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Architecture and Deployment Considerations for Secure Origin BGP (soBGP)
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Status of this Memo

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Abstract

There is a great deal of concern over the security of the Border Gateway Protocol, which is used to provide routing information to the Internet and other large internetworks. This draft provides an architecture for a secure distributed registry of routing information to address these concerns. The draft begins with an overview of the operation of this system, and then follows with various deployment scenerios, starting with what we believe will be the most common deployment option.

1. Background

There are two fundamental pieces of a routing system that need to be secured:

- o Adjacencies between devices running the routing protocol
- o Information carried within the routing protocol.

While security between BGP [[BGP](#)] speakers has been addressed in a number of ways, including cryptographic authentication [[BGP-MD5](#)] and limiting the attack radius through TTL mechanisms [GTSH], security for the information carried within BGP is not considered a solved problem.

This draft proposes a possible solution to securing the information within BGP, using the certificates and protocol extensions proposed in [[SOBGP-BGPTRANSPORT](#)], [[SOBGP-CERTIFICATE](#)], and [[SOBGP-RADIUS](#)].

A large number of people contributed to this draft; we've tried to include all of them here (but might have missed a few): James Ng, Tim Gage, Alvaro Retana, Dave Cook, Brian Weis, and Iljitsch van Beijnum.

2. General Theory

soBGP provides a secure registry mechanism against which a BGP speaker can check:

- o The authorization of the AS listed as the originating AS in any received update to advertise reachability to the prefix listed in the update.
- o The validity of the AS Path contained in the update.

We use the term validity in reference to the AS Path, in this document, to indicate the plausibility of the AS Path listed. As shown in [[PATH-CONSIDER](#)], it isn't possible to communicate authorization through an AS Path; only the existence or nonexistence of the AS Path listed can be proven.

soBGP operates by distributing a set of signed certificates, described in [[SOBGP-CERTIFICATE](#)], containing the information required to validate the two pieces of information given above. These certificates MAY be distributed using the mechanisms described in [[SOBGP-BGPTRANSPORT](#)], or some other mechanism. Once these certificates have

been received and processed (signatures validated, etc, as described in [[SOBGP-CERTIFICATE](#)], they form a database containing:

- o A listing of IP address blocks and the AS authorized to originate them.
- o Policies related to specific prefixes and blocks of addresses.
- o A list of autonomous systems connected to each autonomous system within the internetwork. This connection list is used to build a graph of AS interconnectivity within the internetwork, as described in the section Building the AS Connectivity Graph, below.

This effectively forms a secure registry of routing information which can be used to check the validity of routing information received from BGP peers. This database is termed the "authorization database." No assumption about the location of the authorization database is made within this document.

When soBGP is supported, a BGP speaker MUST have access to the authorization database. Possible methods of access include:

- o Have a local copy of this authorization database, and perform the checks described later in this document against that local database.
- o Pass received routing information to a locally maintained server for validation against that server's copy of the authorization database.
- o Accept filters built from a copy of the authorization database contained on a locally maintained server.

As BGP updates are processed, a security preference is assigned to each prefix, as described further in the Security Preference section of this document. BGP update processing is described in the Receiving and Processing Updates section of this document.

[3.](#) soBGP Operation

Each section below provides detailed information on some aspect of soBGP operation.

[3.1.](#) The Security Preference

Rather than simply noting a given prefix should be dropped (not trusted) or retained (trusted), soBGP extends the concept of locally generated and maintained policy in BGP by assigning each prefix a Security Preference. This allows the local operator to drop prefixes not meeting certain security criteria, while simply lowering their preference for prefixes meeting some security criteria. This allows operators some flexibility in their implementation of security policies, especially as the security system is being tested, or while the security system isn't fully deployed.

While the amount by which the Security Preference is increased or decreased for any operation described in this draft is locally significant to the autonomous system. All devices processing routes against soBGP information MUST use the same mechanisms and values of the Security Preference to ensure consistent routing within the autonomous system.

If the Security Preference is set to a value precluding a route from further consideration in the decision process, the route should be discarded at that point, rather than continuing with the decision process.

The Security Preference value may be used to select among different routes for the same prefix; the higher value MUST be preferred. Any of the following methods may be used:

- A Consider the Security Preference prior to calculating the degree of preference [[BGP](#)] for a prefix.
- B Assign the value of the Security Preference to any of the attributes used in the Decision Process [[BGP](#)]. Care must be taken with attributes for which the lower value is preferred.
- C Use a Cost Community [[COST](#)] and its associated methods to consider the Security Preference at any step in the Decision Process [[BGP](#)] without overloading other attributes. Care must be taken as the lowest value in a Cost Community is preferred.

