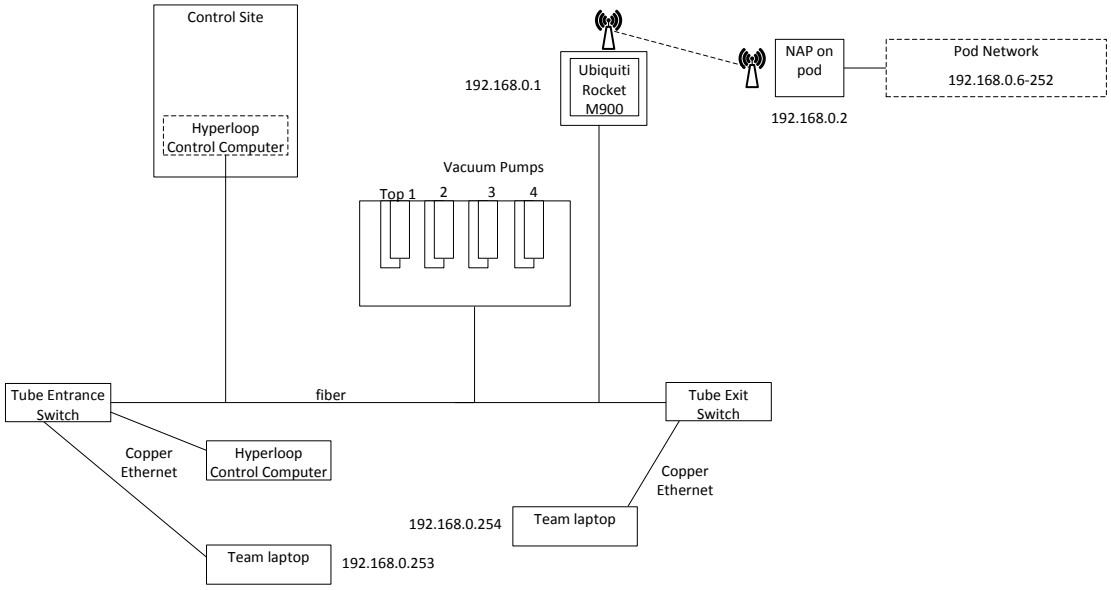
Hyperloop Team Network Guide

General Architecture

Teams are given 3 connections for their equipment to the tube network, the NAP and two access ports for control laptops at either end of the tube, as shown in the following figure.



Note: IP addresses shown for team equipment are an example configuration.

All 3 entry points into team network may be operated simultaneously. There are no restrictions on traffic beyond bandwidth and IP addressing, but it is highly recommended that teams minimize the traffic on their network segment to only what is required to operate their vehicle.

IP addressing

Teams are allocated a static 8-bit subnet of 192.168.0.0/24, with addresses 192.168.0.1-5 reserved for SpaceX network equipment. This network uses 192.168.0.1 as its gateway IP. All remaining addresses, 192.168.0.6-254 are allowed for use by the team equipment. Student equipment must not conflict with reserved IP addresses, and all equipment must have a unique statically allocated IP within the allocated network segment. Any network devices with IPs outside the allocated network segment will not be allowed to send traffic onto the network.

Example valid settings for a device on the team network:

- IP Address: 192.168.0.12
- Netmask: 255.255.255.0
- Gateway: 192.168.0.1

Bandwidth

All traffic to and from the vehicle must be limited to 10 Megabit per second. Traffic shaping and quality of service will be enforced, and traffic will be hard limited at the specified rate. All traffic after the 10Mb/s limit is reached will be discarded. Latency is expected to remain <30 ms, but is not guaranteed.

VEHICLES WHICH EXCEED THEIR BANDWIDTH BUDGET WILL NOT BE ALLOWED TO COMPETE.

Services and Connectivity

No services or servers will be present on this network, including DHCP or DNS. There will be no access to any IP addresses outside the allocated network segment. Teams shall not bridge or otherwise provide remote access to this network, and at no point shall a device be connected to the network which is also connected to the Internet, regardless of the bridging configuration of that device.

The network segment is fully connected at the SpaceX level – all nodes connected directly to the Hyperloop network can reach all other nodes on the same network segment. This means that both team laptops can talk to each other and the pod network at all times.

Pod Monitoring Telemetry

Teams shall send a binary telemetry frame for SpaceX monitoring of the status of their pod. The frame shall be sent via UDP to IP 192.168.0.1, port 3000 at no greater than 10Hz, and must obey the following format, where the type UINTx is an unsigned integer of x bits in length, and INTx is a twos-complement signed integer of x bits in length. The first 5 fields are required; the latter five fields are optional. If a field is unused, its value must be left as 0.

Name	Type	Description
team_id	UINT8	Identifier for the team, assigned by SpaceX. Required.
status	UINT8	Pod status, indicating current pod health and pushing state, as defined below. Required.
acceleration	INT32	Acceleration in centimeters per second squared. Required.
position	INT32	Velocity in centimeters per second. Required.
velocity	INT32	Position in centimeters. Required.
battery_voltage	INT32	Battery voltage in millivolts.
battery_current	INT32	Battery current in milliamps.
battery_temperature	INT32	Battery temperature in tenths of a degree Celsius.
pod_temperature	INT32	Pod temperature in tenths of a degree Celsius.
stripe_count	UINT32	Count of optical navigation stripes detected in the tube.

All multi-byte segments of the frame are expected to be received as big-endian values (aka network order).

The total length of the payload of the packet is 34 bytes. Frames which contain a payload longer than this will be ignored by SpaceX software.

For the status segment of the packet, this is used as a general identifier of state for the team pod. Enumeration as follows:

- 0: Fault – If seen, will cause SpaceX to abort the tube run.
- 1: Idle – Any state where the pod is on, but not ready to be pushed.
- 2: Ready – Any state where the pod is ready to be pushed.
- 3: Pushing – Any state when the pod detects it is being pushed.
- 4: Coast – Any state when the pod detects it has separated from the pusher vehicle.
- 5: Braking – Any state when the pod is applying its brakes.

Not all states are required to be reported. At a bare minimum, ready and fault must be able to be reported by the pod, indicating that the team is ready to be pushed, or must abort due to a detected failure.

This data may be sent by either the pod itself, or the team laptops used for running the pod.