SOURCE MATERIAL FOR MODEL I PAPER II
SCIENCE AND TECHNOLOGY

What is a blockchain? Blockchain also known as distributed ledger technology has been defined to be a decentralized peer-to-peer network based public encrypted and immutable digital federated ledger system. Working like a shared Google document, the ledger is a public database that records transactions in a permanent fashion and distributes copies to all relevant parties without the need for a third party to authorize the transaction.

The first major use of this technology occurred with the creation of Bitcoin, which is a digital crypto-currency introduced in 2009. The seminal paper that introduced this technology to the world was penned by "Satoshi Nakamoto" (a pseudonym used by the author whose identity is still unknown) and was titled " Bitcoin : A Peer to Peer Electronic Cash System.

"Traceability and reliability were the hallmarks set forth by Nakamoto in this innovative method of executing transfers of value between peers.

Transactions are recorded within "blocks" which are stored on each computer in the network. As new blocks are added, they are linked to all preceding transactions. As each computer in the network has its own copy, security of data is improved and vulnerability to cyber attacks is reduced vis a-vis hitherto used models wherein data is stored in a single central location. It is seen as nearly unhackable because to change any information on it, a cyber attack would have to strike all copies of the ledger simultaneously Data put into the blockchain cannot be tampered without being noticed.

Blockchains leverage techniques from a field of computer science known as cryptography to sign every transaction with a unique digital signature belonging to the user who initiated the transaction. These signatures are held privately, but are publicly verifiable. This means that if a user with identity A sends money to identity B, anybody can verify that the money was sent by A, but cannot use As signature for their own transactions. This cryptographic system creates accountability while preventing identity fraud.

Applications of Blockchain

Blockchain is a part of the ever widening canvas of technological developments which range from Artificial Intelligence and Virtualisation to Cloud Computing and Internet of Things. It has begun to make its presence felt in insurance, health care, voting systems, supply chain & logistic, shipping and other sectors too. For instance, NITI Aayog is seriously deliberating on building a new immunisation infrastructure for the country - unified and enhanced by blockchain. Discussions are also in the pipeline on SuperCert- an antifraud identity intelligence blockchain solution for educational certificates. The Gartner Blockchain Spectrum - proposed by Gartner, the research and advisory firm - talks about 3 phases: blockchain inspired solutions (a phase which began in 2012 and will last through the early 2020s), blockchain complete solutions (expected to gain momentum in the market around 2023) and enhanced blockchain solutions.

Smart Contracts

One area where much leeway has been made is smart contracts-self executing contracts wherein the terms can be set out in computer code. The high potential of smart contracts lies in enabling decentralised mi-c repayments such as paying a very small fee in return to accessing small bits and pieces of a digital content (which may be I 'song or a news article).A classic example | the Ethereum - powered music platform "V(USE" wherein artists upload their music 1"111 set their own prices) and users pay pm directly for the music via electronic currency. Mention must also be made of the Open Music Initiative (OMI) announced by the Berklee College of Music in Boston, Massachusetts which aims to build a database in the form of a blockchain seeking to solve the problem of proper identification of right holders.

The Blockchain- IP Interface

IPRs are currently regulated by third party authenticators. these authenticators are governments or administrative bodies of the geographical regions where the IP holder wants to secure and enforce rights. The limiting factor of such a system is its inherent physical limitation. As the market gets more globalized and digitized, it is becoming imperative to look for a more feasible and reliable alternative. The block-chain - IP interface is largely based on the premise that IP management systems could leverage blockchain technology to enforce provable IPRs where verifiable, immutable and secure operations in blockchain could help in the event of disputes. In particular, digital assets such as patents have multiple versions during their life time and block-chains can be used to link all versions of their digital assets and potentially use it for end-to-end life cycle maintenance. No wonder why blockchains are being seriously considered as possible successors to the classic-physical model.