The method selected MUST be consistent through the local Autonomous System.

[3.2](#). Building the AS Connectivity Graph

Each ASPolicyCert advertised by a member of the internetwork contains a list of the autonomous systems the advertising AS is connected to, along with possible policy information about that connection. From this information, a graph of AS connectivity within the internetwork is built.

Any AS can be used as the starting point for building this graph, thus multiple disconnected graphs (representing section of the internetwork running soBGP and providing interconnection information) are possible. If every AS within the internetwork is providing interconnection information, one graph can be built containing all the internetwork's interconnections.

The process of creating this graph is:

- o Examine the list of connected autonomous systems advertised by the current AS.
- o Examine the ASPolicyCert of each AS the current AS is advertis-

ing as connected, and determine if that AS is advertising a connection back to the current AS. This is termed the two way connectivity check.

- o If the two way connectivity check passes, the connection SHOULD be added to the interconnection graph, and marked as trustable.
- o If the two way connectivity check fails, the connection MAY be added to the interconnection graph, but marked so a lower security preference will be assigned to AS_PATHs traversing this link.
- o Repeat this process for each ASPolicyCert in the authorization database.

The resulting graph is called the internetwork graph.

[3.3](#). Validating Routing Information

For each prefix within a given BGP UPDATE message:

- o The local authorization database is examined, and the AuthCert with the longest prefix length encompassing the range of addresses described by the prefix is chosen.

- o If there is no entry in the local authorization database which encompasses the range of addresses described by the prefix, then the route is said to be unverified, and should be handled according to local policy (either discarded, or have its security preference lowered). The rest of this process is ignored in these cases.
- o The second hop in the AS_PATH attribute is examined.
 - o If the second hop in the AS_PATH is advertised as connected by the originating AS, the Security Preference for this prefix SHOULD be increased.
 - o If the second hop in the AS_PATH is not advertised as connected by the originating AS, the Security Preference for

this prefix SHOULD be decreased.

- o If the second hop in the AS_PATH is not advertised as connected by the originating AS and the originator's policy indicates the second hop MUST be validated, the prefix should be removed from further consideration.
- o The AS_PATH attribute is compared to the internetwork graph.
 - o If the AS_PATH described is contained within the internetwork graph, the Security Preference SHOULD be increased.
 - o If the AS_PATH described is not contained within the internetwork graph, the Security Preference SHOULD be decreased.
 - o If the AS_PATH traverses a connection which is only described by one of the two autonomous systems, this is a one way connection. Local policy may be used to determine if the security preference should be increased in this case.
 - o If the AS_PATH described is not contained within the internetwork graph, and the originator indicated the AS_PATH MUST be checked, the prefix should be removed from further consideration.
- o The AuthCert chosen at the first step is examined.
 - o If the authorized AS in the AuthCert matches the originating AS in the AS_PATH, the Security Preference SHOULD be increased.
 - o If the authorized AS in the AuthCert does not match the originating AS in the AS_PATH, the Security Preference SHOULD be

set low enough to cause the route to be discarded.

- o Other policies contained in the local authorization database should be applied as directed by the policy.

[3.4. Validating Received BGP UPDATES](#)

As BGP UPDATES are received, they may be processed in one of several ways:

- o Each prefix may be validated according to the process outlined in Validating Routing Information before they are installed in the Adj-RIB-IN.
- o Each prefix may be validated according to the process outlined in Validating Routing Information after they are installed in the Adj-RIB-In, but before they are considered in the BGP Best Path calculation.
- o Each prefix may be validated according to the process outlined in Validating Routing Information after they are run through the Best Path algorithm, but before they are installed in the local RIB.
- o Routes may be installed in the local RIB, and then validated using the process outlined in Validating Routing Information. Once validation is accomplished, adjustments to the local RIB and routes advertised to BGP peers may need to be adjusted.

[3.5. Aggregation](#)

Aggregation is a difficult problem with any method which attempts to verify the origin of any given prefix, since aggregation removes the relationship between prefixes originated and originators. Prefixes may only be aggregated by an entity which is otherwise authorized to advertise the aggregated prefix.

