GEOSAT PROGRAM Courtesy
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URSC ISAC ISRO

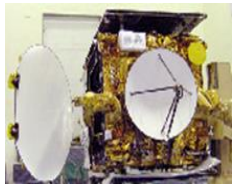
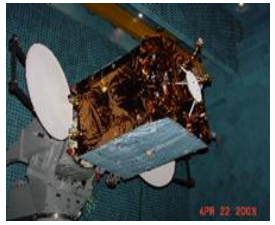
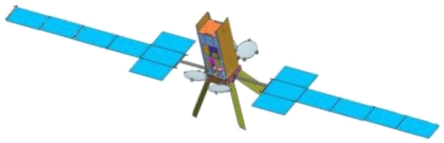
NEXT GENERATION SPACECRAFT BUS

Existing

- ✓ *Four distinct satellite platforms*
- ✓ *Application based platform*
- ✓ *versatile solutions to the varied requirements*
- ✓ *Low turn around time*
- ✓ *state of the art technologies with heritage*

Future

- ✓ *High performance bus in terms of mass and power compatible with GSLV MK-III capabilities.*
- ✓ *Develop advanced spacecraft technologies*
- ✓ *High power / high performance communication payload*
- ✓ *A versatile and modular bus with All EPS as mainstay for next decade*
- ✓ *Indigenous development of space components*

	I-1K Bus	I-2K Bus	I-3K Bus	I-4K/6K Bus
				
Payload, Kg	75 to 125	150 to 275	250 to 350	450-850
Dry Mass, Kg	500 to 600	900 to 1,100	1,200 to 1,500	2,000 to 3000
Payload, kW	0.5	2 to 2.5	3 to 4.5	8 to 18
Life, Year	7	10 to 12	12 to 15	> 15

1. MICROWAVE SPECTRUM

- L-band and S-band - Steady utilization for specific application such as maritime and mobile services
- Utilization of C-band - May experience slight reduction in some regions
- Utilization of X-band - Hold steady for Governmental services
- Ku-band - Main spectrum for satellite services such a FSS, DTH, BSS, Broadband, etc.
- Ka-band - Main utilization by Broadband and HTS Satellite systems
- Emergence of higher frequency bands such as Q-band and V-band
  - Wider utilization is expected in the near future

Name	Freq. Range
L band	1 to 2 GHz
S band	2 to 4 GHz
C band	4 to 8 GHz
X band	8 to 12 GHz
Ku band	12 to 18 GHz
Ka band	26.5 to 40 GHz
Q band	30 to 50 GHz
V band	50 to 75 GHz

3. FLEXIBLE PAYLOAD

- Certain satellite business plans stand to benefit from varying degree of on-orbit payload flexibility

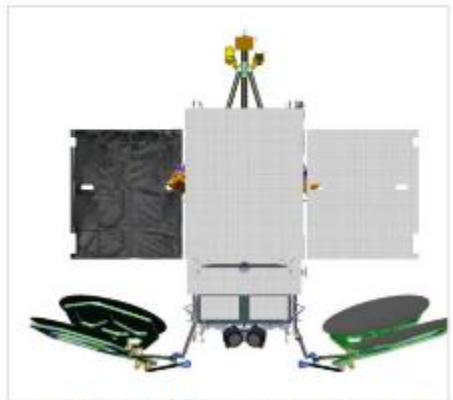
2.OPTICAL SPECTRUM

- Small scale utilization for Inter-Satellite Links (ISL)
- Broader application is expected
- Required technologies for Flexible Payload include
  - Phased array – coverage flexibility
  - Mechanically reconfigurable antenna – coverage flexibility
  - Analog or Digital Channelizer – channel bandwidth, signal routing flexibility