In conjunction with Al, particularly domain specific Al, block-chain technology can work wonders. In the realm of certain IP assessments such as likelihood of confusion evaluation in trademark cases or the existence of an inventive step assessment in patent applications, Al-based software can come in handy. As yet another example consider the use of CAD (Computer Aided Design). Taking a photograph of a design from three different angles is sufficient to create a CAD. Such a CAD could be uploaded to a block chain based app that could search the entire database (comprising all designs registered in the history of the IP regime) for similar designs and the right could be granted or denied using an Al based assessment tool.

Personal Data Protection Bill

The Personal Data Protection Bill was introduced in India's parliament on December 11, 2019, which sets rules for how personal data should be processed and stored, and lists people's rights with respect to their personal information. It also proposes to create an independent new Indian regulatory authority, the Data Protection Authority (DPA), to carry out this law.

- Businesses would have to tell users about their data collection practices and seek customers' consent. Because the bill gives consumers the right to withdraw their consent, business would also have to come up with systems to allow consumers to do so.

- Consumers has the right to access, correct, and erase their data. The bill also allows consumers to transfer their data, including any inferences made by businesses based on such data, to other businesses. All companies would have to develop ways for consumers to do this.

- The bill requires all businesses to make organisational changes to protect data better. These include privacy-by-design principles (an approach in which privacy is a key consideration in how the business is organized), security safeguards, and so on.

- The bill also stipulates that all "sensitive personal data" be stored in India and that "critical personal data" not be transferred out of India. This will distort the market-driven decisions of businesses to access the best data storage services and force such data to be kept locally in India

- A group of "significant data fiduciaries"—people in charge of checking that data is stored fairly and responsibly—will have extra duties, such as carrying out data audits and appointing data protection officers.

- Lastly, the bill also includes rules about nonpersonal data. Under the bill, the government can require any business to share valuable nonpersonal data (such as aggregate mobility data collected by apps like Google maps or liber) with the government. The bill is silent on whether businesses will be compensated for their loss. This could have negative long-term consequences^ on innovation and economic growth

India and Cybersecurity

Amidst the tensions at the border, hackers based in China attempted 40,000 cyber attacks on Indian banking and IT sector in the last week of June 2020. India is fast covering ground in the cyber security front. Aided by the rapid influx of global tech companies, indigenous development of digital technologies, and regulatory changes such as demonetisation, pandemic-lockdown, the Indian public and enterprises are pushing for digitisation. It will make enterprises more reliant on their digital data and networks. So, the increasing importance of enterprise data and networks is increasing the need for solutions to protect these valuable assets. To be secure, India will have to be vigilant and resilient, not only by looking at how to prevent and respond to attacks, but by managing cyber risks that would unleash new opportunities.

In the near future, cybersecurity in India will be very different both in terms of emerging problems and the solutions that will be necessary to combat them. Areas like malware and ransomware protection have always been top-of-mind for Indian enterprise cybersecurity teams. Some cybersecurity areas that requires more attention from Indian enterprises, institutions and individuals would be:

a. Data Loss Prevention

There are always threats from hackers and competitors. It is vital to protect data from both insider (data leaks by employees - either willingly or accidentally) and outside threats. As data becomes more valuable, businesses will be required to deploy technologies like next-generation firewalls with data loss prevention capabilities, "personal data protection will become more important due to the increased awareness of data security by the consumers and the enforcement of data privacy laws by the Indian government. »To avoid losing reputation among customers and to escape government-imposed penalties, enterprises will have to implement strong data loss prevention measures in their business networks.

(b) BYOD Management

As more people switch to smart mobile computing devices due to even online classes, and work from home, there will be greater threats. Thus, businesses or workplaces will be required to implement clear, strong BYOD policies, as well as next-generation tools to automatically enforce these policies.

(c) Endpoint Protection

As the Internet of Things (loT) expands across different industries, the number of weak spots in their cyber defense will also increase. To prevent the loT networks from becoming a liability to businesses, they will have to adopt next-generation firewall solutions that can offer comprehensive endpoint protection and give total visibility over their networks.

