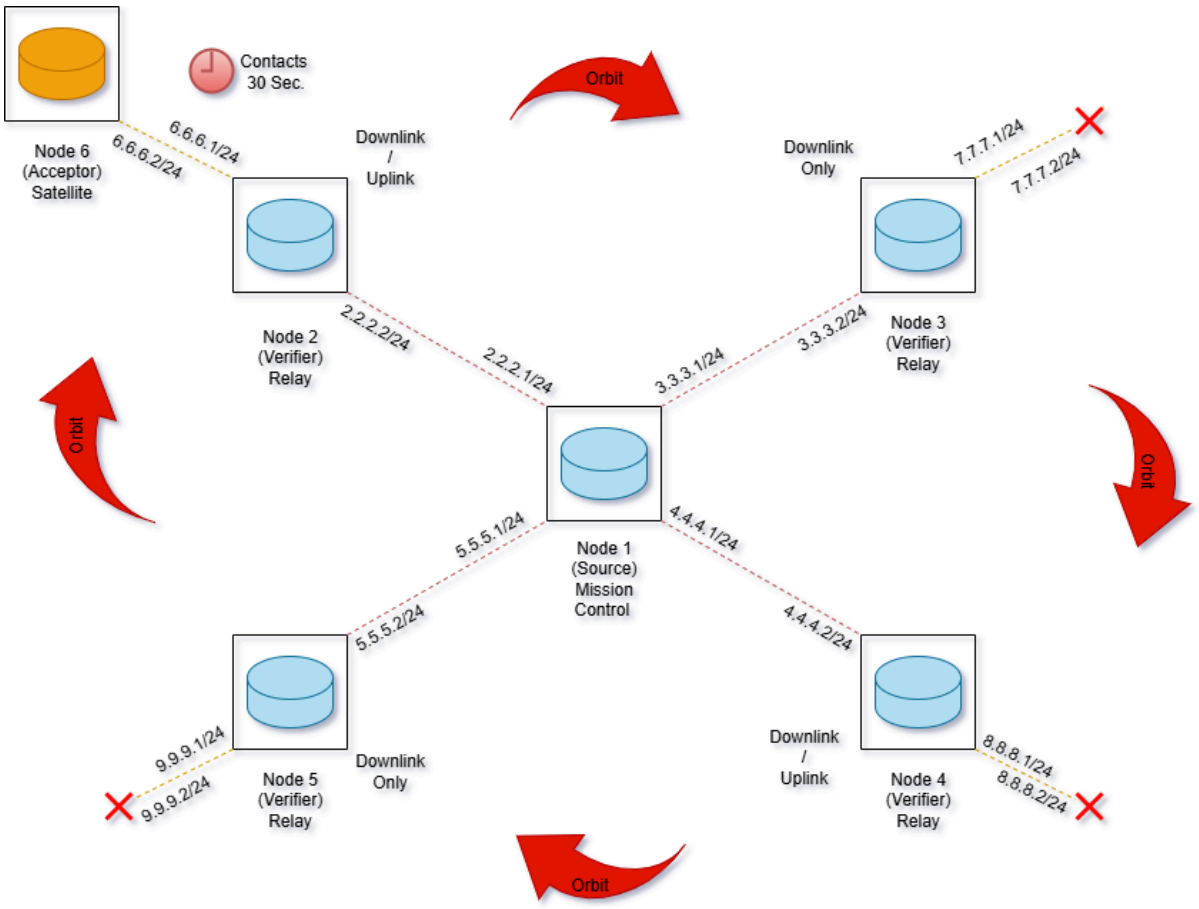
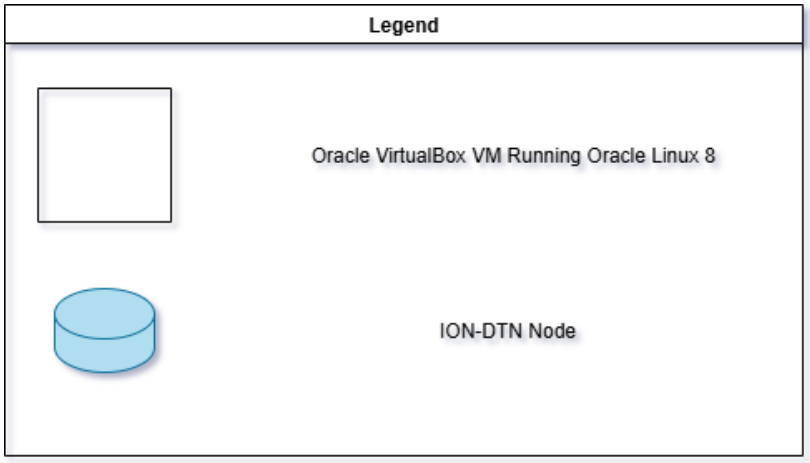
PROJECT ORBITING STAR





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1. Topology Overview

The testbed consists of **six ION-DTN nodes** deployed on **Oracle VirtualBox VMs** running **Oracle Linux 8 OS**. All nodes communicate exclusively using the **Licklider Transmission Protocol (LTP)** as the convergence layer.

- **Node 1 (Source – Mission Control):** Generates and transmits Large CFDP file bundles.
- **Node 6 (Acceptor – Satellite):** Simulates the orbiting satellite as the final bundle receiver.
- **Nodes 2, 3, 4, 5 (Relay/Verifier Nodes):** Intermediate hops for store-and-forward operations. Nodes 3 & 5 are **downlink only**, Node 2 & 4 are **downlink/uplink** to demonstrate anticipated contacts through bundle rerouting

Contacts between nodes are **scheduled and time-limited** (e.g., 30-second windows) to simulate intermittent satellite visibility.

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2. Data Flow & Routing

- Bundles originate at **Node 1 (Mission Control)** and traverse relay nodes depending on **scheduled contacts**.
- **Session purging for bundle rerouting** ensures unused sessions are cleared and bundles can be re-routed when expected contacts change or fail.
- Nodes with “Downlink Only” enforce one-way connectivity, increasing the realism of orbital contact constraints.
- Links marked with a red X in the diagram represent intentionally disabled paths, used to validate rerouting behavior when expected connections are unavailable..

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3. Reliability & Security

- **Store-and-forward reliability** is tested by verifying bundles eventually reach Node 6 despite disrupted paths.
- **Session purging** confirms that resource cleanup supports robust rerouting and prevents stuck bundles on a node without contact.
- **BPSec’s BIB** can be layered over BPv7 to demonstrate secure bundle transfer.
- Contact plan enforces predictability of data flow while modeling orbital constraints.

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4. Design Rationale

- **Oracle VirtualBox + Oracle Linux 8** chosen for portability, reproducibility, and compatibility with ION v4.1.3.
- **Exclusive use of LTP** LTP was selected as it is optimized for long-delay, high-disruption space links, unlike TCP which suffers under frequent contact loss.
- **Multiple relays** allow demonstration of DTN’s resilience under failed paths and limited visibility conditions.
- **Session purging and bundle rerouting** explicitly stress-test LTP’s contact-driven behavior.