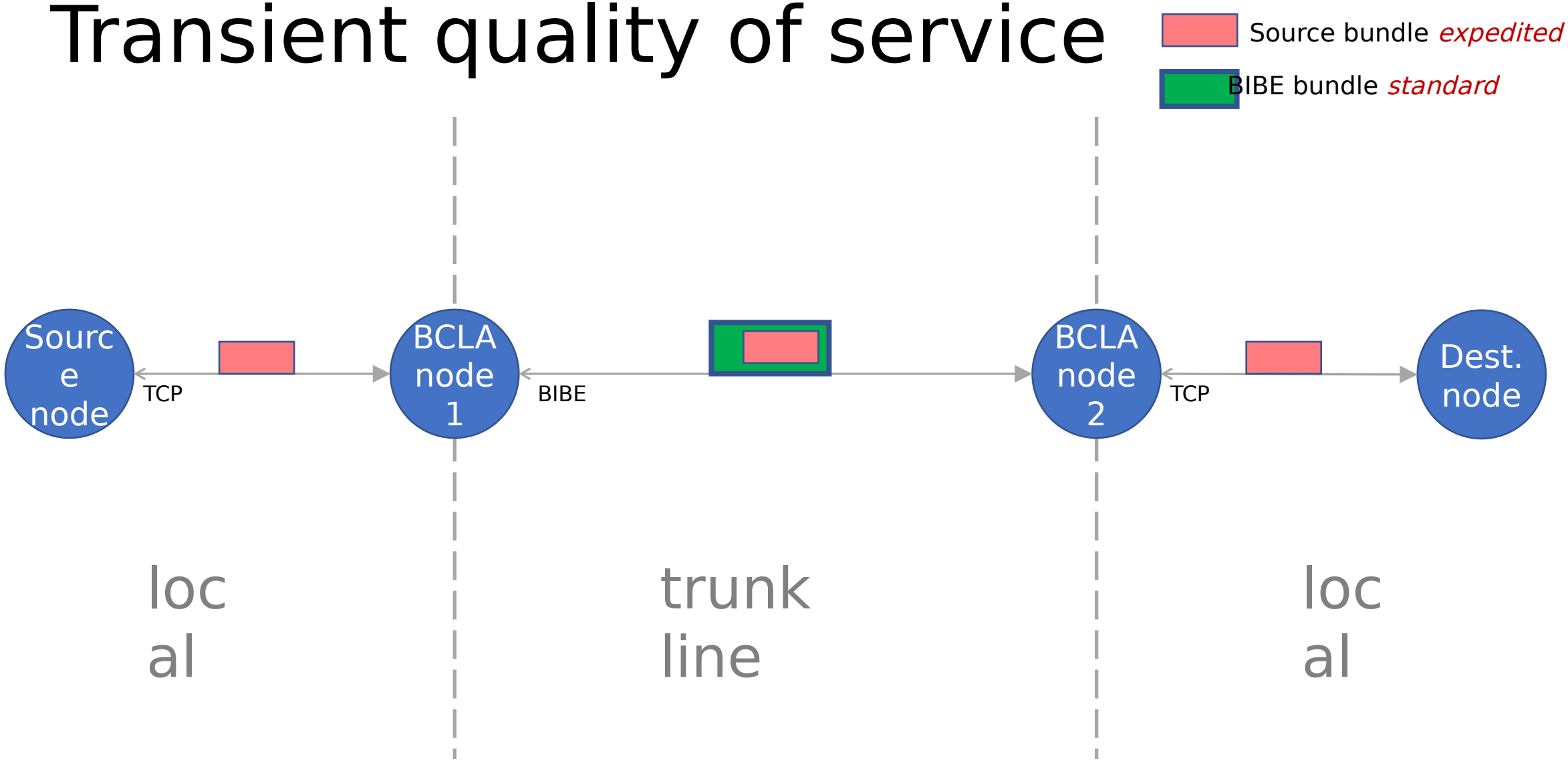
Defense against traffic analysis



Custodial reliability