(d) Proactive Security

Majority of Indian enterprises are unprepared with adequate cybersecurity measures. So Indian companies should gear up for implementing a desired level of cybersecurity with cutting edge solutions as outlined below:

Key Technologies for Adoption

- Al and machine learning-based cybersecurity solutions to mitigate the risks posed by ever-evolving malware, hacks, and other types of cyber-attacks.
- Al-based self-learning applications that will ensure continued protection against evolving risks.
- Al based next-generation firewall solutions that are more contextually-intelligent.
- 7-Layer deeper inspection performing inspection and analyze a broader range of parameters to determine the safety
- Anticipate potential cyber risks and take measures accordingly.

Big Data Analytics

Big data "analytics examines large amounts of data to uncover hidden patterns, correlations and other insights. With modern technology, it's possible to analyze data and get answers from it almost immediately. Big data analytics helps organizations harness their data and use it to identify new opportunities. That, in turn, leads to smarter business moves, more efficient operations, higher profits and happier customers.

3-Way Value Creation: Significant Cost reduction-in storing large amounts of data - plus they can identify more efficient ways of doing business. Faster, better decision making. - analyze information immediately - and make decisions based on what they've learned. New products and services. With the ability to gauge customer needs and satisfaction through analytics comes the power to give customers what they want.

5G wireless and Wi-fi 6

5G is a completely new technology that isn't backwards compatible, which means that new hardware will be needed to broadcast and receive 5G signals. Existing non-5G devices won't be able to connect to 5G networks, even at lower speeds.

According to Forbes, Wi-Fi 6 is reportedly up to four times faster than 5G in certain use cases, so 5G isn't likely to unseat Wi-Fi 6 as the preferred method of connecting to the internet when stationary.

As for use cases, 5G and Wi-Fi 6 each have their niche, but analysts and industry experts have argued that the two complement each other to create a larger, faster, and more accessible internet.

Wi-Fi 6 is supposed to make Wi-Fi networks faster, more reliable, and more energy efficient than ever, but what exactly does that mean? Wi-Fi 6 is the Wi-Fi Alliance's name for 802.11ax under its new naming scheme that is designed to make Wi-Fi generations easier to understand for the average computer user. Wi-Fi 6 replaces Wi-Fi 5 (802.11ac), which in turn replaced Wi-Fi 4 (802.1 In) as the standard for Wi-Fi speed in 2013.

It's easy to get confused about what Wi-Fi 6 is and how it improves upon older Wi-Fi standards, especially with the coming release of 5G wireless technology at roughly the same time. It would make sense that these two new technologies are somehow related, but that isn't the case. Both promise similar improvements to wireless speed, range, and reliability, but they're distinctly different technologies.

What is Wi-Fi 6?

Wi-Fi 6 is the next evolution of wireless local area network (WLAN) technology. The name Wi-Fi 6 is part of a new naming convention the Wi-Fi Alliance imposed on Wi-Fi stand ards to make them more easily understood by Wi-Fi users, making it much like the 3G/4G/5G naming convention used by cellular data networks. The new designations have nothing to do with speed, bandwidth capabilities, or other technical benchmarks -they're purely generational.

Behind the Wi-Fi 6 name is the latest version of the 802.11 wireless networking standard: 802.11 ax. This new Wi Fi stand ard is reportedly up to 30% faster than Wi-Fi 5, but speed hasn't been the main benefit touted by the Wi-Fi Alliance and other industry experts; Wi-Fi 6 also brings lower latency, more simultaneously deliverable data, and improved power efficiency. In order to provide these changes, Wi-Fi 6 is improving on and introducing new technology.

Potential Applications

- IoT hardware will benefit from Wi-Fi 6 through improved battery performance, better outdoor operation, and improved range;
- Home Wi-Fi, which will be faster and more reliable thanks to increased throughput and superior coverage;
- stadiums and other public venues with Wi-Fi will see increased performance
- environments with multiple Access Points belonging to different networks (malls, airports, etc.) will have less signal interference to worry about thanks to transmit beam-forming.
- Wi-Fi 6 may also make wireless last-mile internet connections more plausible due to its superior speeds, ability to handle more users with less latency, and better outdoor performance.