[3.6. Requirements for Systems Running soBGP](#)

This section describes requirements for autonomous systems running soBGP, requirements for BGP speakers forming external adjacencies from within such autonomous systems, and devices exchanging soBGP certificates.

- o Any peering session along the border of an autonomous system

running soBGP SHOULD be authenticated through some means such as [BGP-MD5], IPsec ([ESP], [AH]), or through some other current, effective means of protecting BGP sessions from being hijacked, or otherwise abused.

- o Any peering session along which soBGP certificates are exchanged SHOULD be authenticated through some means such as [BGP-MD5], IPsec ([ESP], [AH]), or through some other current, effective means of protecting BGP sessions from being hijacked, or otherwise abused.
- o The AS_PATH of any routing information received from any BGP peer outside the autonomous system MUST be checked to validate the next hop AS is the AS the update was received from. If the next hop AS in any received update does not match the configured AS the route is learned from, the update MUST be discarded.

4. soBGP Deployment

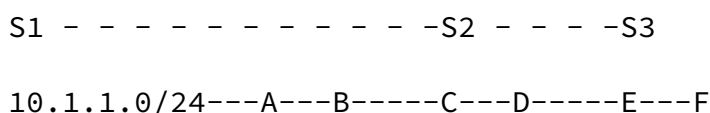
This section begins by describing what we believe to be the most practical deployment of this secure registry of routing information. Following sections describe some other deployment options that may prove useful in some situations, or may prove to be more practical than the deployment outlined in this section.

4.1. Deploying soBGP on Distributed Registry Servers

This deployment scenerio works within three constraints:

- o It may not be not desirable to combine routing and cryptographic processing of soBGP certificates on the same device.
- o The system should be distributed, using as few centralized resources as possible.
- o Trust relationships should be based on existing business and working relationships, rather than building new relationships specifically for securing the routing system.

Assume we have a small internetwork, as shown below:



| AS65000 | AS65001 | AS65002

In this network, we assume each AS has an soBGP server locally within their AS, marked as S1, S2, and S3, above. These servers are interconnected in a way similar to eBGP peering between AS65000, AS65001, and AS65002; S1 and S2 are using the mechanisms described in [SOBGP-BGPEXT] to distribute the certificates described in [SOBGP-CERTIFICATE] between them.

Each server then processes the certificates as described in [SOBGP-CERTIFICATE], and either provides a set of filters or a mechanism through which the eBGP peering routers can authenticate routing information, such as described in [SOBGP-RADIUS]. This deployment technique provides BGP route validation that is:

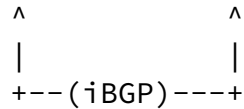
- o Fully Distributed: Local server (or set of servers) which builds the required databases based on received certificates, and distributes certificates throughout the routing system.
- o Locally Controlled: Each local server (or set of server) is maintained and managed by autonomous systems participating in the internetwork.
- o Based on Existing Business Relationships: Peering autonomous systems also peer their soBGP servers, so the system uses existing business relationships to provide the deployment and long term maintenance of the system.
- o Very Little Impact on the Existing Routing System: The current processing and distribution of routing information through [BGP] isn't impacted in any way. The only additional requirements on existing equipment are to compare the routing information to the database results provided by the local servers (i.e., receiving and processing filter lists, or through [SOBGP-RADIUS]).

[4.2.](#) Certificate Processing on Edge Peering Routers

soBGP can also be deployed entirely within BGP speakers at the edge of an Autonomous System (AS).

+-(eBGP)-+		+-(eBGP)-+	
v	v	v	v

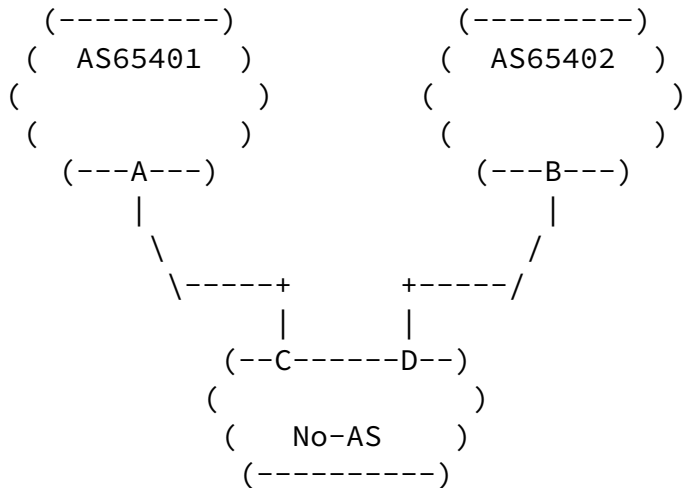
A-----B-----C-----D-----E



In this network, A is sending certificates it has learned from other sources to B using the mechanisms described in [[SOBGP-BGPEXT](#)]. It is passing these certificates to D via iBGP, and D is passing these certificates to E via eBGP. Each edge router, B and D, process these certificates locally, building the databases required to validate received routing information from them.

