The SCPS Network Protocol (SCPS-NP)

SCPS-FP
SCPS-TP
SCPS-SP
SCPS-NP

SCPS-FP
SCPS-TP
SCPS-SP
SCPS-NP

SCPS-FP
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SCPS-FP
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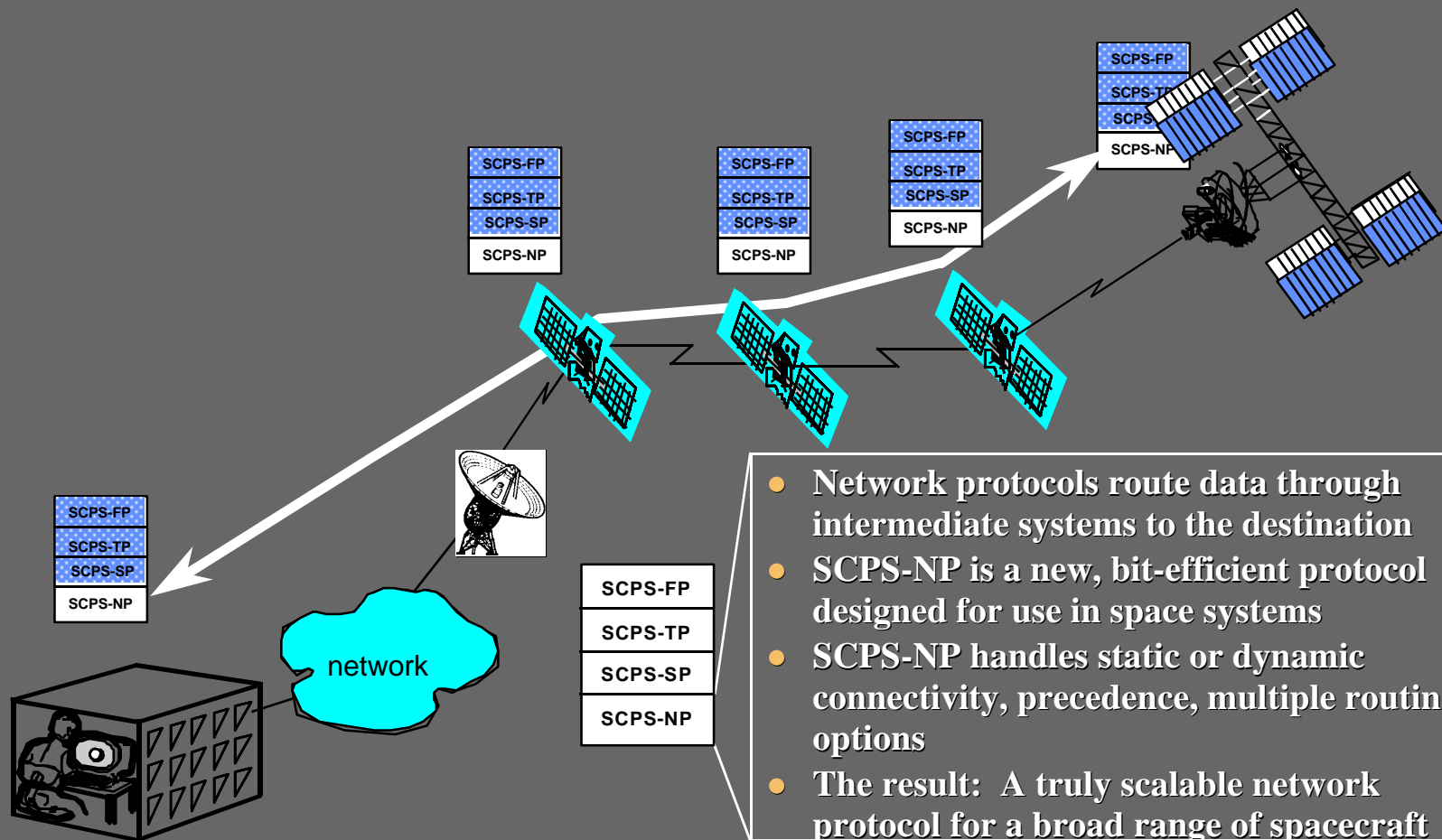SCPS-SP
SCPS-NP

SCPS-FP
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network

SCPS-FP
SCPS-TP
SCPS-SP
SCPS-NP

- **Network protocols route data through intermediate systems to the destination**
- **SCPS-NP is a new, bit-efficient protocol designed for use in space systems**
- **SCPS-NP handles static or dynamic connectivity, precedence, multiple routing options**
- **The result: A truly scalable network protocol for a broad range of spacecraft**

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Background and Operational Need

- The SCPS-NP is a new protocol that was designed because attempts to use existing network protocols (e.g. IP, ISO 8473) did not result in acceptable solutions
  - The main problem with existing protocols was bit efficiency in providing the required set of services
- The SCPS-NP was defined to meet the following needs
  - Routing within satellite constellations
  - Different routing treatments for different messages
  - Different message handling based on precedence (priority)
  - Highly bit-efficient operation
- Specialized capabilities are optional
  - Missions with modest requirements are not penalized by having to support unneeded capabilities

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SCPS-NP Functional Requirements

- **Requirements resulting from spacecraft constraints**
  - Low bit overhead
  - Small implementation size, low complexity
  - Efficient use of buffer memory
  - Potentially more than one end system per spacecraft
- **Requirements resulting from the space environment**
  - Routing algorithms
    - Must be able to accommodate dynamic topologies
    - Select different algorithms based on network, connectivity, and circumstance
    - May be used to maximize probability of receipt
  - Must be able to suppress routing loops
  - Must have separate signalling of corruption and congestion

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SCPS-NP Functional Requirements (Concluded)

- Requirements resulting from the needs of specific missions:
  - Point-to-point, multicast, and broadcast addressing
  - Precedence (priority) and precedence-based congestion management
  - Selectable address size
- Other factors affecting the protocol design
  - Transmitting bits is relatively expensive compared to the computational cost to reduce transmitted bits
  - Some candidate commercial networks wish to use proprietary routing algorithms - need algorithm-independent interface to routing function
  - Protocol should handle a variety of communication situations: close-proximity line-of-sight, statically connected, and truly connectionless

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Functional Overview of SCPS-NP

- **Provides datagram service to users**
  - Unicast
  - Multicast
  - Broadcast
- **Provides several addressing modes**
  - Managed connections use a single permanent virtual circuit (PVC) address for bit efficiency
    - PVC addresses may be two or four octets in length
  - Connectionless operation uses source and destination addresses for flexibility
    - End system addresses are two, four, or sixteen (IPv6) octets in length
- **Packet headers only contain required fields - optimizes bit-efficiency**

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Functional Overview of SCPS-NP (Continued)

- Provides selectable routing method
  - "Normal" - picks single "best" route for datagram
  - Two-path limited flood routing - improves reliability by sending datagram on best and next-best routes
  - Flood routing - Highest reliability routing achieved by sending datagram on all interfaces
- Provides flexibility in routing table maintenance method
  - Static - locally configured or remotely configured through MIB
  - Dynamic - routing exchange protocols still being evaluated - will be environment-specific
- Provides precedence (priority)-based datagram handling
  - Affects order of processing datagrams
  - Used in congestion control to protect important data
- Internet Control Message Protocol (ICMP)-derived protocol used for signaling

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Things to Remember About SCPS-NP

- Must support different connectivity and routing environments
- Supports different modes of operation - from highly managed to highly protocol-driven
- Services support basic data transfer, local system support, and network diagnostics
- Uses header construction techniques geared to meet bit-efficiency requirements

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