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Contact Plan for Time-Variant Routing

Abstract

Some networks, such as in space, have links that are up and down based on a known schedule. The links characteristics, such as latency and bandwidth, are often also known in advance. This document describes a data model, also known as contact plan or graph, and file format to be used as input to forwarding and routing engines. This specification applies for both IP and Bundle Protocol.

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1. Introduction

Some networks, such as in space, have links that are up and down based on a known schedule. The links characteristics, such as latency and bandwidth, are also known in advance. This document describes a data model and file format to be used as input to forwarding and routing engines.

For delay-tolerant networks using the Bundle Protocol(BP) [[RFC9171](#)], implementations have defined different formats ([\[iondtncp\]](#), [\[ionipncp\]](#), [\[ud3tncgf\]](#), [\[hdtncp\]](#)) for such data. This specification aims to specify a common interoperable format.

Since networks may have some combination of IP and BP, it is useful to have in a single file the contact plan for all types of networks and address space, hence this combined format.

While this work is related to space communications, it could be applied to any use case that is using a contact plan. s

1.1. 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.

2. Data Model and File Format

The file is coded in JSON[[RFC8259](#)].

The file has the following first level properties:

- *type: mandatory. always set to "tvrContactPlan". This enables identification of that file outside of the expected context.
- *version: mandatory. this document set to 1. New specifications may define new versions.
- *lastUpdated: mandatory. the last time this file was updated in [\[RFC3339\]](#) format
- *contacts: mandatory. a non-empty array of contact objects/records as defined below.

A contact record has an "address" family. This document defines 4 families: "ip4", "ip6", "ipn", "dtn". Others may be added to the IANA registry (see [Section 5](#)). Each address family has a different syntax as shown below.

- *"ip4": addresses are expressed in CIDR format[\[RFC4632\]](#). The /length suffix may be removed for a single /32 IPv4 address.
- *"ip6": addresses are expressed in [\[RFC4291\]](#) format. The /length suffix may be removed for a single /128 IPv6 address.
- *"dtn" and "ipn": endpoint id are expressed using the URI syntax as described in [\[RFC9171\]](#).

The "source", "next-hop" and "destination" are using this syntax.

A contact record contains the following properties:

- *id: mandatory. a unique identifier for this contact record expressed as a UUID [\[RFC4122\]](#)
- *source: optional. single ip/bp node id. if unknown, do not specify.
- *next-hop: optional. single ip/bp node id. if unknown, do not specify.
- *destinations: mandatory. a non-empty list of ip/bp network prefixes
- *start time: mandatory. [\[RFC3339\]](#) format
- *stop time: mandatory. [\[RFC3339\]](#) format
- *bandwidth: optional. in bits/sec.

*latency: optional. in ms

The following shows an example of a contact plan.

<CODE BEGINS>

```
{
  "type": "tvrContactPlan",
  "version": 1,
  "lastUpdated": "2025-01-17T23:20:50Z",
  "contacts": [
    {
      "id": "f81d4fae-7dec-11d0-a765-00a0c91e6bf6",
      "family": "ip4",
      "source": "192.0.2.0",
      "destinations": ["198.51.100.0/24", "203.0.114.0/28", "192.0.3.1"],
      "nextHop": "203.0.113.1",
      "startTime": "1985-04-12T23:20:50Z",
      "stopTime": "1985-04-13T14:12:48Z",
      "bandwidth": 1000000,
      "latency": 30000
    },
    {
      "id": "f81d4fae-abcd-efgh-a765-00a0c91e6b88",
      "family": "ip6",
      "source": "2001:db8::1",
      "destinations": ["2001:db8:abcd::/48"],
      "nextHop": "2001:db8:3::1",
      "startTime": "2030-04-12T23:20:50Z",
      "stopTime": "2031-04-13T14:12:48Z",
      "bandwidth": 10000000,
      "latency": 300000
    },
    {
      "id": "659e4fae-7dec-11d0-a765-00a0c91e6b04",
      "family": "dtn",
      "source": "dtn://ud3tn2.dtn/",
      "destinations": ["dtn://18471/", "dtn://81491/"],
      "nextHop": "203.0.113.1",
      "startTime": "1985-04-12T23:20:50Z",
      "stopTime": "1985-04-13T14:12:48Z",
      "bandwidth": 1000000,
      "latency": 30000
    },
    {
      "id": "f81dab43-7dec-e8a2-a765-00a0c91e6bf6",
      "family": "ipn",
      "destinations": "ipn:5.34",
      "nextHop": "ipn:7.43",
      "startTime": "1985-04-12T23:20:50Z",
      "stopTime": "1985-04-13T14:12:48Z",
      "bandwidth": 1000000,
      "latency": 30000
    }
  ]
}
```

```
}  
  ]  
}
```

<CODE ENDS>

3. Considerations

Some Bundle Protocol implementations have defined an interface where the add, change, delete actions are performed on contact info to update the underlying contact plan. We believe this can be better accomplished at the API level, instead of within the file format. For example, if a REST API is used, the HTTP methods can be used for that purpose.

4. TODO or Comments (section to be deleted when ready for publication)

*bp convergence layer syntax (FW: needed)

*wildcard for dtn as in ION

*notion of timezone: (FW: do not agree to have it)

*JSON schema

*Media-Type: application/json or specific one

*FW: extension mechanism for additional parameters: probability of contact. (MB: IANA registry)

5. IANA Considerations

TBD: registry of "address family"

6. Security Considerations

TBD

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>>.

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Hinden, R. and S. Deering, "IP Version 6 Addressing Architecture", RFC 4291, DOI 10.17487/RFC4291, February 2006, <<https://www.rfc-editor.org/info/rfc4291>>.

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[RFC9171]

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[ud3tncgf]

"uD3TN Contacts Data Format", <https://gitlab.com/d3tn/ud3tn/-/blob/master/doc/contacts_data_format.md>.

[hdtncp]

"High-rate Delay Tolerant Network Contact Plan Example", <<https://github.com/nasa/HDTN/blob/master/module/scheduler/src/contactPlan.json>>.

[iondtnpc]

"ION "dtn" scheme configuration commands file", <<https://sourceforge.net/p/ion-dtn/code/ci/current/tree/bpv7/doc/pod5/dtn2rc.pod>>.

[ionipncp]

"ION "ipn" scheme configuration commands file", <<https://sourceforge.net/p/ion-dtn/code/ci/current/tree/bpv7/doc/pod5/ipnrc.pod>>.

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