4.3. Multihoming Deployment

Multihoming presents a special challenge to the deployment of soBGP within a large scale internetwork.

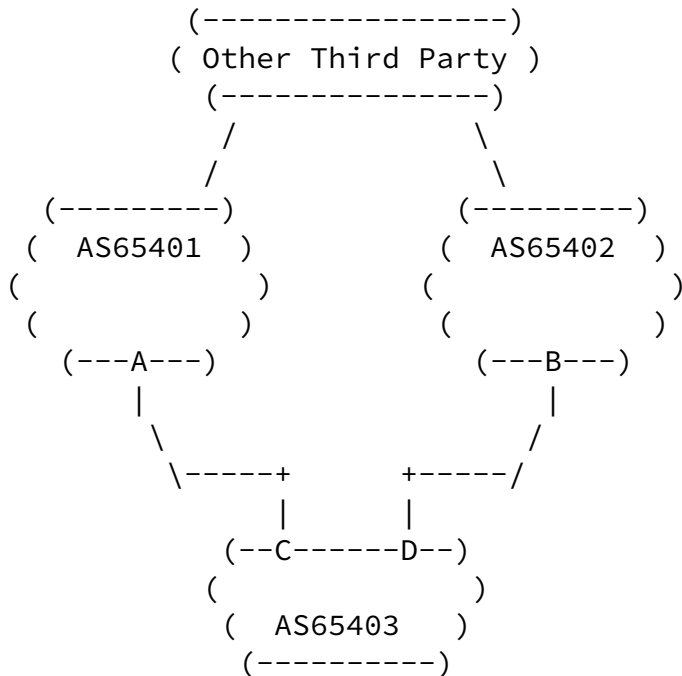


Assume No-AS has obtained a block of addresses, 10.1.1.0/24, from AS65401, and would like to advertise that same block of addresses through AS65402. Since No-AS has no AS number, it cannot generate any soBGP certificates, and must rely on its upstream providers to work out the security impact in some way. The simplest solution would be, of course, for NOAS to obtain an AS number, and fully participate in soBGP, but barring that, what other solutions are there?

AS65401 could issue a certificate allowing AS65402 to originate just the prefix in question, 10.1.1.0/24, or AS65401 could simply list AS65402 in the certificate covering 10.1.1.0/24 as an authorized originator for this address space (as multiple authorized originators are allowed).

[4.4.](#) Proxy Advertisement of Certificates

Note there is no requirement for a given entity which originates routes into the routing system to actually originate the corresponding certificates required for the correct origination of the route to be validated, and the AS Path attached to the route to be verified.



In this case, AS65401, AS65402, or some other third part may actually advertise the certificates necessary for AS65403 to originate validated routes.

[5.](#) Other Deployment Considerations

In this section, we move from specific deployment scenerios to other deployment considerations, such as key generation and protection, and memory utilization/impact.

[5.1.](#) Certificate Generation and Private Key Protection

There is only one private/public key pair per autonomous system; certificates are generated as determined by local policy and as required to account for changes in the network. Since the entity's private key is not used in any part of the operations verifying received information, or in generating information to transmit to other devices, these certificates could be generated on some secure central system in the AS, and the results, containing only public keys, can be transmitted throughout the network.

Securing the private key of each entity should be relatively easy in this environment, since the location of the private key can be carefully constrained; no device other than the system which generates the required certificates needs use of the private key.

[5.2.](#) Impact on Performance and Memory Utilization

Detailed performance and memory utilization characteristics of soBGP will be the subject of future investigation. However, as this is an important area of consideration, we present some suggested analysis below. (In other words, this is a guess).

In terms of memory, each device running sobGP will need to store:

- o Each of the Entitycerts Received. The maximum number of Entitycerts within the routing system would be the number participating autonomous systems multiplied by the number of outstanding Entitycerts from each autonomous system.
- o Each of the ASPolicycerts Received. The number of ASPolicycerts within the system will probably be similar to the number of Entitycerts within the system.
- o Each of the PrefixPolicycerts Received. The number of PrefixPol-

icityCerts within the system will depend on the number of address blocks each participant in the routing system advertises, and could double during key rollover.

