

Delay Tolerant Network – Network Management

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Agenda

Overview – Delay Tolerant Network (DTN)

Overview - Network Management (NM)

Categories of DTN NM

Where to Next

Overview – Delay Tolerant Network

DTN answers a system that experiences one or more of the following:

- **Disconnection -**

Where an end-to-end path is not always available.

- **Disruption -**

Where free-space links are often interrupted

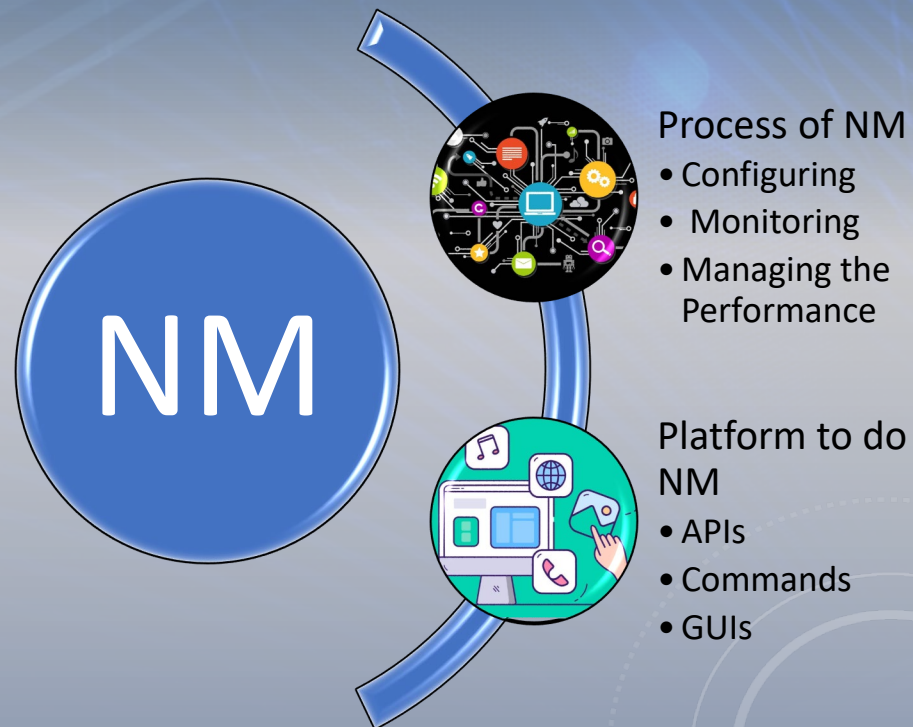
- **Delay**

Where long distances negate acknowledgment-based protocols

There are many DTN implementations available all with different properties and Technology Readiness Levels (TRL).

- **Interplanetary Overlay Network (ION)**
From Jet Propulsion Lab
- **High-Rate Delay Tolerant Networking (HDTN)**
From Glenn Research Center
- **Delay Tolerant Network Marshall Enterprise (DTNME)**
From Marshall Space Flight Center
- **BPNODE**
From Goddard Space Flight Center (GSFC)
- **D3TN (formerly uPCN)**
Commercial

Overview - Network Management



Adding NM to systems enables:

1. Collecting data from all components of the network
2. Allows the operator(s)/administrator(s) control over how each node interacts with one another

Therefore, the data captured by NM:

1. Shows Health/Performance
2. Monitors Security
3. Accelerates Troubleshooting

Categories of DTN NM

Splitting up Network Management for DTN

The DTN NM Working Group at NASA has broken NM into 5 categories to simplify the large front of NM.

DTN NM Categories				
Mission Planning	Configuring Nodes	Monitoring Nodes	Troubleshooting Nodes	Misc.

Categories of DTN NM

NM for Mission Planning

System level information that DTN users and DTN providers will need to build, design and share, to achieve end-to-end data through the DTN during the service execution phase.

- Contact Plan Generation
 - Link quality confidence, connection reference, list of destination endpoints, start time, duration, contact vs. range
- Network Topology
 - See network as a whole, node ownership constraints, connectivity option(s) and which protocol(s)
- Assets of the Node
 - Available features, storage info, connection info (node capabilities, manager for the node etc.)
- Service Level Agreement
 - Data latency, policy agreements, planned data throughput, data interface

Categories of DTN NM

NM for Configuring Nodes

Encompasses all DTN pieces regarding NM that involves creating, updating and managing a DTN node's configuration.

- Edit DTN node configuration
 - Via standard DTN protocols, command line, cognitive engine, and/or integrated flight system
- Validation of Contact Plan
 - Verification of contact plan prior to distributing, and access control list
- Security
 - Key management, policy, hash checks and integrity
- Quality of Service (QoS)
 - Select convergence layer based on the quality of the link and validation of contact plan
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Categories of DTN NM

NM for Monitoring Nodes

Encompasses all DTN systems answering the health question of the node/network.

- Node information in real-time/last snapshot and as network log, if possible
 - Link stats, contact info, and number of bundles exceeded the DTN configured limits.
 - Storage stats – bundle sizes within storage, percentage of storage used or free
 - Link state – what protocol, aggregated rate per session/period of time, data rate per bundle plus latency, if connection active/inactive
 - Bundle Stats – bundle status reports, bundles received and transmitted, bundles in custody, where the bundle arrived, rejected bundles, deleted bundles, expired bundles, all per source ID

Categories of DTN NM

NM for Troubleshooting Nodes

Includes all DTN pieces required to fix and troubleshoot the node/network.

- Realtime pieces of NM for Monitoring Nodes Category
- Packet Sniffing and Task Manager Capabilities
 - View sent/received headers, time stamp, data itself, system space, memory allocations and CPU usage
- Restart DTN Node Capabilities
 - Through another node, out of band and/or bootstrap the node
- Query All Log Files/State into one log of the Network
 - At least the Nodes that are Pertinent
- Tools to Exercise the Network
 - Bping, Bundle perf, BP trace
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Categories of DTN NM

NM for Misc.

Includes additional systems that may need to be needed for future advancements (e.g., automation or autonomy systems that allow the network to self-detect faults and/or self-correct them.

- Priority Numbers
 - Sending data via its number and priority manager for valid numbering
- Bandwidth Limits
 - Know what the link limit from NM for Mission Planning is and send under/within range
- State of the Vehicle
 - Data volume left (congestion control and contact plan updates based on log information)
- Decentralized Storage Routing
 - Intentionally sending to another node with the intention that it will return to alleviate storage restrictions by utilizing another node to store it temporarily
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Where to Next?

The DTN NM WG will continue to gather inputs from partners, industry and stakeholders. When completed, a document will be formulized and cross-referenced with current DTN protocols to create a new list of recommendations specifically answering DTN NM.

Acknowledgements

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