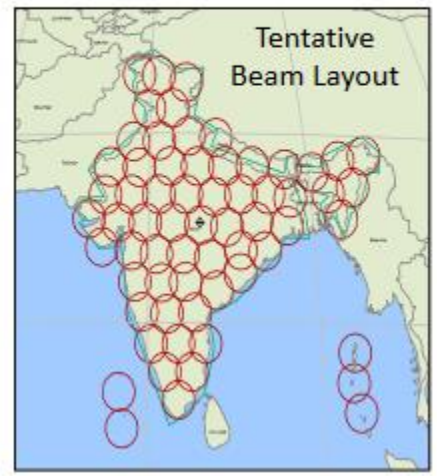
KA Band High Throughput Satellite

HTS Payload Highlights

- 80 - 100 user spot beams, 10-12 hubs
- No. of TWTAs : 70-80 (120 – 150W)
- #4 Antenna Reflectors of ~3.0m dia
- Payload Mass : ~1.5 T
- Payload DC Power : ~13 - 15 kW
- Thermal Dissipation (Conduction) : ~ 6-8 kW

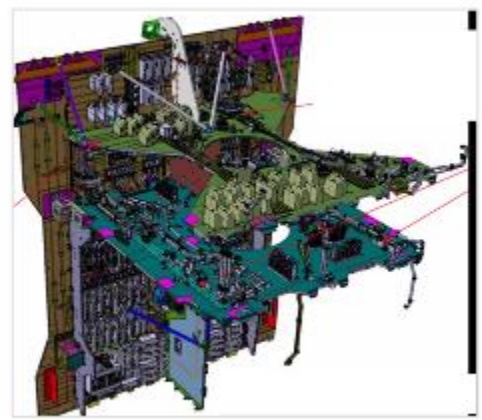


Typical Reflector deployment



Specific features for upcoming HTS:

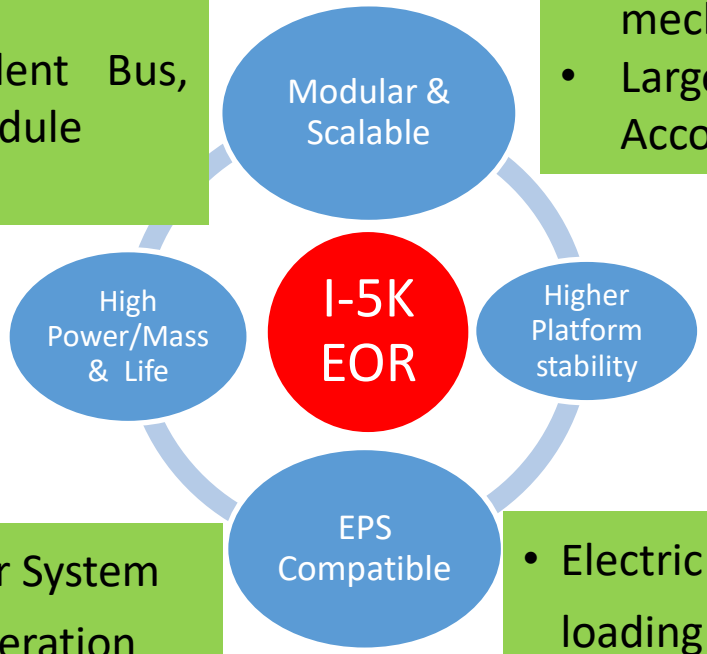
- Larger payload carrying capacity (using EPS or hybrid approach).
- Larger power generation to support large number of high power HPAs.
- Thermal dissipation management to support Radiation cooled as well as Conduction cooled TWTAs.
- ~Four no. deployable reflector with hinge towards AEV, to increase antenna focal length for feed cluster accommodation on bus structure itself.
- Multiple intermediate decks to enable LNA & TWTA integration near antenna feed system to minimize waveguide run and improve I/O losses.