Performance will depend on the cryptographic processing requirements imposed by the certificate signature methods, as described in [[SOBGP-CERTIFICATE](#)]. However, all of this additional memory and processing would most likely be required on a distributed soBGP server, rather than on routers themselves.

The primary impact on routers and routing protocol convergence will be the memory and processing requirements added from the additional route filters or processing as required by the deployment technique used.

[6](#). Normative References

[BGP] Rekhter, Y., and T. Li, "A Border Gateway Protocol 4 (BGP-4)", [RFC 1771](#), March 1995.

[SOBGP-BGPEXT]

Ng J (editor), "Extensions to BGP to Support Secure Origin BGP (soBGP)", [draft-ng-sobgp-bgp-extensions-01.txt](#), April 2004

[SOBGP-CERTIFICATE]

Weis, Brian (editor), "Secure Origin BGP (soBGP) Certificates", [draft-weis-sobgp-certificates-01.txt](#), October 2003

[7](#). Informative References

[SOBGP-RADIUS]

Lovnick, C, "RADIUS Attributes for soBGP Support", [draft-lonvick-sobgp-radius-04.txt](#), February 2004

[PATH-CONSIDER]

White, Russ, "Considerations in Validating the Path in Routing Protocols", [draft-white-pathconsiderations-02.txt](#), April 2004

[COST]

Retana, A., White, R., "BGP Custom Decision Process", [draft-retana-bgp-custom-decision-00](#), October 2002.

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Extensions to BGP Transport soBGP Certificates
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1. Contributors

A large number of people contributed to or provided valuable feedback on this document; we've tried to include all of them here (in no particular order), but might have missed a few: Russ White, Alvaro Retana, Dave Cook, John Scudder, David Ward, Martin Djernaes, Chris Lonvick, Brian Weis, Tim Gage, Scott Fanning, Barry Friedman, Jim Duncan, Yi Yang, Robert Adams, Tony Tauber, Iljitsch van Beijnum, and Jonathan Natale.

2. Abstract

There is a great deal of concern over the security of routing systems within the Internet, particularly in relation to the Border Gateway Protocol [[BGP](#)], which is used to provide routing information between autonomous systems. This document proposes a system where the origin of any advertisement within BGP can be verified and authenticated,

preventing the advertisement of prefix blocks by unauthorized networks, verifying that the final destination in the path is actually within the autonomous system to which the packets are being routed, and proving the validity of the AS Path contained in the update.

This document does not:

- o Attempt to provide information on how such a security system could or should be deployed; readers are referenced to [SOBGP-ARCH] for this discussion.
- o Attempt to determine what sorts of keys should be used within such a system, nor how any sort of trust relationship can or should be built between the entities cooperating within the routing system. These are considered in [[SOBGP-CERTIFICATE](#)].
- o Attempt to analyse the performance, memory utilization, or other impacts on devices running this protocol; these are addressed in [[SOBGP-ARCH](#)].
- o Attempt to analyze the security protection provided by the proposed security system. This may be address in a future draft.

This document primarily focuses on extensions to the BGP protocol itself to support such a security system through the transport of the certificates described in [[SOBGP-CERTIFICATE](#)].

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3. Definitions

- o Entity: A participant in the internetwork routing system.

4. The Security Message

This document proposes a new message type, the SECURITY message, which is to be used for carrying security information within the BGP protocol. The SECURITY message is type [TBD]. The SECURITY message is used to transport the certificates described in [[SOBGP-CERTIFICATE](#)].

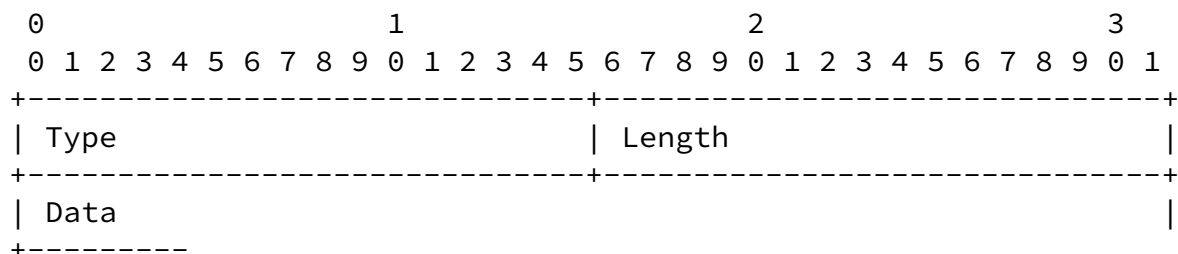
4.1. Negotiating Security Capability

The ability to exchange SECURITY messages MAY be negotiated at session startup, as described in [[CAPABILITY](#)]. The capability code is <to be assigned by IANA>.