Internet of Things Trending in 2021

The fourth wave of the Industry revolution is about being digitally empowered and driving new technologies and IT services across edge and cloud assets to drive productivity. These technologies include everything from advanced analytics, industrial Internet of Things (loT) platforms, artificial intelligence, and digital twins and serve the manufacturing sector's core needs. In the last few years, it has been observed that the Internet of Things has boomed. According to industry research, there will be 35 billion IoT devices installed globally by 2021 and 75.44 billion by 2025. Essentially, as a tech-driven network of connected devices, the IoT has the

potential to enable data sharing within the system better. Its ability to let machines and equipment to communicate will impact industries.

- The pandemic has significantly enhanced telemedicine resources, and 43.5% of people utilized telehealth facilities in April 2020.

Internet of Things Made Universal in Manufacturing

Due to the pandemic manufacturing industry and other environments with costly machinery have experienced the virtues of remote monitoring first-hand. Remote tracking of machinery has undergone a trial in the post-pandemic era, and many organizations have now embraced these capabilities.

With the help of IoT driven technology, manufacturers and pharmaceutical businesses were able to connect industrial assets this year to remote operations, ensuring business as usual during the pandemic period. The benefits and positive impact promise significant investments flowing in IoT in 2021, according to industry reports.

Connected Devices in Healthcare

The pandemic has significantly enhanced telemedicine resources, and 43.5% of people utilized telehealth facilities in April 2020. One of telemedicine's significant benefits is that it reduces contact between patients, healthcare workers, and other patients. IoT devices help medical workers to have real-time information on patient data while they remain at home.

In coming years there will be a greater need to use connected healthcare solutions to manage illnesses and monitor health. Telemedicine is expected to continue even after the pandemic is over. According to industry experts, there will also be greater interest in digital health devices among consumers due to convivence and more affordable prices, and the technology will grow $185.6 billion by 2026.

Internet of Behaviour

IoB captures the "digital information" of people's lives from various sources, and public or private entities can use that information to influence behaviour. The COVID-19 changed the way many organisations think. Work-from-home and social distancing are the new normal for everyone and staying healthy is one of the topmost concerns. So, we expect to see more IoT technologies in the field that monitors behaviour in various ways to enforce health and safety guidelines. Organisations are taking advantage of technology to monitor consumer and customer behaviours.

Some of the useful technological tools here include location tracking, big data, and facial recognition. The Internet of Behaviours (IoB) can be perceived as a people-centric approach to the IoT. This trend highlights the importance of keeping the customers at the center of each organisational strategy to succeed in the long term.

The Digital Divide

The digital divide refers to the gap between demographics and regions that have access to modern information and communications technology (ICT), and those that don't or have restricted access. This technology can include the telephone, television, personal computers and internet connectivity.

The digital divide typically exists between those in urban areas and those in rural areas; between the educated and the uneducated; between socioeconomic groups; and, globally, between the more and less industrially developing countries.

Even among populations with some access to technology, the digital divide can be evident in the form of lower-performance computers, lower-speed wireless connections, lower-priced internet use connections such as dial-up and limited access to subscription-based content.

The digital divide in developing countries includes a lack of access to digital technology and internet service. It can also include a lack of accessibility to modern, high-quality new technologies such as mobile phones and Wi-Fi access. Bridging the Digital Divide Proponents for bridging the digital divide include those who argue it would improve digital literacy, digital skills democracy, social mobility, economic equality and economic growth.

The UN, for example, has helped to raise awareness regarding the global digital divide through the yearly celebration of World Information Society Day. It has also created the Information and Communication Technologies Task Force in an effort to bridge the global digital divide. However, overcoming the digital divide has not gotten easier, particularly in the aftermath of the COVID-19 pandemic.