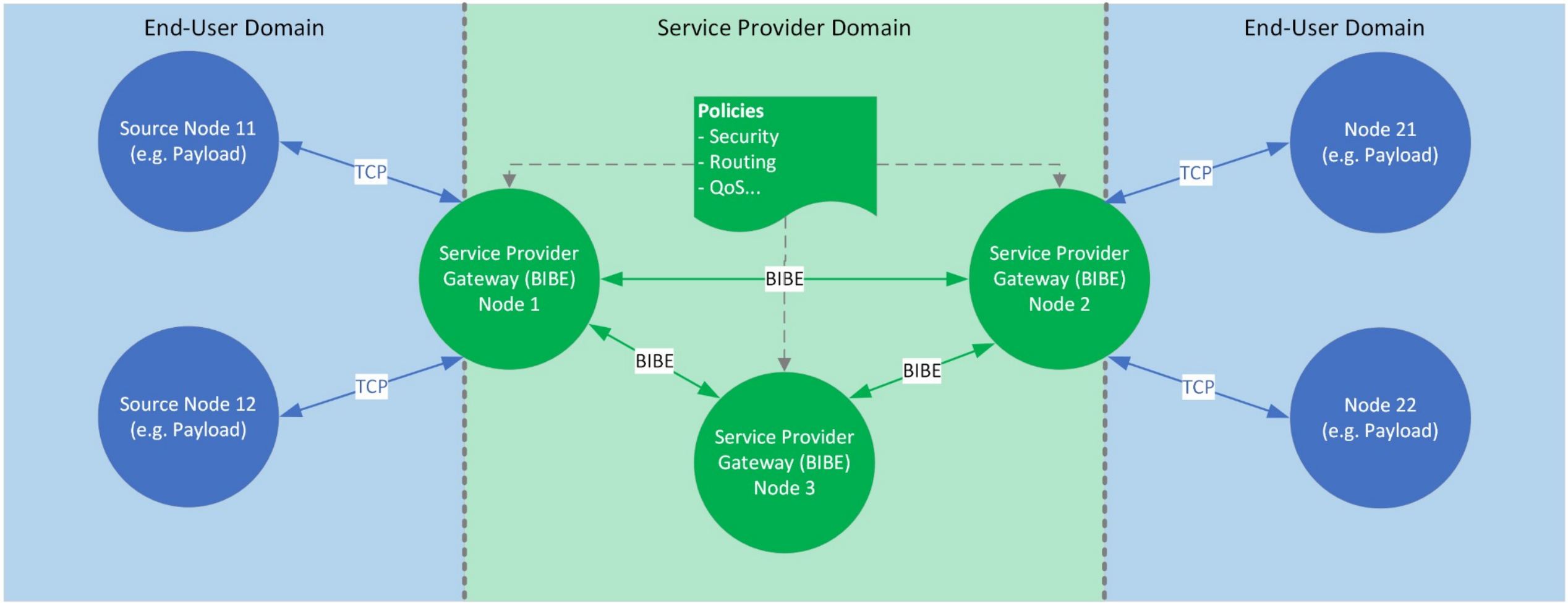


Transient quality of service

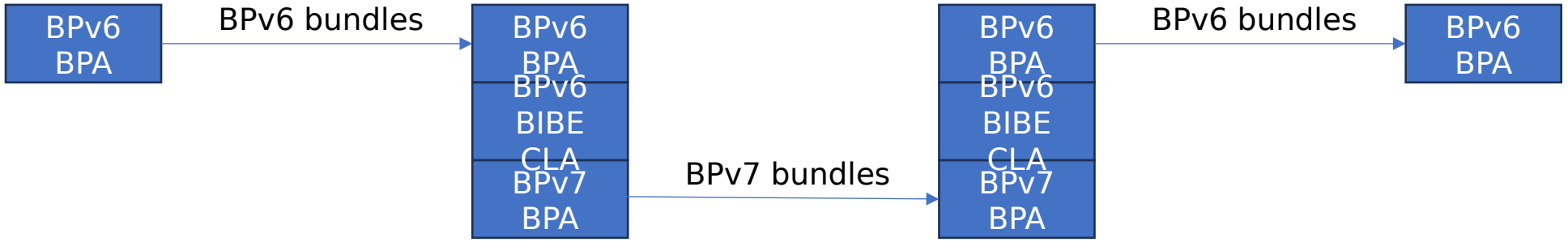