- o Speakers MAY negotiate the exchange of SECURITY information only or SECURITY and NLRIs.
- o If the exchange of SECURITY messages is negotiated, the SECURITY option message MUST be exchanged before any other SECURITY messages are exchanged. The option bits in this message determine if SECURITY messages or NLRIs will be exchanged first.
- o If two BGP speakers have negotiated to exchange SECURITY messages, they SHOULD exchange the soBGP certificates contained in their local databases.

4.2. The Security Message Format

The SECURITY message is formatted as described in [[BGP](#)], with a type code of [TBD]. Within each message is a series of TLVs, or security message blocks, formatted as:



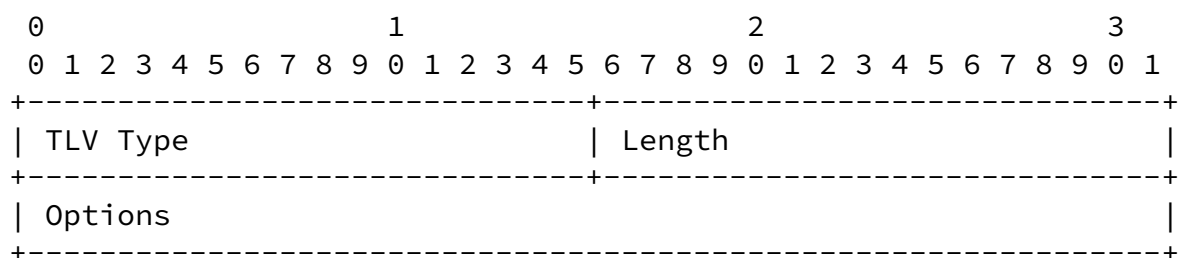
- o Type: A two octet unsigned integer describing the type of information contained within the data field.
- o Length: A two octet unsigned integer describing the length of the data field, in octets.
- o Data: The data, as described within this and other documents which describe information to be carried within the SECURITY message type.

Two TLVs are currently defined within the SECURITY message. Further TLVs are defined for carrying certificates in [SOBGP-CERTIFICATE].

[4.2.1.](#) The SECURITY Option TLV

The SECURITY Option TLV provides a way for exchanging speakers to inform their peers about local configurations which may pertain to the peering session. SECURITY Option TLVs are encapsulated within a TLV Type 1, and transmitted within the SECURITY message type.

If SECURITY Option TLVs are transmitted, they MUST be transmitted before the transmission of any other SECURITY data.



- o TLV type: (2 octets), 1 (0x0001)
- o Length: (2 octets), set to 2
- o Options: (4 octets), a bitfield, described below

The options field is a 32 bit bitfield, allowing up to 32 different options to be specified.

- o Bit 0: If set, indicates that SECURITY information should be

sent before NLRI information on this session; if cleared, indicates that NLRI information should be sent before SECURITY information.

