08 – Logistics and Surface Transport

SUMMARY

In this chapter, a comprehensive system of modular surface vehicles is described for just about every application needed. Also described is an end-to-end logistics transport system that is largely automated and launcher/lander agnostic.

LOGISTICS

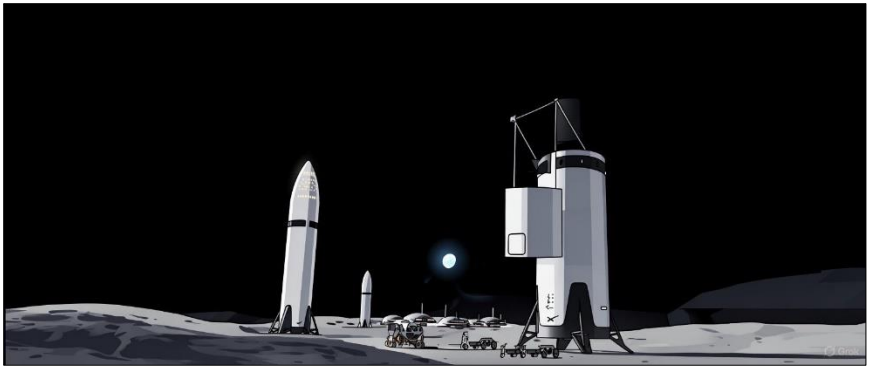
The transportation of cargo from the Earth to the Moon opens up the interesting question of what sort of logistics system makes the most sense.

The Network's Logistics Working Group (LogWG) has met via Zoom several times to discuss this matter. Among the attendees include individuals who have served in military logistics and so bring that experience with them.

Our inspiration is the Intermodal shipping container system that has thoroughly revolutionized international trade. One shipping container can start in a factory overseas, be closed and sealed, transported to the dock loaded on a ship, transported across an ocean to another dock, transferred by train to a regional distribution center, redistributed and then finally driven to the final store. Could something like this be implemented for transport from Earth to bases on the Moon and Mars?

Choosing the right in-space shipping solution is tricky business as there are several tradeoffs. My view is that, at a distribution facility at Kennedy Space Center, cargo should be secured in pallet containers within unitary containers shaped to roughly conform within the fairing of the launch vehicle. For example, the Starship's fairing is 9 meters in diameter so the container could be 8 meters and roughly cone shaped. Blue Origin's New Glenn rocket has a fairing of 6 meters so the container could be 5 meters in diameter. After exiting Earth's atmosphere, the fairing could come off (to be retrieved) and the upper stage could be docked with a propellant depot so that the entire mass of the unitary container and its contents could be sent to the Moon.

"StarShuttle". Credit: Adapted from SpaceX image.



Concept of a modified Starship logistics system. Adapted from SpaceX image.

Once having landed on the Moon, a crane system could remove the unitary and drop it onto two connected MSTVs which would transport it to the Logistics Hab (LogHab) at the main base. If one side of the unitary container is flat, then any size of container could dock with the LogHab. Each pallet with tracking devices would be unloaded from the unitary containers and individually, automatically transported to the correct department using automated pallet jacks like Amazon is starting to do in some distribution l centers. For those pallets needing to be transported to another base/settlement, the automated pallet jacks would transport those to other airlocks in the LogHab attached to standardized container to be transported to more distant bases. All containers may themselves be more valuable as resources than shipped back empty. For example, copper is very hard to come by on the Moon so a reinforced copper shipping container would be of great value to lunar settlements.

But intelligent minds can disagree with our proposed logistics system and all views are welcome.

SURFACE TRANSPORT

We have seen how private American companies are solving the rocket transportation system between the Earth and Moon. But it doesn't stop there. How will goods and crew be transported on the surface once they get there?

Several countries and companies have developed surface vehicles. We can start with NASA's Crew Surface Vehicle (CSV). This was developed during the early Constellation Program before the Shuttle money was freed up.

Crew Exploration Vehicles

There are several interesting features which stand out. One is that they conceived of a side docking mechanism that would allow crew to go from a habitat directly into the short sleeve environment of the cabin. This would partially eliminate the need to do decompression procedures when transitioning from a habitat to the surface vehicle.