Multiple intermediate equipment decks

- Next generation I-5K EOR with 4000 Kg to 5000 Kg LOM
- Modular bus - Independent Bus, Payload and Propulsion module
- U-Payload Module

- Articulated Deployment mechanism
- Large and Multiple Antenna Accommodation



- 100V Fully Regulated Power System
- 20 kW to 30 KW Power generation
- Flexible Solar Array.
- 1553 Bus Interfaces
- 1500-2000 Kg P/L mass with 20 kW Power, In loop Tracking Payload
- Thermal Design to support 400 W/m2 (Isothermal panels to Isothermal spacecraft)

- Electric Propulsion : 850Kg Xenon loading
- Development of high capacity Xenon Tank, High thrust SPT, Modular PPCU
- Robotic arm mechanism with closed loop pointing
- Life : 15 years Plus

- Definition and development of new I-5K EOR bus structural configuration.
- Development of 100 V bus with High power 2kW BDR modules with stackable provisions to support 20kW to 30kW Spacecraft Power
- Technological challenges and developmental activities that are required to be carried out in different areas.
- Realization of state of art communication payload delivering around 20 kW power
- Definition and developmental initiative for the design of thermal control system to meet the challenges posed by communication P/L operating in excess of 20 kW of power.
- Definition and developmental initiative for the operationalization of electric propulsion system with fine tilt robotic arm mechanism and appropriate closed loop control systems.
- Bus electrical subsystems shall be configured based on functional requirements (Digital, Power, Drive & RF electronics packages)
- Overall dry weight optimization of the bus for maximizing the payload capabilities and on-orbit life.
- Shall work out a detailed mass efficient configuration of the spacecraft.
- Spacecraft shall be compatible with both GSLV MK-III as well as a commercial launch vehicle for lifting the payload of the 4 to 5 ton class.