- o Bit 1: If set, indicates that this peer will only transmit

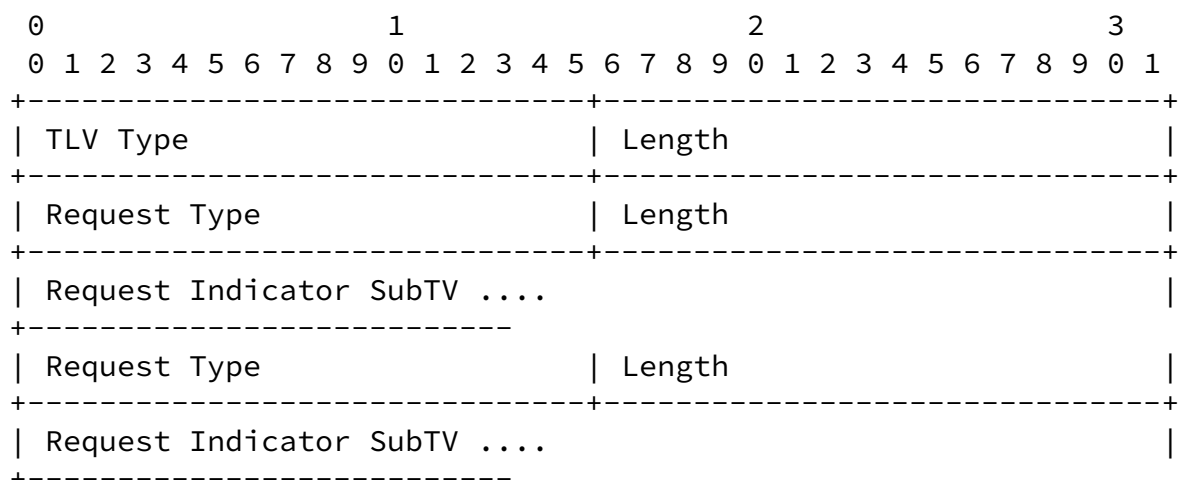
validated certificates of any type along this session. This bit MUST NOT be used for eBGP sessions.

- o Bit 2: If set, indicates that this peer will only accept validated certificates of any type along this session (valid only on iBGP sessions).

Bit 0 in the option field allows the operator to configure the local device so it receives all prefixes first, decreasing convergence to the minimum time, or receives all SECURITY information first, allowing all prefixes to be validated before they are installed.

Bits 1 and 2 allow peers along an iBGP session to trust the certifications they receive without validating them. If bit 1 is set on the transmitting peer, bit 2 is set on the receiving peer, and the BGP peering session is an authenticated or encrypted iBGP session, the receiving peer may accept all received certificates from the transmitting peer as already validated. This is called a trusted peering relationship.

[4.2.2.](#) The Request TLV



- o TLV type: (2 octets), 2
- o Length: (2 octets), set to the total length of the request in octets.
- o Request Type: (2 octets), treated as an unsigned integer indicating the type of information requested.
- o Length: (2 octets), set to the number of requests of the request type included in this request.

- o Reserved: (2 octets), set to 0x0000.
- o Request Indicator: The information indicated by the request type bit field.

The Request Type field indicates the type of certificates requested. Four request types are defined in this document.

- 1 Any certificate matching the Request Indicator are requested.
- 2 EntityCerts matching the Request Indicator are requested.
- 3 ASPolicyCerts matching the Request Indicator are requested.
- 4 PrefixPolicyCerts matching the Request Indicator are requested.

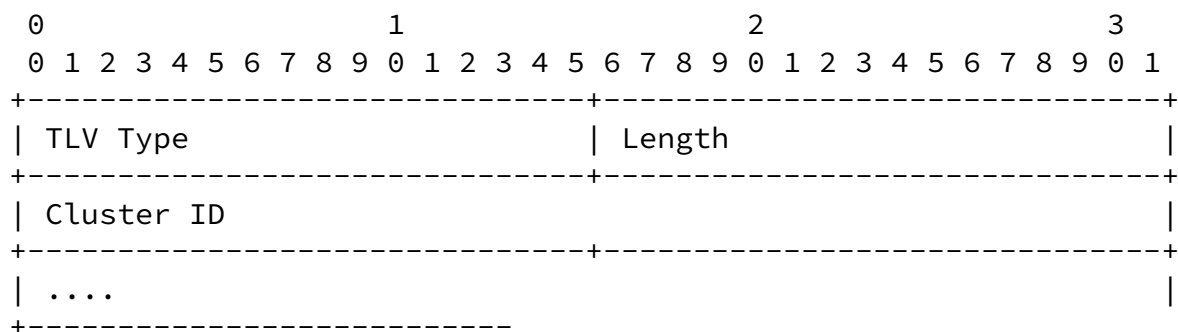
Request indicator SubTVs restrict the set of certificates returned; there may be one or more request indicator SubTVs included in a request. Each SubTV consists of a two octet type field, treated as an unsigned integer, and a fixed length field containing the request indicator.

- o Type 1: A four octet origin/authorized AS Number; two octet AS numbers shall be right justified within this field (placed in the two least significant octets).
- o Type 2: A four octet signer/authorizer AS Number; two octet AS numbers shall be right justified within this field (placed in

the two least significant octets).