India Digital Divide

India's digital divide has further deepened because COVID-19 pandemic.

- The nation has the second-largest internet user base in the world with more than 630 million sub scribers. It also has the lowest mobile data prices offered anywhere. Despite this, for every Indian citizen with an internet sub scription,

there is a citizen in a rural area who lacks one. Considering 66% of the population lives in rural areas, there is a sizeable percentage of the country's people living in regions where internet access is minimal.

- Marginalised and vulnerable communities, esp., those living in poverty, could benefit the most from the connectivity and opportunities digital technology provides. By closing the gap in digital access between rural and urban communities in India, the nation will be able to develop and progress more efficiently as a whole. Digital Access as an Equalizer Digital inclusion is essential in the post-pandemic scenario as the "new normal" becomes more digital than ever. Today, meetings, social events and other large gatherings are moving to online alternatives to practice social distancing and reduce the risk of spreading illness. However, for the many people in India who do not have access to stable internet connections, life is put on standby. As a result, these individuals fall behind as society resumes life online.

Prior to the pandemic, only 23.8% of households across the country had access to the internet. Additionally, there is a wide divide in access between urban and rural households. Of the 66% of India's population that resides in rural communities, only 14.9% have internet access compared to 42% of urban households.

Gender Inequality in India India's digital divide between rural and urban regions contributes to social gender inequality in the society. »36% of Indian males have mobile internet access compared to only 16% of females. This inequality of digital access across genders creates greater dependence on men for women who often rely financially on their spouses in the Indian family context. These women don't afford a device on their own. As the male head of the family is often the only member to possess a digital device, women rely on their spouses to have internet connectivity. This limits what and for how long they may use these devices. Some villages even limit women's use of mobile phones, further hindering their connectivity to social media and educational resources and information. This diminishes women's overall digital empowerment and independence. By limiting women's freedom to use the internet, these villages also restrict the possibility of individual growth and evolution of perspective by blocking access to the digital global network.

Geographical Divide Even geographical differences lead to disparities in internet access'. Himachal Pradesh is a remote, mountainous region in the Himalayas and the sparsely populated deserts of Rajasthan are two territories that face higher levels of digital exclusion. Residents of these areas are mostly tribal communities who already experience marginalisation from the rest of Indian society. Therefore a lack of internet access bolsters already existing challenges for these communities. Evidently,

the digital divide deepens several other partitions across the societal fabric. In addressing the digital divide, many other related issues would also be resolved.

Divide in Educational Attainment India has the largest student body in the world with 315 million students, this leaves the country with a large amount of responsibility in maintaining education for all students during pandemic-driven school closures. Currently, the COVID-19 outbreak has exposed and expanded the divide between private and government educational institutions.

Private schools in India had less of a challenge transitioning to online learning since the more affluent student population is more likely to have consistent internet access and mobile devices available at home. In comparison, government institutions lack similar access to e-learning solutions. Additionally, the students who attend government-funded schools are more likely to experience inconsistent electricity, poor internet connection or inhospitable housing conditions that prohibit online learning.

The differences in operations between the two institutional groups will result in students receiving different educations during lockdown conditions. This is especially concerning for students enrolled in government schooling as there is increased reliability on parents to continue educating students independently despite potentially lacking the time, resources or intellect. Furthermore, these students will face greater difficulty than their peers at private institutions in finally resuming regular schooling after a long gap.

Closing the Digital Divide The digital divide in India is challenging the nation's current educational methods across its entire student body. The digital divide in India must be addressed and rectified. • Digital connectivity is more necessary than ever before in guaranteeing that students can sustain their studies while schools remain physically closed.

•For starters, an increased financial stimulus for education is necessary to allow greater access to online resources for children who may not have any. This way, schools can rely on and distribute their own digital resources for at-home learning instead of depending on students to have mobile devices at home. Further-more, this will provide essential funding to education in India, which already received low government expenditure.