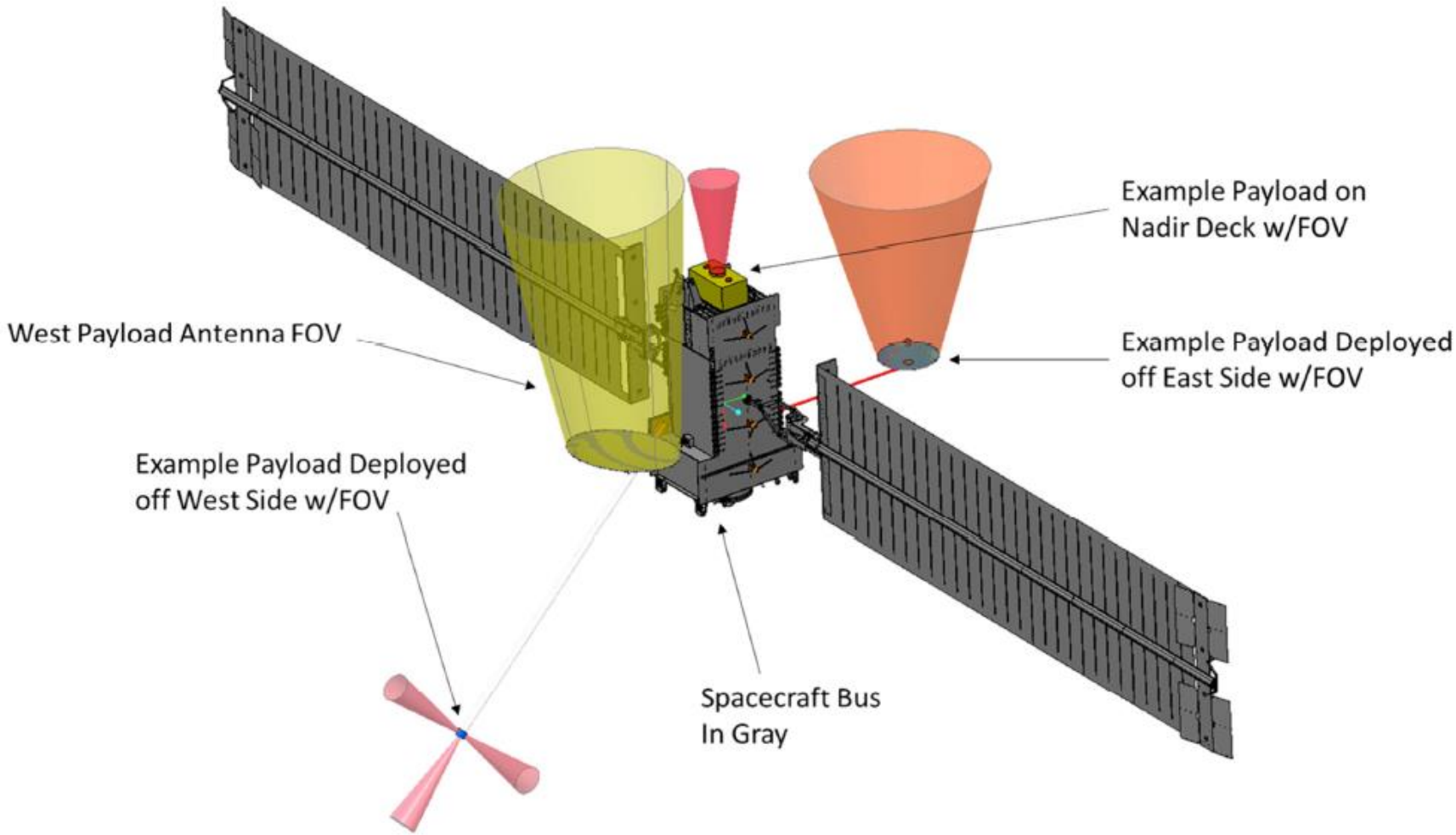
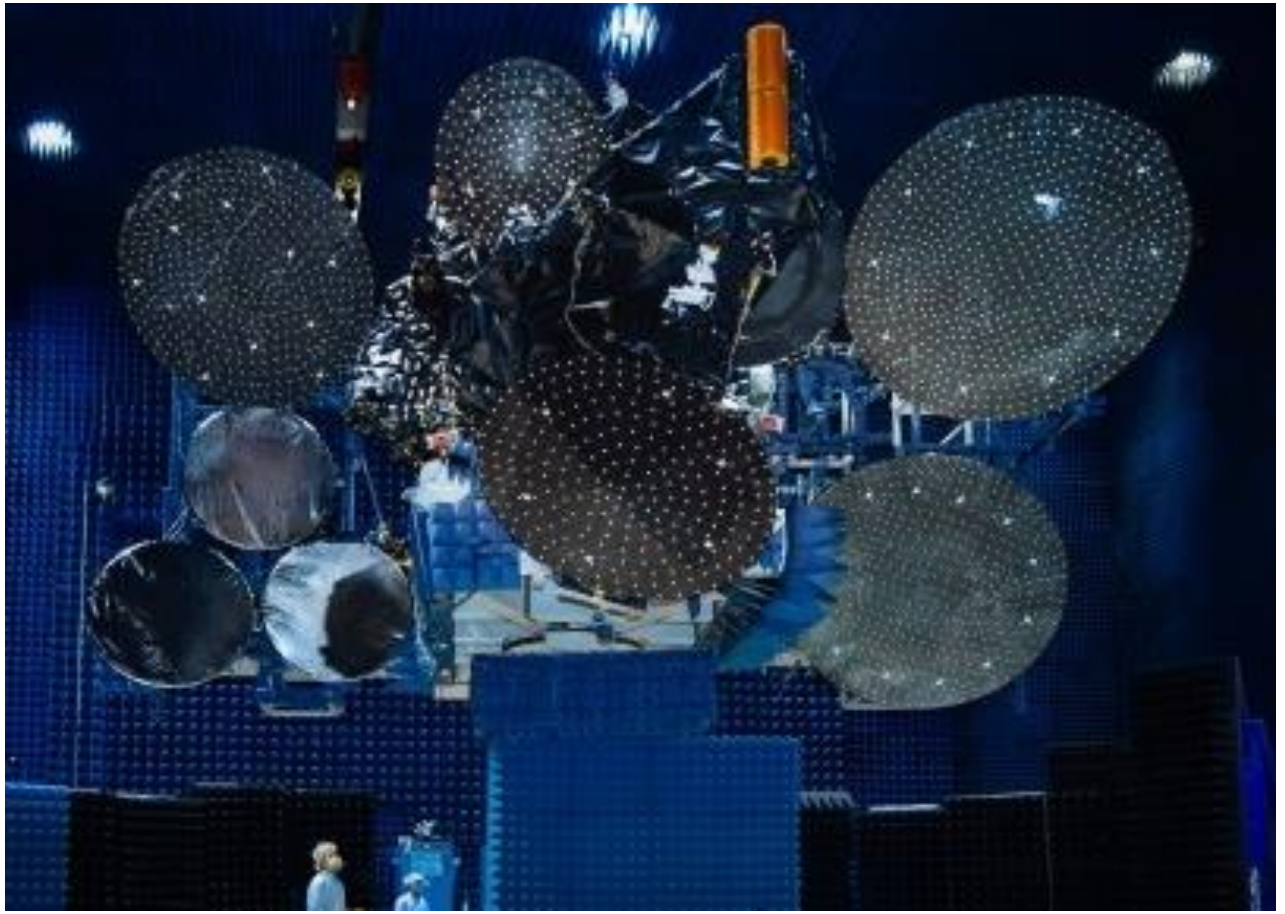


