

Bundle-in-Bundle Encapsulation
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Abstract

This document describes Bundle-in-Bundle Encapsulation (BIBE), a Delay-Tolerant Networking (DTN) Bundle Protocol (BP) "convergence layer" protocol that tunnels BP "bundles" through encapsulating bundles. The services provided by the BIBE convergence-layer protocol adapter encapsulate an outbound BP "bundle" in a BIBE convergence-layer protocol data unit for transmission as the payload of a bundle. Security measures applied to the encapsulating bundle may augment those applied to the encapsulated bundle.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

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[1.](#) Introduction

This document describes Bundle-in-Bundle Encapsulation (BIBE), a Delay-Tolerant Networking (DTN) Bundle Protocol (BP) [[RFC5050](#)] "convergence layer" protocol that tunnels BP "bundles" through encapsulating bundles.

Conformance to the bundle-in-bundle encapsulation (BIBE) specification is OPTIONAL for BP nodes. Each BP node that conforms to the BIBE specification provides a BIBE convergence-layer adapter (CLA) that is implemented within the administrative element of the BP node's application agent. Like any convergence-layer adapter, the BIBE CLA provides:

- o A transmission service that sends an outbound bundle (from the bundle protocol agent) to all BP nodes in the minimum reception group of the endpoint identified by a specified endpoint ID.

- o A reception service that delivers to the bundle protocol agent an inbound bundle that was sent by a remote BP node via the BIBE convergence layer protocol.

The BIBE CLA performs these services by:

- o Encapsulating outbound bundles in BIBE protocol data units, which take the form of Bundle Protocol administrative records as described later.
- o Requesting that the bundle protocol agent transmit bundles whose payloads are BIBE protocol data units.
- o Taking delivery of BIBE protocol data units that are the payloads of bundles received by the bundle protocol agent.
- o Delivering to the bundle protocol agent the bundles that are encapsulated in delivered BIBE protocol data units.

Bundle-in-bundle encapsulation may have broad utility, but the principal motivating use case is the deployment of "cross domain solutions" in secure communications. Under some circumstances a bundle may arrive at a node that is on the frontier of a region of network topology in which augmented security is required, from which the bundle must egress at some other designated node. In that case, the bundle may be encapsulated within a bundle to which the requisite additional Bundle Security Protocol (BSP) [[RFC6257](#)] extension block(s) can be attached, whose source is the point of entry into the insecure region (the "security source") and whose destination is the point of egress from the insecure region (the "security destination").

Note that:

- o If the payload of the encapsulating bundle is protected by a Payload Confidentiality Block (PCB), then the source and destination of the encapsulated bundle are encrypted, providing a defense against traffic analysis that BSP alone cannot offer.
- o Bundles whose payloads are BIBE protocol data units may themselves be forwarded via a BIBE convergence-layer adapter, enabling nested bundle encapsulation to arbitrary depth as required by a given security policy.

- o Moreover, in the event that no single point of egress from an insecure region of network topology can be determined at the moment a bundle is to be encapsulated, multiple copies of the bundle may be encapsulated individually and forwarded to all candidate points of egress.
- o Finally, because the BIBE CLA (like any CLA) may conform to the Compressed Bundle Header Encoding (CBHE) specification [[RFC6260](#)], a bundle that is forwarded by BIBE and protected by multiple layers of encryption might be slightly smaller than a similarly protected bundle whose multiple PCBs have explicit security sources and destinations. This is because BSP extension block security sources and destinations are encoded as endpoint ID references, which are not subject to CBHE compression (and in fact make CBHE compression of the bundle impossible); retention of the complete "dictionary" in the bundle's primary block is mandatory. When a bundle is forwarded via a BIBE CLA, explicit security sources and destinations in the BSP extension blocks are unnecessary. Implicit security sources and destinations are asserted in the primary blocks of the encapsulating and encapsulated bundle(s), which may be compressed as described in the CBHE specification.

Taken together, these capabilities provide flexibility in security that is comparable, and in some ways superior, to that offered by the explicit security sources and destinations of [[RFC6257](#)].

[2.](#) BIBE Design Elements

[2.1.](#) BIBE Protocol Data Unit

The BIBE protocol data unit is a Bundle Protocol administrative record constructed as follows:

- o Record type code is 7, i.e., bit pattern 0111.
- o The content of the administrative record consists of a single BP bundle.

[2.2.](#) BIBE Bundle Transmission Service

When a BIBE convergence-layer adapter is requested by the bundle protocol agent to send a bundle to all bundle nodes in the minimum reception group of the endpoint identified by a specified endpoint ID:

- o If the BIBE CLA is CBHE-conformant and the destination endpoint ID is likewise CBHE-conformant, the CLA SHOULD encode the primary

block of the bundle in the manner prescribed by the CBHE specification.

- o The CLA MUST place the possibly encoded bundle in the content of a new BIBE administrative record.
- o This new BIBE administrative record constitutes a BIBE convergence-layer protocol data unit which is to be conveyed from the BIBE CLA to a peer BIBE CLA at the destination node(s).
- o To accomplish conveyance of the BIBE convergence-layer protocol data unit to its peer CLA, the CLA MUST request that the bundle protocol agent transmit -- to the destination endpoint -- a bundle whose payload is the BIBE convergence-layer protocol data unit (i.e., the new BIBE administrative record).
- o Selection of the values of the parameters governing the bundle transmission requested by the CLA, other than the destination endpoint ID, is an implementation matter. The parameter values governing transmission of the encapsulated bundle MAY be consulted for this purpose.

2.3. BIBE Bundle Delivery Service

When a BIBE CLA receives a BIBE convergence-layer protocol data unit from the bundle protocol agent (that is, upon delivery of the payload of a bundle whose transmission was requested by a BIBE CLA):

- o The BIBE convergence-layer protocol data unit constitutes a BIBE administrative record.
- o If the BIBE CLA is CBHE-conformant and the bundle that forms the content of that administrative record is CBHE-encoded, the CLA MUST decode the primary block of that bundle in the manner prescribed by the CBHE specification.
- o The CLA MUST deliver the possibly decoded bundle to the bundle protocol agent.

Note that, upon delivery of a bundle from a BIBE CLA, the bundle protocol agent will perform the bundle reception procedures defined in [section 5.6 of \[RFC5050\]](#) as usual: the formerly encapsulated bundle may be forwarded, delivered, etc.

3. IANA Considerations

The BIBE specification requires IANA registration of the new BIBE administrative record (type code 7) defined in [section 2.1](#) above.

4. Security Considerations

The BIBE specification introduces no new security considerations.

5. Acknowledgments

Although the BIBE specification diverges in some ways from the original Bundle-in-Bundle Encapsulation Internet Draft authored by Susan Symington, Bob Durst, and Keith Scott of The MITRE Corporation ([draft-irtf-dtnrg-bundle-encapsulation-06](#), 2009), the influence of that earlier document is gratefully acknowledged.

6. Normative References

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