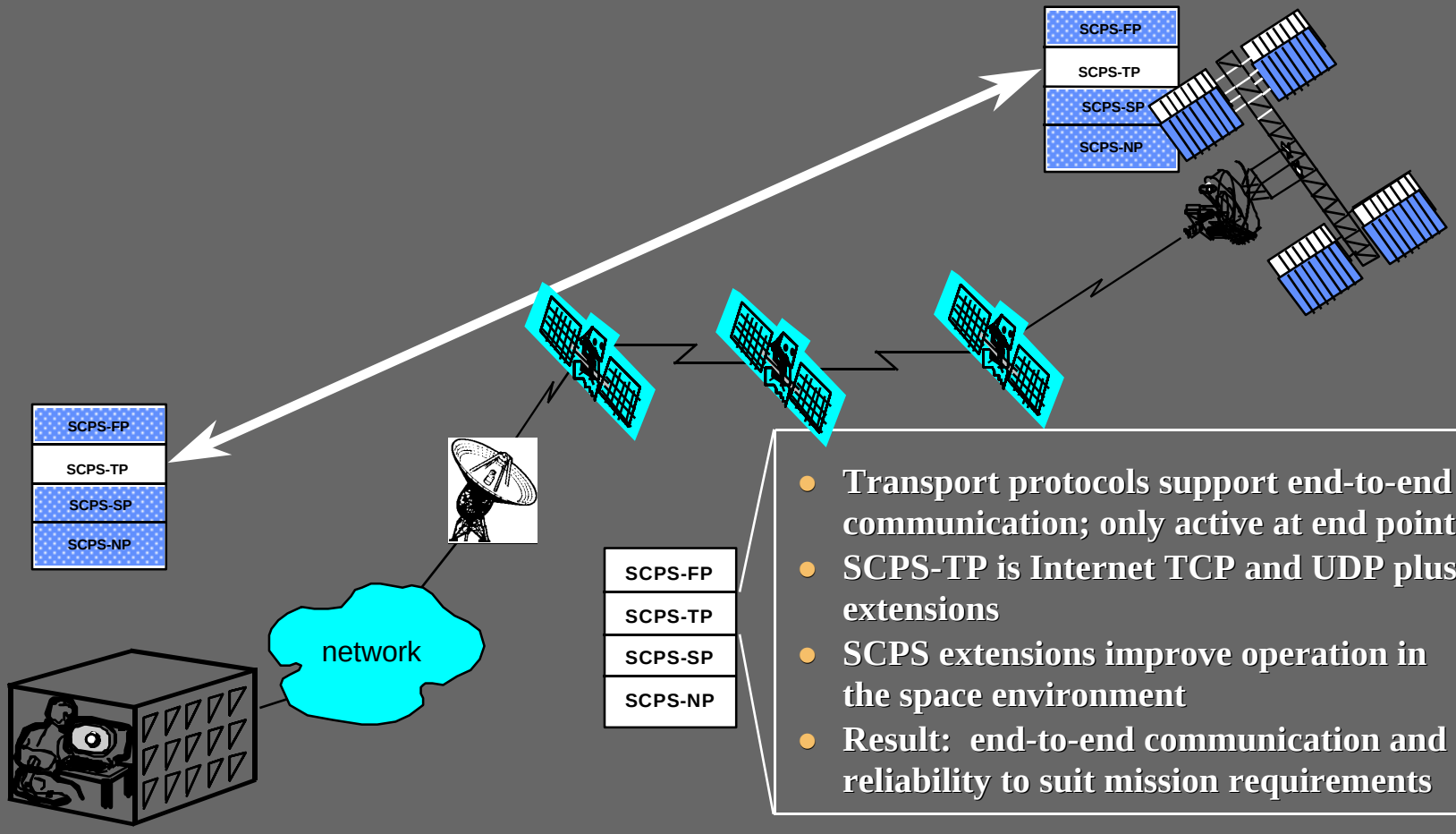
# The SCPS Transport Protocol (SCPS-TP)