Figure 1. External view of typical LM 2100 showing a variety of potential payload mounting locations

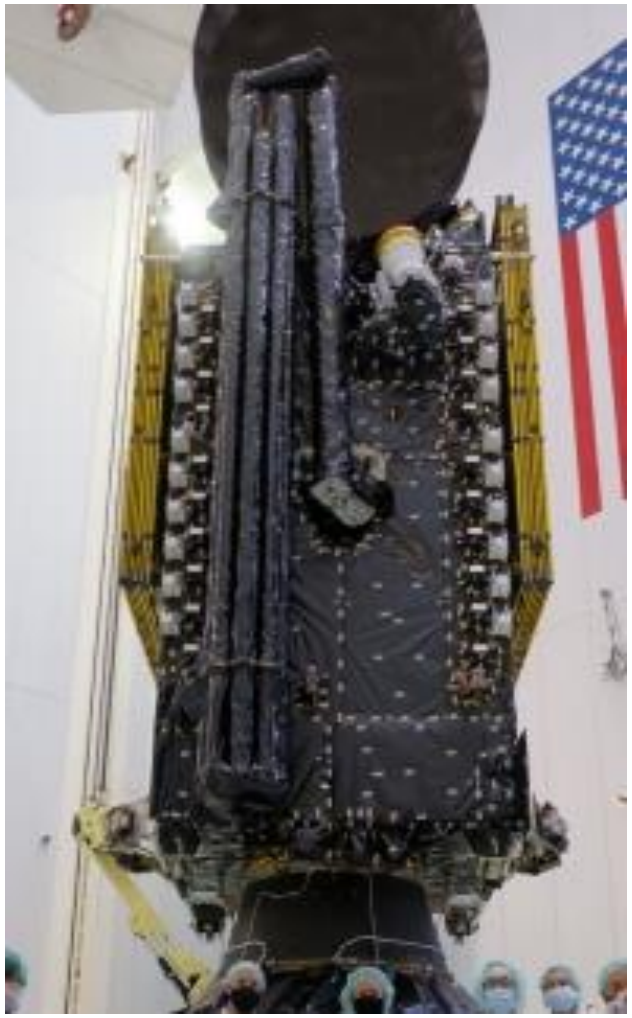
LM2100 platform – SaudiGeoSat-1



Star One D2 mission's reflectors deployed during CATF.

Built on Maxar1300 platform

Spacecraft is equipped with X, C, Ku and Ka band transponders for Communications in Brazil. launched in Jan 2021.

