IPN URI Schema update


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Background

An IPN scheme URI is defined in RFC6260 and RFC9171 as:

\[ \text{ipn:node-nbr.service-nbr} \]

Where:

- \textit{node-nbr} is the \texttt{unique}* identifier of the node on which a particular service endpoint is expected to exist.
- \textit{service-nbr} is the identifier of the service.

* The uniqueness constraint is really important for interoperability.
The perceived problems

- The only IANA registry for *node-nbrs* is the CBHE registry
  - Predates BPv7

- There are minor inconsistencies between RFC6260, RFC7116, and RFC9171
  - Some behaviour assumed or implied, not specified, e.g. *node-nbr* uniqueness

- A single flat numbering space for all *node-nbrs*
  - Inefficient encoding in CBOR penalises later registrations
  - No reservation for convenient short *node-nbrs* as used today in private networks, resulting in unofficial use of “licensed spectrum”
Proposed solutions

1. Clarify usage of ipn scheme URI `node-nbrs` and `service-nbrs` with BPv7
2. Clone/rename IANA CBHE Node number registries to clarify BP version
3. Reserve low numbers for **Private Use** – official “unlicensed spectrum”
4. Introduce new *Numbering Authority* prefixes to allow flexibility of allocation with efficient encoding
Usage clarifications for BPv7

For node-nbrs:

- The value zero (0) for the node-nbr component MUST NOT be used except as part of the URI ipn:0.0.
- Values greater than or equal to $2^{64}$ for the node-nbr MUST NOT be used, to allow concise unsigned integer (type 0) CBOR encoding.
- All 'ipn' scheme URIs for endpoints co-located on a single bundle processing node MUST share the same value for the node-nbr component.

For service-nbrs:

- The value of the service-nbr component of an 'ipn' scheme URI of the EID of an administrative endpoint MUST be zero (0).
- Values greater than or equal to $2^{64}$ for the service-nbr component MUST NOT be used, to allow concise unsigned integer (type 0) CBOR encoding.
Rename IANA CBHE registries for BPv6

- “CBHE Node Numbers” -> “Bundle Protocol Version 6 ‘ipn’ Scheme URI Node Numbers”
- “CBHE Service Numbers” -> “Bundle Protocol Version 6 ‘ipn’ Scheme URI Service Numbers”
- No alteration to the current assignments or policies

This change has no impact on existing BPv6 implementations.
New IANA *node-nbrs* registry for BPv7

- “Bundle Protocol Version 7 'ipn' Scheme URI Null Authority Node Numbers registry”*
- All values and policies copied from CBHE Node Numbers registry, except:
  - Values $[1..2^{14}]$ are now **Private Use**
  - Values $[2^{21}..2^{28}]$ are no longer “Reserved for Private or Experimental Use”
  - Values $[2^{42}..2^{64}]$ are now **Experimental**

This change allows:

- Official “unlicensed spectrum” with efficient encoding when interoperability is not required, as is already deployed.
- Returns a range of numbers to the available pool to be allocated.

* More on the “Null Authority” part later…
New IANA service-nbrs registry for BPv7

- “Bundle Protocol Version 7 'ipn' Scheme URI Service Numbers”

- Policies:
  - Values [0..23] are **RFC Required** -
    - 0 allocated to the “Administrative Endpoint”
  - Values [24..4095] are **Specification Required**
  - Values [4096..2^{32}) are **Private Use**
  - Values [2^{32}..2^{64}] are **Experimental Use**

This allocation policy mirrors the TCP/UDP service/port number policies.

I could find no current specifications for any active “well-known” BPv7 services that needed immediate assignment - but I could be wrong.

This sets us up perfectly for Marc Blanchet’s draft on service numbers: [https://datatracker.ietf.org/doc/draft-blanchet-dtn-bp-application-framework/](https://datatracker.ietf.org/doc/draft-blanchet-dtn-bp-application-framework/)
Any questions so far?
Numbering Authorities

The problem:

- Allocating from a flat number space results in inefficient CBOR encoding.
  - The smallest node-nbr allocated to CCDS is 16384, which is encoded in a minimum of 7 octets, i.e. ipn:16384.0 is encoded as:

```
82 # array(2)
 02 # uri-code: 2
82 # array(2)
19 4000 # node-nbr: 16384
00 # service-nbr: 0
```

- Later allocations from the registry are forced to have even longer minimum encodings
Numbering Authorities

The proposal:

- Introduce an optional Naming Authority identifier as a prefix results in much more concise CBOR encoding
  - E.g. ipn:2.1.0 encodes to 6 octets:
    
    | 82  | # array(2) |
    | 02  | # uri-code: 2 |
    | 83  | # array(3) |
    | 02  | # auth-nbr: 2 |
    | 01  | # node-nbr: 1 |
    | 00  | # service-nbr: 0 |

- Allow optional Naming Sub-authority identifier, at the discretion of a Naming Authority.
  - E.g. ipn:2.7.1.0

- Managed via IANA “Bundle Protocol Version 7 ‘ipn’ Scheme URI Authority Numbers registry”
Advantages

● Easy to detect by examining the array size in the CBOR encoding
  ○ Check is 1 octet after the "schema supported?" check

● Backwards compatible, as authorities are optional:
  ○ If no auth-nbr then consult the IANA “Bundle Protocol Version 7 'ipn' Scheme URI Null Authority Node Numbers registry” registry.

● Removes contention on the “Bundle Protocol Version 7 'ipn' Scheme URI Null Authority Node Numbers registry”.
Questions?