BIBE in Service Provider networks

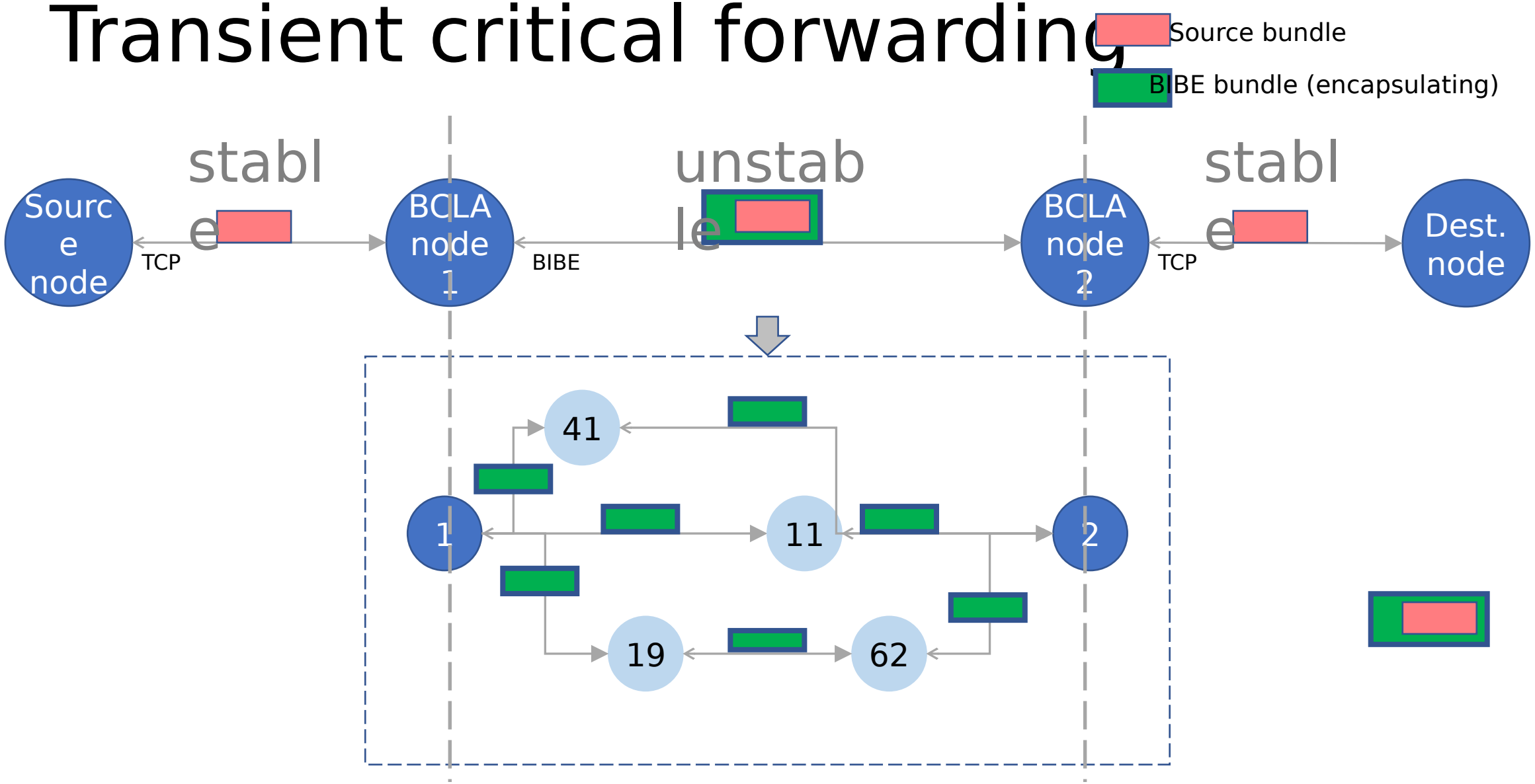
BIBE is critical to enforce policies within Service