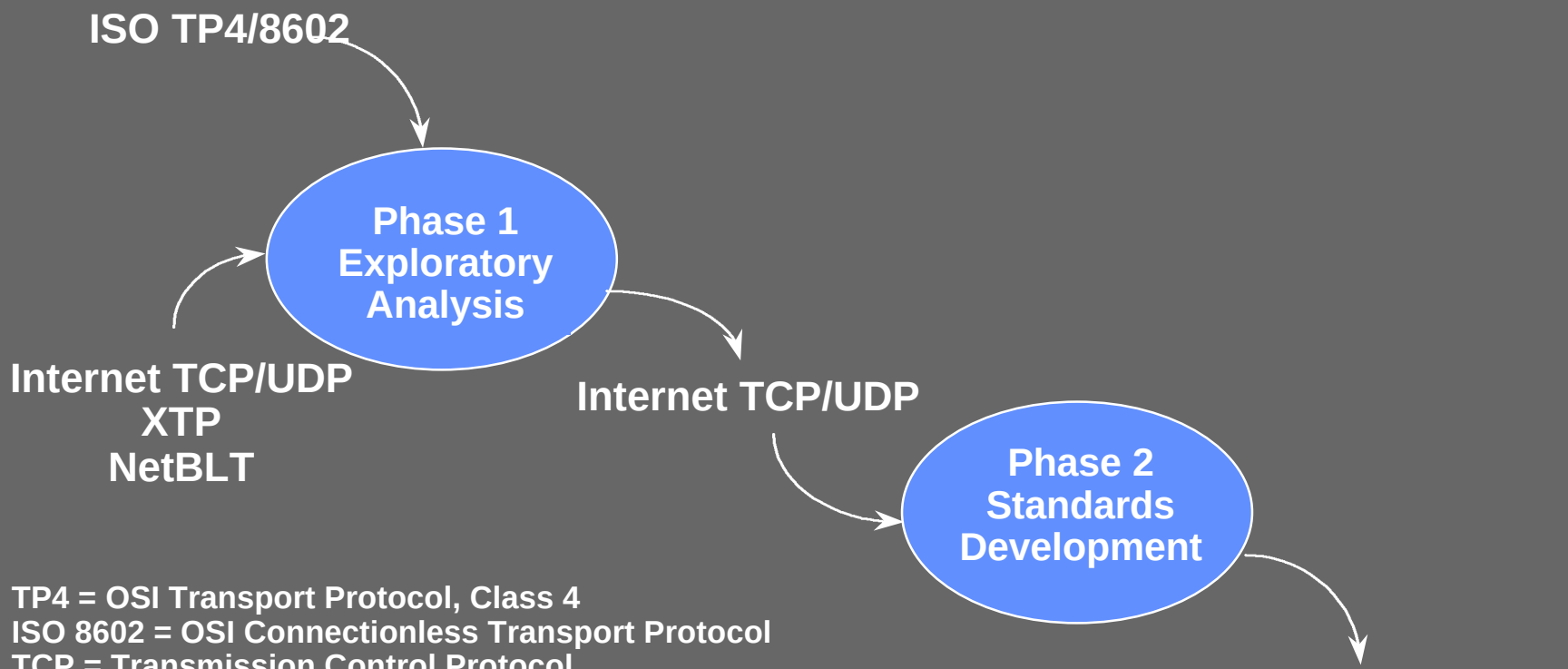



- Transport protocols support end-to-end communication; only active at end points
- SCPS-TP is Internet TCP and UDP plus extensions
- SCPS extensions improve operation in the space environment
- Result: end-to-end communication and reliability to suit mission requirements

# Requirements for Reliable Data Transfer Identified by 1993 SCPS Exploratory Study

- Support for end to end data transfer
- Transfer with full reliability (complete, correct, in sequence, no duplication)
  - Uplink for command and table loads
  - Downlink for compressed data transfer
- Transfer with “best effort” reliability (correct, in sequence, no duplication, possibly with gaps)
  - For transfer of telemetry, image data, etc.
- Transfer with minimal reliability (correct, possibly incomplete, possibly out of sequence)
  - Minimal reliability must support multicast operation
- Other requirements address priority, etc.

# Evolution of SCPS-TP




TP4 = OSI Transport Protocol, Class 4
ISO 8602 = OSI Connectionless Transport Protocol
TCP = Transmission Control Protocol
UDP = User Datagram Protocol
XTP = Express Transfer Protocol
NetBLT = Network Block Transfer Protocol
SCPS-TP = Space Communications Protocol Standards - Transport Protocol

# Factors affecting use of TCP in terrestrial and spacecraft communication environments

| Factor | Terrestrial Communication | Spacecraft Communication |
|---|---|---|
| Bit Error Rate | < $10^{-9}$ | $10^{-5}$ to $10^{-12}$ |
| Round Trip Delay | Milliseconds to seconds | Seconds to hours |
| Continuity of Connectivity | Continuous | Intermittent: 10% (LEO) to 90% (TDRSS) per orbit |
| Forward and Reverse Links | 1:1 (Equivalent Rates) | 10:1 to 2000:1<br>Some have downlink only |
| CPU Capacity | Unrestricted | Possibly low (1750, 80186) |
| Memory Availability | Unrestricted | Possibly low |
| Communication Goals | Fair access over time<br>High aggregate throughput over time<br>High reliability | High throughput during contact period<br>• Low horizon angles<br>• Data compression<br>Maximum link utilization |
| Primary Sources of Data Loss | Congestion | Congestion<br>Corruption<br>Link outage |

# Modifications to TCP to support spacecraft communication environments

| Factor | Spacecraft Communication | TCP Mods Required |
|---|---|---|
| Bit Error Rate | $10^{-5}$ to $10^{-12}$ | Corruption response<br>SNACK<br>End-to-end Header compression |
| Round Trip Delay | Seconds to hours | Large windows<br>Timer modifications |
| Continuity of Connectivity | Intermittent: 10% (LEO) to 90% (TDRSS) per orbit | Link outage support |
| Forward and Reverse Links | 10:1 to 2000:1<br>Some have downlink only | Rate control<br>Revised Ack strategy<br>Header compression |
| CPU Capacity | Possibly low (1750, 80186) | Header Precomputation |
| Memory Availability | Possibly low | Increased robustness of implementation |
| Communication Goals | High throughput during contact period<br>• Low horizon angles<br>• Data compression<br>Maximum link utilization | Congestion response and slow start made optional (supported by rate control)<br>Header precomputation<br>Separate corruption response<br>SNACK |
| Primary Sources of Data Loss | Congestion<br>Corruption<br>Link outage | Separate response for each type of loss and support for incoming signals of loss type |

# Things to remember about SCPS-TP

- SCPS-TP is TCP and UDP with modifications to suit the spacecraft communications environment
- Depending on configuration options selected, SCPS-TP can be less than TCP, identical to TCP, or a super-set of TCP
  - Mission requirements dictate which options are selected
  - We anticipate that a small number of profiles (2 or 3) will emerge that cover the vast majority of mission classes