- o Type 3: A four octet IPv4 address is included in the request indicator.
- o Type 4: A sixteen octet IPv6 address is included in the request indicator.
- o Type 5: An eight octet starting serial number is included in the request indicator.
- o Type 6: An eight octet ending serial number is included in the request indicator.

[4.2.3](#). The Cluster List TLV



- o TLV type: (2 octets), 3
- o Length: (2 octets), set to the number of cluster IDs in the TLV

The use of the Cluster List TLV is described in the Reflecting SECURITY messages section below.

[5](#). Receiving and Processing SECURITY messages

Each section below describes the receipt and processing of SECURITY messages.

5.1. Processing SECURITY Messages Containing a Certificate

For each certificate received, the BGP speaker MUST:

- o Examine the certificate to determine if a copy of this certificate already exists in the local database. Any certificate which is found to already be held locally MUST be discarded.
- o If the certificate is received through an untrusted peering relationship, place the certificate in a local certificate database and process according to [[SOBGP-CERTIFICATE](#)].
- o If the certificate is received through a trusted peering relationship, place certificate in a local certificate database, treating it as if it is already validated according to [SOBGP-CERTIFICATE].
- o If a received certificate is successfully validated using the process described in [[SOBGP-CERTIFICATE](#)], it should be readvertised to all peers outside the local autonomous system (eBGP peers). If the peering relationship is trusted, the certificate

should be advertised as validated by marking it as indicated in [[SOBGP-CERTIFICATE](#)].

5.2. Reflecting SECURITY Messages

A BGP speaker MAY be configured to reflect received SECURITY messages, with or without processing them, in a way similar to the way BGP routing information is reflected among iBGP speakers, described in [[BGP-REFLECTION](#)]. When reflecting SECURITY messages, a BGP speaker MUST:

- o Examine the SECURITY message for the presence of a Cluster List TLV.

- o If a Cluster List TLV exists, and the local router ID is contained in the list of Cluster IDs, discard the SECURITY message.
- o If a Cluster List TLV exists, and the local router ID is not contained in the list of Cluster IDs, add the local router ID to the list and retransmit the SECURITY message to all BGP peers which have negotiated receipt of SECURITY messages.
- o If a Cluster List TLV does not exist, add a new Cluster List TLV to the SECURITY message, including the local router ID in the new TLV.

5.3. Filtering of Certificates

A BGP speaker may, for reasons of policy, filter soBGP certificates received from a peer.

- o If a BGP speaker is part of a transit AS, it SHOULD NOT filter soBGP certificates.
- o A BGP speaker MAY discard soBGP certificates which describe the authorization of address space which is being filtered out of the local routing information.

5.4. Receiving and Processing Requests

If a device receives a Request TLV, as described in the section "The Security Message," above, it should:

- o Examine the request to ensure it is logically consistent. For instance, requesting an Entitycert based on an IPv4 address range is not logically consistent, since these certificates only

contain an AS and a Signer AS. If the request is not logically consistent, discard it.

- o If the request is logically consistent, examine its local databases, and transmit the certificates requested which fulfill the conditions supplied in the request indicator SubTVs.
- o If more than one of the same request indicator is included in a request message, they shall be treated as an OR condition; if any of the conditions match, the certificate shall match the set.

6. Security Considerations

This document defines extensions to BGP that address specific security concerns for the protocol. While it adds functionality, the flexibility allows it to not introduce any new security concerns.

7. IANA Considerations

This document defines the Security Message for BGP, which contains a series of TLVs. IANA is expected to maintain a registry of all the values defined, as follows:

The SECURITY message Type field :

- o Type value 0 is reserved.
- o Type values 1 through 3 are assigned in this document.
- o Type values 4 through 16575 MUST be assigned using the "IETF Consensus" policy defined in [RFC2434](#) [[RFC2434](#)].
- o Type values 16576 through 32895 SHOULD be assigned using the "Specification Required" policy defined in [RFC2434](#) [[RFC2434](#)].
- o Type values 32896 through 65535 are for "Private Use" as defined in [RFC2434](#) [[RFC2434](#)].

- o Types 1 through 3 are assigned in this document.
- o Types 4 thru 16575 MUST be assigned using the "IETF Consensus" policy defined in [RFC2434](#) [[RFC2434](#)].
- o Type values 16576 through 32895 SHOULD be assigned using the "Specification Required" policy defined in [RFC2434](#) [[RFC2434](#)].
- o Type values 32896 through 65535 are for "Private Use" as defined in [RFC2434](#) [[RFC2434](#)].

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