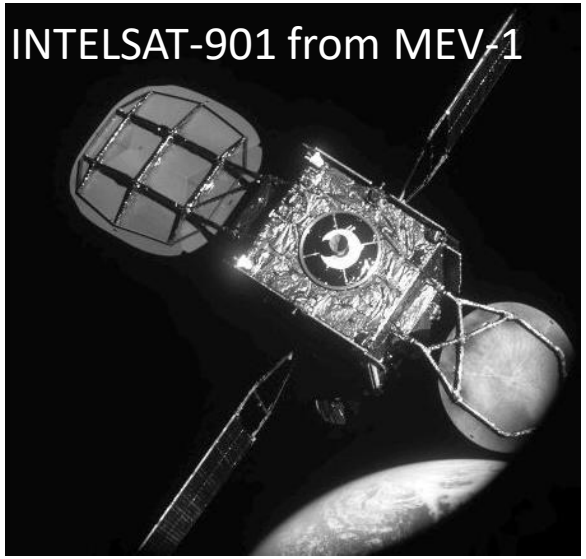


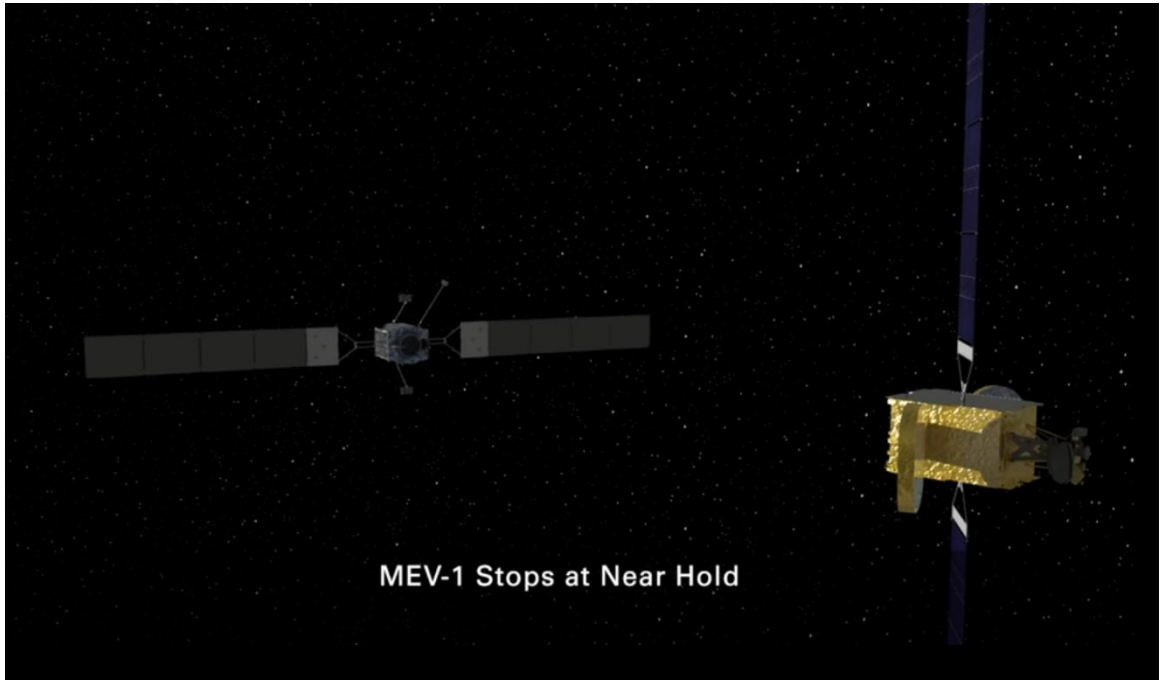
Sirius SXM-8 satellite built on Maxar1300 platform and launched in June 2021. The satellite is based on 20kW power and provides radio services in radio, audio entertainment, traffic, weather, data and information services using 30 feet UFA operating in S band. SXM-9/10 are planned in 2022-25