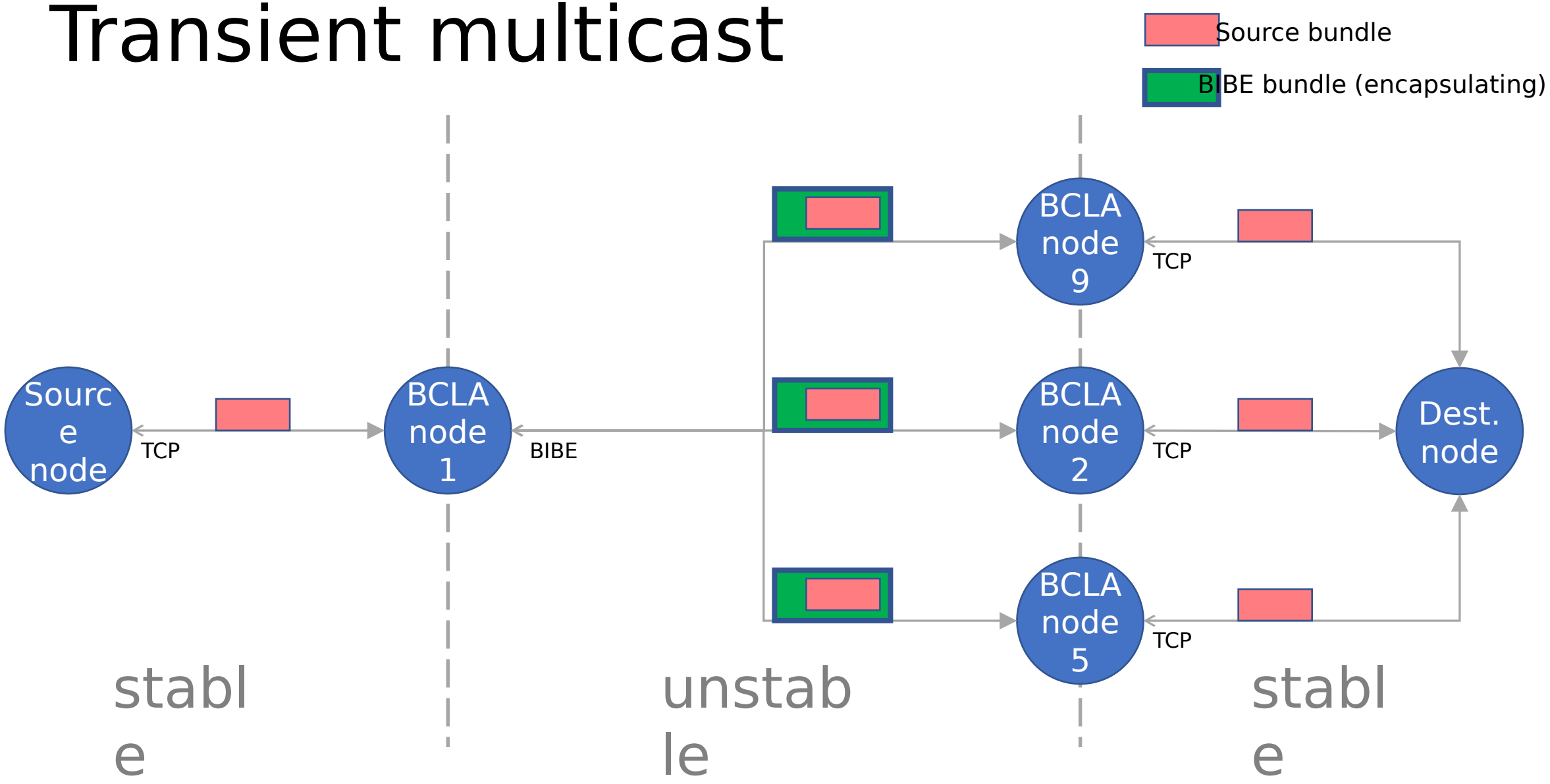
BPv6 compatibility



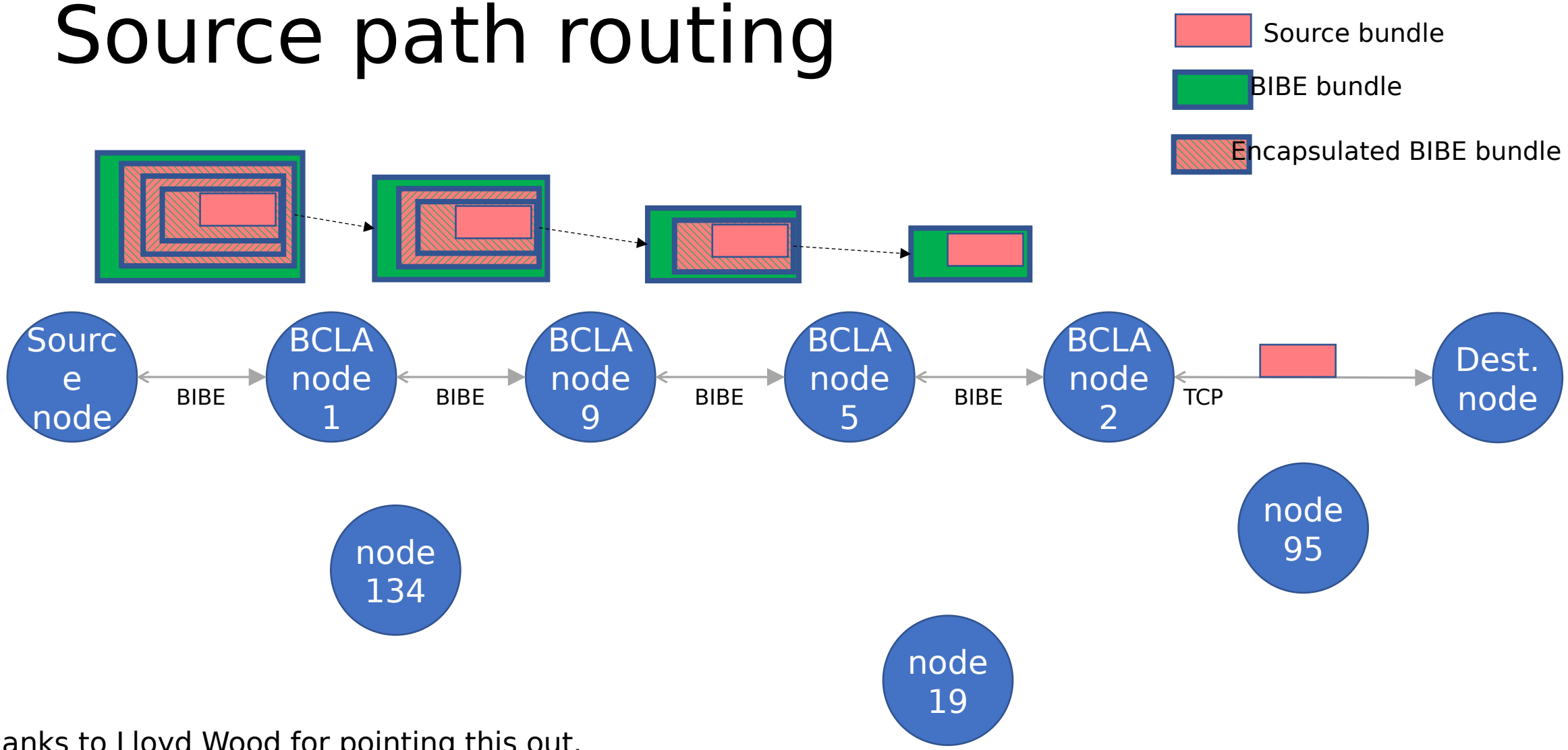