Addressing rising healthcare prices could also help diminish the digital divide in India. Increasing costs push millions of Indians into poverty each year for basic healthcare; this reduces available funds for non-essential spending, including internet subscriptions or mobile devices.

Big Data

Big Data is huge dataset generated at a source (like space rocket launch, nuclear test, super online sales) which can't be managed by traditional RDBMS systems. All social media platforms, Telecom and health care industries deals with huge data usually in petabytes (1024 terabytes or 1 million gigabytes). Data has variety (structure, semi-structured), which flows at high speed. Big Data frame works are designed with concept of distribution of data to handle Big data characters such as 1. Volume (storage space); 2. Velocity (Processing speed-high speed of data accumulation); 3. Verity (structured, semi-structured and unstructured data); 4. Veracity (extracting required data -inconsistencies & uncertainty 5. Value (extract useful data).

Artificial Intelligence

Artificial Intelligence is the science and engineering of making intelligent machines, esp. intelligent computer programs.

What AI Aims

- To Create Expert Systems-The systems which exhibit intelligent behavior, learn, demonstrate, explain, and advice its users.
- To Implement Human Intelligence in Machines-Creating systems that understand, think, learn, and behave like humans.
- **AI Domain** : Strategy Gaming (chess), where machine can think of options).
- Natural Language Processing-to understand natural human language
- Expert Systems- (provide explanation and advice to the users).
- Vision Systems-used by doctors to diagnose or Police to identify criminals
- Speech Recognition« writing Recognition
- Intelligent Robots

Space Initiatives

Heavy Lift Vehicles

To attain total self-reliance in the launch of heavy satellites, weighing above 4 tonnes, and to meet future demands, the ISRO is working on a fleet of five new rockets. The new fleet of rockets are similar to the existing SSLV, PSLV and GSLV and GSLV Mk3 rockets, but they would be powered by more capable, powerful and technologically advanced engines. Presently, India pays and utilises the services of Ariane-5, a foreign rocket, to launch satellites that weigh over 4 tonnes.

This new fleet of heavy-lift rockets would place a payload weighing anywhere between 4.9 tonnes and over 16 tonnes in the Geo synchronous Transfer Orbit (GTO) - an enormous improvement over GSLV Mk3 rocket's 4-ton capability. GTO is an intermediary orbit, 180km at its closest point and 36,000km at its farthest point from the Earth, into which heavy satellites are launched by rockets. After being placed in GTO, the satellites use their onboard propulsion to reach a circular orbit 36,000 km above the earth (equal distance from the earth at any given point of time). Being in the 36,000km circular orbit (Geostationary orbit) allows for communication and monitoring of a large portion of the Earth. Three satellites in GSO orbit are capable of covering nearly the entire globe.

Upgrade

The upgradation of lift capability of GSLV Mk3 to 7.5 tonnes to GTO, is complete. This major upgrade is made possible by the development of two rocket engines: (a) semi-cryogenic engine that burns a special variant of kerosene (dubbed ISRO sene) and liquid oxygen; (b) cryogenic engine that burns a mixture of liquid hydrogen and liquid oxygen. The semi-cryogenic engine stage is dubbed as the SC120, and the upgraded cryogenicengine stage is dubbed as the C32. As per ISRO's naming convention for rocket stages, the letter refers to the type of engine fuel-Solid (S), Liquid (L), Semi-cryogenic(SC) and Cryogenic(C) and the accompanying number refers to the mass (in tonnes) of propellant carried. Simply put, a rocket is a combination of multiple engines (stages) that are vertically stacked. The stage will soon be inducted into the rocket, so that India do not have to depend on foreign sources for the launch of heavy communication satellites (weighing over 4 or 5 tonnes).

The configuration of the fleet of five heavy-lift rockets have more powerful rocket stages-SC400 semi-cryogenic stage, the C27 cryogenic stage, and S250 solid rocket booster. Depending on the type of mission, payload to be lifted and rocket required, different variants of engines would be stacked vertically to run a relay race to space. Each stage would detach from the rocket after propelling the rocket to a certain

altitude and speed, then the next engine would take over. This process goes on until the satellite (payload) reaches its final orbital destination.

