Best practice for National Research and Education Networks (NRENs) for publishing both their customer AS cones AND the NREN-Transit they provide
(DRAFT)

Background

It's common for NRENs to provide mutual transit. For example, NRENs peering with Internet2 will see both Internet2's member routes and routes Internet2 has learned from other NRENs. This adds complexity for NRENs that wish to filter the prefixes accepted from their peers. To retain the benefits of offering mutual transit, NRENs must have a method to discover the entire set of routes (the peer's direct routes, plus routes for networks they offer transit) that should be accepted from a peer.

This paper suggests a best practice for NRENs to announce their direct customer routes and routes they announce as part of offering transit service among the NRENs.

Recommendation

Each NREN maintains the following as-sets (using Internet2's AS 11537 as an example):

- AS11537:AS-CUSTOMER (as-cone of Internet2's customers)
- AS11537:AS-NREN-PEERS (list of the as-set announced by NREN peers that include their customer and transit as-cones)

NOTE: In this example, AS11537:AS-NREN-PEERS contains the customer and transit as-sets of Internet2's NREN peers. So it would contain `AS20965:AS-CUSTOMER and AS-GEANTNRENPEERS for GEANT.`

Each NREN maintains aut-num export lines for each of its NREN peers, for example (aut-num of AS11537):

- `export to: AS20965 AS11537:AS-CUSTOMER and AS11537:AS-NREN-PEERS`
- `export to: AS7575 AS11537:AS-CUSTOMER and AS11537:AS-NREN-PEERS`

The following is a snapshot of NREN-announced as-cones and the difference seen from Internet2's perspective between the as-cone and the actual set of origin ASs seen from that peer (updated 9-April-2024)

AARNET (AS7575) as-set="AS7575:AS-CUSTOMER" count of origins outside customer cone 1 out of 94 origins seen.

list of origins outside customer cone [10906]

AMPATH (AS20080) as-set="AS-AS20080-TRANSIT" count of origins outside customer cone 6 out of 23 origins seen.

list of origins outside customer cone [28609, 263076, 262441, 19611, 27676, 263358]
ANKABUT (AS47862) as-set="AS47862" count of origins outside customer cone 9 out of 9 origins seen.
list of origins outside customer cone [59968, 50602, 58283, 51182, 61137, 47862, 57143, 52216, 50811]
No AS-SET for APAN (AS7660)
CANARIE (AS6509) as-set="AS6509:AS-CANARIE" count of origins outside customer cone 1 out of 150 origins seen.
list of origins outside customer cone [577]
CEDIA (AS61468) as-set="AS61468:AS-CEDIATRANSITMIEMBROS" count of origins outside customer cone 3 out of 16 origins seen.
list of origins outside customer cone [27947, 22724, 61468]
CERN (AS513) as-set="AS-CERNEXT" count of origins outside customer cone 0 out of 0 origins seen.
CERNET (AS23911) as-set="AS4538:AS-CUSTOMERS-V6" count of origins outside customer cone 2 out of 27 origins seen.
list of origins outside customer cone [38272, 133475]
CSTNET (AS7497) as-set="AS7497:AS-CUSTOMERS" count of origins outside customer cone 0 out of 1 origins seen.
No AS-SET for CUDI (AS18592)
No AS-SET for CUDI (AS28569)
No AS-SET for ENSTINET (AS6879)
GEANT (AS20965) as-set="['AS-GEANTNRN', 'AS-GEANTNRENPEERS']" count of origins outside customer cone 3 out of 511 origins seen.
list of origins outside customer cone [199354, 24349, 328702]
No AS-SET for GOREX (AS35889)
No AS-SET for HBKU (AS34945)
No AS-SET for JGNX (AS17934)
KACST (AS8895) as-set="RIPE::AS8895:AS-KACST" count of origins outside customer cone 0 out of 7 origins seen.
KREONET2 (AS17579) as-set="AS1237:AS-KREONET" count of origins outside customer cone 0 out of 36 origins seen.
No AS-SET for NEAAR (AS396390)
NKN (AS9885) as-set="AS-NIC-NKN-BGP-PEERS" count of origins outside customer cone 2 out of 105 origins seen.
list of origins outside customer cone [152576, 132124]
NORDUNET (AS2603) as-set="AS-NORDUNET" count of origins outside customer cone 3 out of 155 origins seen.
list of origins outside customer cone [200264, 9113, 48670]
OMREN (AS206350) as-set="AS206350" count of origins outside customer cone 2 out of 2 origins seen.
list of origins outside customer cone [28885, 206350]
QFN (AS29384) as-set="AS29384" count of origins outside customer cone 1 out of 1 origins seen.

list of origins outside customer cone [29384]
REANNZ (AS38022) as-set="RADB::AS-REANNZ-MEMBERS" count of origins outside customer cone 1 out of 32 origins seen.
list of origins outside customer cone [3477]
REDCLARA (AS27750) as-set="AS27750:AS-MEMBERS" count of origins outside customer cone 39 out of 45 origins seen.
list of origins outside customer cone [52224, 263683, 262156, 27790, 263186, 264724, 265884, 27933, 61476, 28068, 263204, 4270, 61486, 10671, 264630, 61496, 5692, 263235, 52424, 28107, 27981, 28109, 264785, 270033, 27993, 52442, 52314, 264798, 20191, 27875, 265700, 23140, 27750, 27883, 21612, 264687, 26610, 27897, 27770]
RNP (AS1916) as-set="RADB::AS-RNP" count of origins outside customer cone 4 out of 78 origins seen.
list of origins outside customer cone [268744, 61612, 28157, 28222]
SINET (AS2907) as-set="JPIRR::as2907:as-sinet" count of origins outside customer cone 13 out of 108 origins seen.
list of origins outside customer cone [1921, 7650, 18183, 38254, 47, 9264, 7472, 17713, 7539, 18422, 11096, 7610, 1659]
SINGAREN (AS23864) as-set="AS23864:AS-FOR-NREN-TRANSIT" count of origins outside customer cone 0 out of 7 origins seen.
No AS-SET for STARLIGHT (AS10764)
SURFNET (AS1103) as-set="AS-SURFNET" count of origins outside customer cone 0 out of 25 origins seen.
TENET (AS2018) as-set="AS-TERTIARY" count of origins outside customer cone 0 out of 5 origins seen.
No AS-SET for TRANSPAC (AS22388)
TWAREN (AS7539) as-set="AS7539:AS-TWAREN" count of origins outside customer cone 0 out of 8 origins seen.
UBUNTUNET (AS36944) as-set="AS-UBUNTUNET" count of origins outside customer cone 1 out of 18 origins seen.
list of origins outside customer cone [327945]