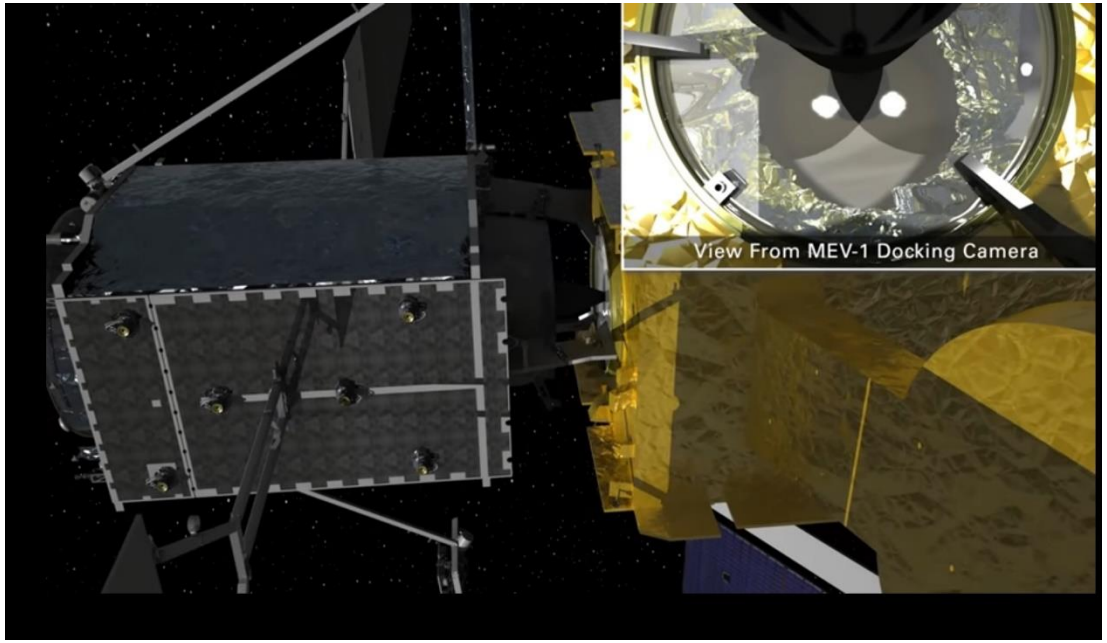
SXM-8 spacecraft built on Maxar1300 platform

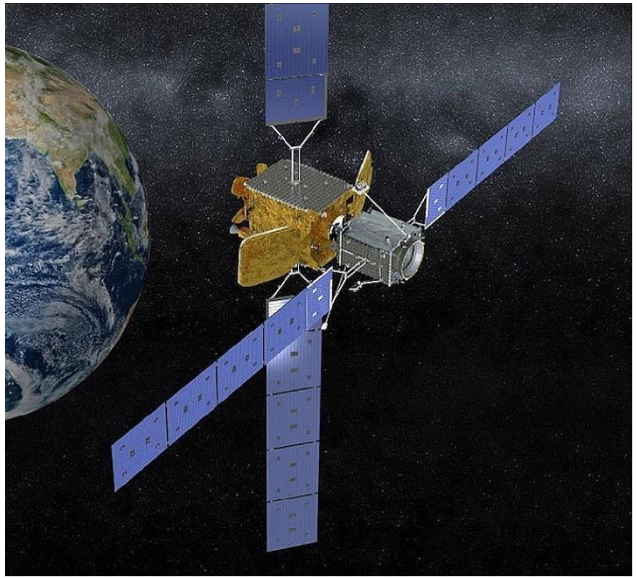
Eutelsat-172B; the latest all EPS satellite on Eurostar 3000EOR platform

- Multi mission satellite with 14 C band, 36 Ku band and HTS Ka band (1.8Gbps) payload transponders
- All EPS, LOM 3551kg, 13kW of Power, and mission life of 15 years
- First satellite in Eurostar platform with Electric Orbit Raising (EOR) Operations

