Heaviness of Rockets

Why in news?

The ISRO's LVM3 M2/OneWeb India-1 mission carried almost 6 tonnes of payload into lower-earth orbit, the most that any ISRO mission has delivered into space till date.

What is LVM3- M2?

- LVM3-M2 is the commercial satellite mission of NewSpace India Limited (NSIL), a Central Public Sector Enterprise (CPSE) under the Department of Space.
- This mission is being undertaken as part of the arrangement between NSIL and OneWeb Ltd, a U.K. based company.
- The LVM3 weighing around 644 tonne carried 36 satellites weighing about 5.7 tonne.
- OneWeb in partnership with ISRO and NSIL demonstrated its commitment to provide connectivity across India by 2023.
- This launch represents more than 70% of OneWeb's planned 648 Low Earth Orbit (LEO) satellite fleet that will deliver high-speed, low-latency connectivity worldwide.
- Launch Vehicle Mark 3 (LVM3) is the **heaviest rocket** of ISRO.
- Other heavier rockets - **Ariane** of Europe, **Falcon Heavy** of SpaceX, **Long March** of China, etc.

Salient features of the Mission

- First commercial mission of LVM3
- First multi-satellite mission with 36 OneWeb Satellites onboard
- First launch of LVM3 to LEO
- First Indian rocket with 6 ton payload
- First NSIL Mission with LVM3
- First OneWeb Mission with NSIL/DoS

What rockets does India have now?

- India currently has three operational launch vehicles
    - Polar Satellite Launch Vehicle or PSLV
    - Geosynchronous Satellite Launch Vehicle or GSLV Mk-II
    - Launch Vehicle Mark-3 or LVM3
- In addition, ISRO has been working on a reusable launch vehicle (RLV).
- **PSLV** - The PSLV has been the most commonly used since 1993.
- It has carried as many as 53 successful missions and only 2 flights have failed.
- **GSLV-MkII** - The GSLV-MkII rocket has been used in 14 missions, of which four have ended in failures.
- **LVM3** - The LVM3 has flown five times and has never disappointed.

What are the constraints?

- **Tyranny of the rocket equation**- The size of a launch vehicle is dictated by
  - The destination in space it is headed towards
  - The kind of fuel mix that is being used (solid, liquid, cryogenic)
  - The size of the payload
- The choice of any two of these variables places severe restrictions on the flexibility of the third, that is popularly referred to as the "tyranny of the rocket equation".
- **Gravity till LEO**- Most of a rocket's energy is burnt in travelling to the lower earth orbit because the force of gravity is the strongest here.
- **Gravity of the destination** - If a space mission is headed towards any celestial body, more energy would be expended compared to simply attaining a space orbit.
- **Efficiency of the fuel** - Most modern-day rockets use multiple sets of fuels to power the different stages of the flight to optimise the results.

What innovations can fulfill the objectives of future missions?

- The rockets can make multiple trips, carrying components of larger structures that can be assembled in space, similar to International Space Station being built.
- The other is the possibility of the use of resources available in situ on the Moon and Mars.

References

1. The Indian Express | Heaviness of rockets
2. ISRO | LVM3-M2 / OneWeb India-1 Mission
3. NSIL | New Space India Limited

Quick facts

Launch Vehicle Mark 3 (LVM3)

- Launch Vehicle Mark 3 (LVM3) is the **heaviest rocket** of ISRO.
- LVM3 was earlier called Geosynchronous Launch Vehicle Mark III (GSLV Mk III).
- The name of the vehicle is changed from GSLV to LVM because the rocket will not deploy the satellites in the geosynchronous orbit.
- In 2014, the GSLV-Mk-III was named LVM-3 as it launched the Crew module Atmospheric Re-entry Experiment **(CARE)** into space.

GSLV Mk III

- GSLV Mk III is a **three stage** vehicle with two solid strap-on motors, one liquid core stage and a cryogenic upper stage.
- It is a medium-lift launch vehicle primarily designed to launch communication satellites into geosynchronous orbit.

- GSLV Mk III has the capability to launch 4000 kg payload into Geosynchronous Transfer Orbit (GTO) and 8000 kg payload into Low Earth Orbit (LEO).
- GSLV Mk III carried India's second lunar mission **Chandrayaan-2** and will be used to carry **Gaganyaan**, the first crewed mission under Indian Human Spaceflight Programme.

New Space India Limited (NSIL)

- New Space India Limited (NSIL) is a **commercial arm of ISRO**.
- Its mandate includes
    - Owning satellites for earth observation and communication
    - Building satellites and launching them as per demand
    - Providing launch services for satellite belonging to customer
    - Building launch vehicles and satellites through Indian industry
    - Space based services related to earth observation and communication satellites on commercial basis
    - Technology transfer to Indian industry