Another interesting characteristic is that they included a glass hemisphere at the front center of the cabin -- rather like the Plexiglass domes allowing dog to look through fences. This would allow crew to remain inside the cabin while driving up to, examining rocks, and using manipulators to bring samples through a small port into the cab -- all without ever having to exit the cab.

But national astronauts actually want to get out and walk. So, on the back of the cab, they had rear-entry space suits. In this way, none of the dust would get into either the CSV or the habitat. The challenge would be how to clean the suits and how many different ports would be needed given all the different sizes of the crew.

Rear-entry suits.. Credit: NASA

Lunar Cruiser

The Japanese Space Agency (JAXA) has also been working on the Lunar Cruiser with automotive giant, Toyota. It also is a pressurized vehicle, but the difference is that it has door that open on the side for easy exiting of suited astronauts.

Open Vehicles

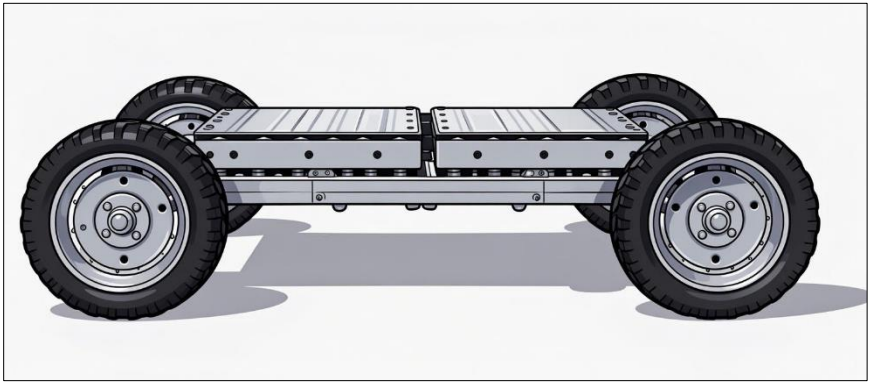
Several companies have developed concepts for open "air" vehicles. In this way, astronauts can drive right up to a rock of interest, the front gate lowers, and the astronauts step out a few meters to examine the rock, collect the specimen, and get back into the rover. It wouldn't be a shirt sleeve environment, but it would have maximum accessibility while being lower mass to launch from Earth.

The Network's Vehicle Concept

As we survey the vehicle concepts put out by others, we immediately recognize that they are designed for the government paradigm that doesn't take into full account the inevitable reality that the Starship fleet is going to bring. Rather, they are typically designed to meet (and often

funded by) government requirements. And governments are currently confined by the vision of just a few government astronauts conducting geologic exploration and collecting more rocks to set next to the Apollo samples.

From our perspective, when you have a fleet of Starships, countries will naturally take advantage of that reality. Vehicles will be used for large-scale exploration (see Chapter 13). But they will also be used to transport volatiles probably tens of kilometers to be processed at a Peak of Eternal Light. With time, they will be traveling long distances making resources from any part of the Moon available at bases in order parts of the Moon. So, they will need basic compacted dirt roads (see Chapter 10). Given these circumstances, what sort of requirement would drive the design of surface vehicles?



The electric chassis onto which will slide various modules and implements.

The Network believes that surface vehicles should be modular with the basis being an electric chassis that can travel roughly the distance of a standard Model 3 Tesla. The platform / battery pack of this chassis should rise above the tops of the wheels so that crew and (open and closed) cargo modules can slide between chassis. There should also be anchor points on the front and back of the chassis to turn it into a tractor. Crew modules can be open or closed depending upon the need. We also believe that it should be designed so that portions of it could be produced from in situ (local) resources. We call this concept the Modular Surface Transport System (MSTM).

It may be that someone reading this chapter has an interest in moving this concept forward on a space advocate level. It could be the development of a 3D design and the animation to help get the concept out. Or perhaps it may involve tracking down and contacting university EV clubs and pitching the concept. Let us know by visiting our website.