Transient critical forwarding



Transient multicast

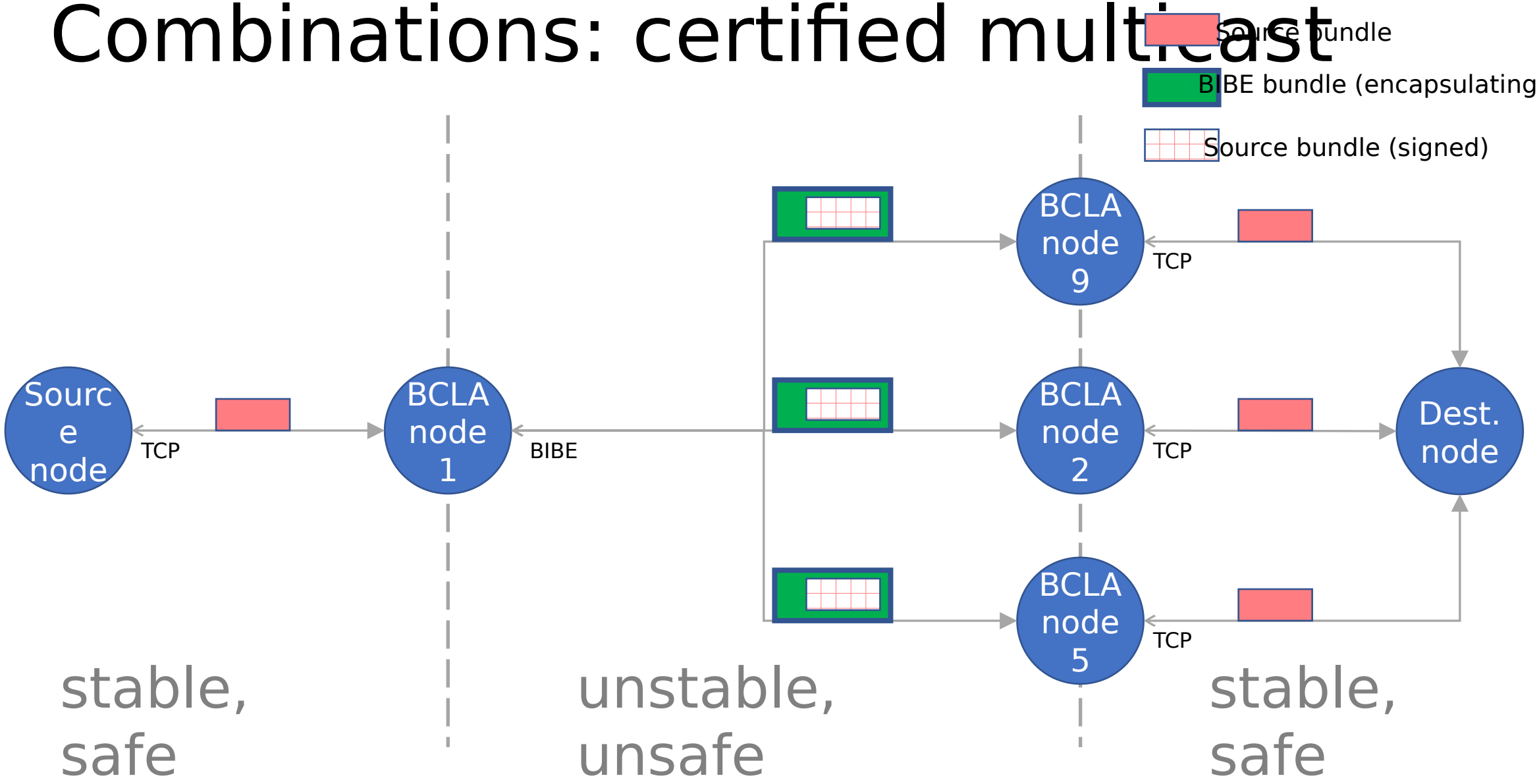


Source path routing



Thanks to Lloyd Wood for pointing this out.

Combinations: certified multicast



Questions?