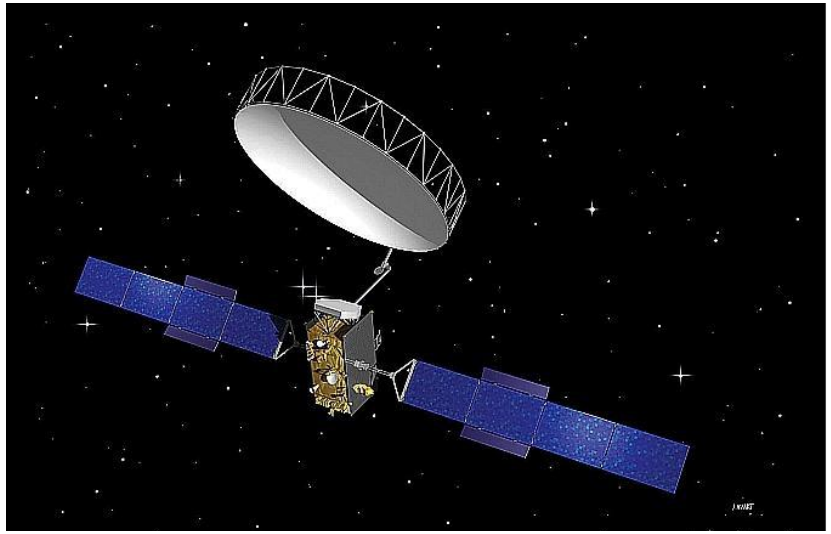

INTELSAT-901 from MEV-1


MEV-1 Stops at Near Hold


View From MEV-1 Docking Camera



SES-9 satellite on 702HP platform



Overall Inmarsat-4A F4 (Alphasat-I XL) Spacecraft

PAYLOAD SYSTEM

- ✓ High capacity, HTS satellite for advanced technology applications
- ✓ Migration higher frequency bands e.g. Q & V to provide higher usable bandwidths and facilitate high bit rate voluminous data transfer for multimedia applications
- ✓ Multi mission Payloads
- ✓ GEO Ku/Ka/Q&V band HTS systems
- ✓ Flexible beam sizing to meet variable capacity demands
- ✓ Flexible TWTAs, Multiport amplifiers
- ✓ Mechanical or electrical beam steering, Coverage shaping or hopping
- ✓ Full connectivity between all beams
- ✓ Coverage: Mechanical or electrical beam steering, Coverage shaping or hopping
- ✓ Power: Flexible TWTAs, Multiport amplifiers, Load balancing from thin/sparse to dense traffic zone

Emerging S/C Configuration – BUS SYSTEMS

- ✓ Inverted U- Payload Structure Modularity in design (bus, propulsion and payload modules) with plug and play interfaces
- ✓ Fully regulated 100V bus with bus bars and 2kW BDR
- ✓ Modular Power generation, distribution and transfer capability with 20 – 30 kW scalable architecture & Flexible solar arrays
- ✓ Integrated Onboard Computer and Driver Electronics architecture
- ✓ High Thrust Electrical Propulsion System (EPS) for Orbit raising, on-orbit operations for better efficiency
- ✓ Use of optical / RF trackers for platform pointing accuracy
- ✓ Articulated Deployment Mechanism For Reflectors
- ✓ Two Deployable Thruster Mechanism Assemblies (DTMA) with robotic arm to orient the thrusters either in Electric Orbit Raising or station keeping.
- ✓ 18m Unfurlable Antenna Development

Emerging S/C Configuration – BUS SYSTEMS

- ✓ Batteries with higher Specific energy with wider Temperature Operation
- ✓ Advanced batteries: Li-Po, Li-Si,Li-FS, Solid state battery
- ✓ High capacity surface heat pipes for direct mounting of high dissipating RF components
- ✓ Thermal design to enhance radiating area requirements

THANK YOU