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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



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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#### **7. References**

##### **7.1. Normative References**

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", [BCP 14](#), [RFC 2119](#), DOI 10.17487/RFC2119, March 1997, <<https://www.rfc-editor.org/info/rfc2119>>.



- [RFC4271] Rekhter, Y., Ed., Li, T., Ed., and S. Hares, Ed., "A Border Gateway Protocol 4 (BGP-4)", [RFC 4271](#), DOI 10.17487/RFC4271, January 2006, <<https://www.rfc-editor.org/info/rfc4271>>.
- [RFC5065] Traina, P., McPherson, D., and J. Scudder, "Autonomous System Confederations for BGP", [RFC 5065](#), DOI 10.17487/RFC5065, August 2007, <<https://www.rfc-editor.org/info/rfc5065>>.

## **7.2. Informative References**

- [Analysis] Sriram, K. and D. Montgomery, "Measurement Data on AS\_SET and AGGREGATOR: Implications for {Prefix, Origin} Validation Algorithms", SIDR WG presentation, IETF 78, July 2010, <[http://www.nist.gov/itl/antd/upload/AS\\_SET\\_Aggregator\\_Stats.pdf](http://www.nist.gov/itl/antd/upload/AS_SET_Aggregator_Stats.pdf)>.
- [RFC1930] Hawkinson, J. and T. Bates, "Guidelines for creation, selection, and registration of an Autonomous System (AS)", [BCP 6](#), [RFC 1930](#), DOI 10.17487/RFC1930, March 1996, <<https://www.rfc-editor.org/info/rfc1930>>.
- [RFC3779] Lynn, C., Kent, S., and K. Seo, "X.509 Extensions for IP Addresses and AS Identifiers", [RFC 3779](#), DOI 10.17487/RFC3779, June 2004, <<https://www.rfc-editor.org/info/rfc3779>>.
- [RFC6472] Kumari, W. and K. Sriram, "Recommendation for Not Using AS\_SET and AS\_CONFED\_SET in BGP", [BCP 172](#), [RFC 6472](#), DOI 10.17487/RFC6472, December 2011, <<https://www.rfc-editor.org/info/rfc6472>>.
- [RFC6811] Mohapatra, P., Scudder, J., Ward, D., Bush, R., and R. Austein, "BGP Prefix Origin Validation", [RFC 6811](#), DOI 10.17487/RFC6811, January 2013, <<https://www.rfc-editor.org/info/rfc6811>>.
- [RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in [RFC 2119](#) Key Words", [BCP 14](#), [RFC 8174](#), DOI 10.17487/RFC8174, May 2017, <<https://www.rfc-editor.org/info/rfc8174>>.
- [RFC8205] Lepinski, M., Ed. and K. Sriram, Ed., "BGPsec Protocol Specification", [RFC 8205](#), DOI 10.17487/RFC8205, September 2017, <<https://www.rfc-editor.org/info/rfc8205>>.





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