‘Parom’ – Russia’s Replacement for the Space Shuttle at the ISS
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With the approaching irrevocable grounding of the space shuttle fleet, space planners must face the need to replace piecemeal as many of its capabilities as possible. And as the construction of the International Space Station has demonstrated, a key ability is not just to carry payloads into orbit, but also to accurately bring them to a desired point in space and attach them gently to a structure already there.

Without the shuttle acting as such a carrier, each payload designed to visit a space station must have its own navigation, guidance, control, and mating hardware. That hardware, and the power systems and propellant tanks to feed it, often can outweigh the deliverable payload on every launch and then often get in the way of operations once the delivery has been performed.

Now the Russians have proposed a specific spacecraft that promises to perform these tasks efficiently (and to use another critical word again, “gently” – a trait that makes building the payloads much easier). It is an old idea, dusted off and implemented with improved versions of tried-and-true Russian space hardware – and it really looks like a major contributor to continuing and expanding orbital operations in the post-shuttle era.

The project is called ‘Parom’, the Russian word for ‘tugboat’. Functionally, it is the full equivalent of the harbor tugs in major earthside ports. Cargos without their own propulsion are towed to locations where they are wanted. The tugboat then moves on to another cargo, stopping once and awhile for refueling and maintenance.

The ‘Parom’ that the Energia Rocket and Space Corporation (Russia’s manufacturer and operator of most human-related space vehicles) wants to build is a Soyuz-sized ‘flying docking tunnel’ surrounded by propellant tanks, thrusters, solar cells, and avionics bays. It can dock in either direction, can thrust in either direction, and can be refueled repeatedly. Its components are to be designed for a 15 year lifetime involving up to 60 round trips between low orbit and the space station.

The basic mission profile is simplicity itself. Based at a docking bay at the ISS (perhaps only an attach point with minimal interface with the station), it departs for a lower orbit when a station-bound cargo canister (or assembly component) is placed into a parking orbit by any of a number of launch vehicles. The cargo vehicle must have a simple end-mounted mechanism for mechanical attachment and for short-term stabilization and power – nothing more sophisticated is needed. Parom approaches and docks to the cargo vehicle, and then pushes it up to the space station where it docks its free end to a fully-functional port.

At that point, Parom's hatches can be opened and crewmembers can enter the cargo canister, if that's the mission. Or propellant can be fed through transfer lines into the station (and into Parom's own tanks, whenever needed).

Alternately, the station's robot arm can grapple the payload, detach it from Parom, and place it where needed – perhaps in an assembly area, or perhaps over a 'common berthing mechanism' on the US side that allows transfer of full-size science racks or other large cargoes. Or perhaps the payload can be delivered to applications not yet even imagined. Parom is to have the flexibility to accommodate practically anything that anyone can get into a parking orbit, up to a mass of 12 metric tons and possibly more than twice that.

The space delivery options made available by such a spacecraft are as wide as space itself. Parom could visit free-flying materials processing modules co-orbiting with the ISS, bringing them in for annual servicing and then redeploying them on its way out for a parking orbit pickup. Some Russian designs have Parom providing the space-to-space transport for the proposed 'Klipper' follow-on human spacecraft, also still on the drawing board (and awaiting funding from foreign partners).

Parom-class tugs could carry satellites into higher orbits for deployment, or emplace and then retrieve co-orbiting science and industrial satellites near the ISS. They could operate autonomously in geosynchronous orbit and even around the Moon, carrying cargo canisters that include additional propellant supplies. In another application, ISS-based Paroms (and more than one may be stationed there, once the Russians install additional docking ports) might be able to serve as emergency crew refuges, with portable consumables packages for life support..

Practically all of the components of this 'Parom' design have already been flight tested. The structural framework is easy to build, and the power, control, approach and docking systems would be outgrowths of existing Soyuz and Progress systems. Those avionics boxes that couldn't last 15 years can be designed for in-space change-out.

And Russia has twice used tugboat-style vehicles to bring components to a space station. Both for the 'Kvant' module (Mir, 1987) and the 'Pirs' airlock module (ISS, 2001), the component was mounted atop a detachable 'propulsion module' that later departed. In both cases, however, rendezvous guidance gear was installed on the station-bound component, not on the proto-tugboat that was the ancestor of the Parom design.

Last October, Energiya president Nikoay Sevastyanov told a space conference. "We want to lower the cost of cargo supplies by a factor of four." His deputy chief designer, Nikolai Bryukhanov, had recently told reporters that "with consideration for the cost of the development and manufacture of the tug, the system will repay in less than two years of use" – clearly implying that customers would be expected to pay for the service. Once funding was approved, Bryukhanov promised the spacecraft could be ready in five years.

And in November, Energiya's plan received the blessing of Russian Federal Space Agency head Anatoly Perminov, who touted its benefits at a press conference and

announced plans to conduct its first flight within three years (it wasn't clear if this would be a test flight and 'proof of concept' or the first fully-operational vehicle).

The plans are to phase out Progress flights soon afterwards, although cargo canisters carrying four tons of supplies (instead of the 2.5 tons carried inside each Progress) would then be launched regularly for pick-up by the operational 'Parom' tug. How many would eventually be deployed remains unclear – but in the case of logistical support for a post-shuttle space station, 'Parom' could well be the answer to a worrisome problem.