In terms of materials, ISRO is developing carbon-carbon composites, ceramic matrix composite for reusable vehicles, metal-foams for crash landing interplanetary probes, besides crucial components such as solar panels, fibre optics Atomic clocks, deployable antennas, lithium-ion batteries, Application-Specific Integrated Circuits and Micro Electro Mechanical System Devices.

PSLV XL:

- Height: 44m "Stages: 4
- 'Lift-off weight: 320 tonnes
- Pay-load mass: 1860kg
- Orbit:475km Sun Synchronous Polar Orbit; 1300kg in GTO.
- Propulsion: Solid & liquid* 1st Launch: 20 Sept 1993. Notable: Chandrayaan-1, Mangalyaan, IRS.

GSLV-III

- Height: 43.43m
- Stages: 3
- Lift-off weight: 640 tonnes
- Payload mass: GTO-4000 kg; LEO-10,000 kg
- Orbit: GTO.
- Propulsion: solid, liquid, Cryogenic 1st Launch: 18 Dec 2014 (suborbital); 5 Jun 2017 (Orbital). Notable CARE, Chandrayaan-2.

Gaganyaan

Gaganyaan (Sanskrit for SkyCraft), a hugely complex mission to send Indian astronauts to space, is in the making.

ISRO successfully completed a crucial test, Gaganyaan Service Module Propulsion System - System Demonstration Model (SDM), of the Gaganyaan spacecraft's propulsion system, which would help Indian astronauts remain in orbit and also aid their safe return. The expendable rocket's task ends about 16-20 minutes after lift-off and it falls back into the sea (in a phased manner), after ejecting the satellite.

Once placed into orbit, the satellite/spacecraft is an independent entity in space that needs to navigate and propel itself, without the powerful propulsion of the rocket tli.it got it up there. The payload (satellite are the module carrying astronauts) must

stay hum bit for a designated mission tune, while enduring the harsh conditions of zero gravity, severe temperature variations, and i nblt.il movement at very high speeds for example, the International Space Station, which continues to orbit the earth, moves at a whopping 7km/second (27,850km/hour).

While satellites stay in orbit for many years, India's Gaganyaan mission would remain in orbit for up to a week in a designated orbit - requiring use of the spacecraft's own engines. The GSLV Mk3, India's heaviest rocket, is meant to carry the 7.5ton Gaganyaan module into a orbit 170kms from earth and 400kms from earth at its nearest and farthest points in orbit respectively. Thereafter, the Gaganyaan module will be raised to a uniform 400kms low-earth-orbit. Similarly, the same propulsion system would be used to lower the orbit and bring the spacecraft closer to the earth to aid re-entry.

The Gaganyaan integrated module consists of two parts - Crew Module and Service Module. While the crew module will house astronauts, the service module will provide the propulsion to raise the orbit and later lower the orbit. To slow down the spacecraft (travelling at 7.5 kms per second) and facilitate re-entry, the five engines are fired on the service module. Once it re-enters earth's gravity, the service module detaches and the crew module alone makes a controlled descent, with its parachutes and crew module propulsion systems.

New Space India

It is a new Indian space consortium responsible for end-to-end realisation aims 12 numbers per year of solid and liquid fuel powered stages/engines of the rocket /PSLV, under new contract.

Lunar and Planetary Spacecraft

- Chandrayaan-1 «Chandrayaan-2 »Mars Orbiter Mission (MOM)
- MOM-2
- Chan-drayaan-3 & «Shukrayaan-1 (proposed) Crewed Mission 'Gaganyaan Facilities
- Indian Deep Space Network
- ISRO Satellite Centre
- Telemetry, Tracking and Command Network "Master Control Facility
- Satish Dhawan Space Centre
- Thumba Equatorial Rocket Launching Station
- Satellite Integration and Testing Establishment
- VSSC
- LPSC

- Propulsion Complex