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**Deprecation of AS_SET and AS_CONFED_SET in BGP
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Abstract

[BCP 172](#) (i.e., [RFC 6472](#)) recommends not using AS_SET and AS_CONFED_SET in Border Gateway Protocol (BGP). This document updates [RFC 4271](#) and proscribes the use of the AS_SET and AS_CONFED_SET types of path segments in the AS_PATH. This is done to simplify the design and implementation of BGP and to make the semantics of the originator of a route clearer. This will also simplify the design, implementation, and deployment of various BGP security mechanisms.

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1. Introduction

[BCP 172](#) [[RFC6472](#)] makes a recommendation for not using AS_SET and AS_CONFED_SET in Border Gateway Protocol (BGP). This document advances the recommendation to a standards requirement in BGP. It updates [[RFC4271](#)] and proscribes the use of the AS_SET and AS_CONFED_SET types of path segments in the AS_PATH.

The AS_SET path segment in the AS_PATH attribute (Sections [4.3](#) and 5.1.2 of [[RFC4271](#)]) is created by a router that is performing route aggregation and contains an unordered set of Autonomous Systems (ASes) that the update has traversed. The AS_CONFED_SET path segment

(see [[RFC5065](#)]) in the AS_PATH attribute is created by a router that is performing route aggregation and contains an unordered set of Member AS Numbers in the local confederation that the update has traversed. It is very similar to AS_SETs but is used within a confederation.

By performing aggregation, a router is combining multiple existing routes into a single new route. The aggregation together with the use of AS_SET blurs the semantics of origin AS for the prefix being announced. Therefore, the aggregation with AS_SET (or AS_CONFED_SET)

can cause operational issues, such as not being able to authenticate a route origin for the aggregate prefix in new BGP security technologies such as those that take advantage of X.509 extensions for IP addresses and AS identifiers [[RFC3779](#)] [[RFC6811](#)] [[RFC8205](#)]. This in turn could result in reachability problems for the aggregated prefix and its components (i.e., more-specific prefixes). The aggregation as described above could also create traffic engineering

issues, because the precise path information for the component prefixes are not preserved.

From analysis of past Internet routing data, it is apparent that aggregation that involves AS_SETs is very seldom used in practice on the public Internet [[Analysis](#)] and when it is used, it is often used incorrectly -- reserved AS numbers ([[RFC1930](#)]) and/or only a single AS in the AS_SET are by far the most common cases. Because the aggregation involving AS_SETs is very rarely used, the reduction in table size provided by said aggregation is extremely small, and any advantage thereof is outweighed by additional complexity in BGP. As noted above, said aggregation also poses impediments to implementation of new BGP security technologies.

In the past, AS_SET had been used in a few rare cases to allow route aggregation where two or more providers could form the same aggregate prefix, using the exact match of the other's aggregate prefix in some

advertisement and configuring the aggregation differently elsewhere. The key to configuring this correctly was to form the aggregate at the border in the outbound BGP policy and omit prefixes from the AS that the aggregate was being advertised to. The AS_SET therefore allowed this practice without the loss of BGP's AS_PATH loop protection. This use of AS_SET served a purpose that fell in line with the original intended use. Without the use of AS_SET, aggregates must always contain only less-specific prefixes (not less than or equal to) and must never aggregate an exact match.

2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in

[BCP](#)

[14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

3. Recommendation to Network Operators

Operators MUST NOT generate any new announcements containing AS_SETs or AS_CONFED_SETs. If they have already announced routes with AS_SETs or AS_CONFED_SETs in them, then they MUST withdraw those routes and re-announce routes for the component prefixes (i.e., the more-specific prefixes subsumed by the previously aggregated prefix) without AS_SETs or CONFED_SETs in the updates. Route aggregation that was previously performed by proxy aggregation (i.e., without the

use of AS_SETs) is still possible under some conditions. When doing this, operators MUST form the aggregate at the border in the outbound

BGP policy and omit any prefixes from the AS that the aggregate was

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being advertised to. As with any change, the operator should understand the full implications of the change.

It is worth noting that new BGP security technologies (such as those that take advantage of X.509 extensions for IP addresses and AS identifiers [[RFC3779](#)] [[RFC6811](#)] [[RFC8205](#)]) might not support routes with AS_SETs/AS_CONFED_SETs in them, and may treat routes containing them as infeasible. Future BGP implementations may also do the same.

It is expected that, even before the deployment of these new or future technologies, operators may filter routes with AS_SETs/AS_CONFED_SETs in them. Other than making that observation, this document is not intended to make any recommendation for how an implementation should behave when receiving a route with AS_SET or AS_CONFED_SET in it. This document's focus is entirely on the sender side, as discussed in the preceding paragraph.

4. Security Considerations

This document obsoletes the use of aggregation techniques that create

AS_SETs or AS_CONFED_SETs. Obsoleting these path segment types from BGP and removal of the related code from implementations would potentially decrease the attack surface for BGP.

5. IANA Considerations

This document requires no IANA actions.

6. Acknowledgements

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