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SCIENCE AND TECHNOLOGY

INDIAN SPACE PROGRAMME

The Indian Space Programme has two components in it.

Launch Vehicles

Launch Vehicles are used to transport and put satellites or spacecrafts into space. In India, the launch vehicles development programme began in the early 1970s. The first experimental Satellite Launch Vehicle (SLV-3) was developed in 1980. An augmented version of this, ASLV, was launched successfully in 1992. India has made trernendous strides in launch vehicle technology to achieve self-reliance in satellite launch vehicle programme with the operationalisation of Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV).

ISRO also makes the Rohini series of sounding rockets used by the Indian and international scientific community to launch payloads to various altitudes for atmospheric research and other scientific investigations. These rockets are also 'used' to qualify some of the critical systems used for advanced launch vehicles.

SLV-3: Satellite Launch Vehicle-3 (SLV-3), India's first experimental satellite launch vehicle was successfully launched on July 18, 1980 from SHAR Centre Sriharikota, when Rohini satellite, RS-1, was placed in orbit. SLV-3 was a 22 m long, all solid, four stage vehicle weighing 17 tonnes capable of 'placing 40 kg class payloads in low earth orbit.

It employed an open loop guidance (with stored pitch programme) to steer the vehicle in flight along pre- determined trajectory. The first experimental flight of SLV-3, in August 1979, was only partially successful. Apart from" the July 1980 launch, there were two more launches held in May '1981 and April 1983, orbiting Rohini satellites carrying remote sensing sensors.

ASLV: Augmented Satellite Launch Vehicle (ASLV) was developed to act as a low cost intermediate vehicle to demonstrate and validate critical technologies. With a lift off weight of 40 tonnes, the 23.8 m tall ASLV was configured as a five stage, all-solid propellant vehicle, with a mission of orbiting 150 kg .class satellites into 400 km circular orbits, The strap-on stage consisted of two identical 1m diameter solid propellant, motors, Under .the ASLV programme four developmental flights were conducted.

The first 'developmental, flight took place on March 24, 1987 and the, second on' July, 13, 1988" ASLV-D3 was , successfully launched on May 20, 1992, when SROSS-C_2 (106 kg) was put into an orbit of 255 x 430 km, ASLV-D4, launched on May 4, 1994, orbited SROSS-C_2 weighing 106 kg, It had two payloads, Gamma Ray Burst (GRB) Experiment and Retarding Potentio Analyser (RPA) and

functioned for seven· years, ASL V provided valuable inputs for further development

PSLV: The Polar Satellite. 'Launch Vehicle, usually known by its abbreviation PSLV is the first operational launch vehicle' of ISRO, PSLV is capable of launching 1600 kg satellites in 620 km sun-synchronous polar orbit and 1050 kg satellite in geo-synchronous transfer orbit In the standard configuration, it-measures 44.4, m tall, with a lift off weight of 295 tonnes. PSLV' has four stages using solid and liquid propulsion systems alternately, The first stage is one of the largest solid propellant boosters in the world and carries 139 tonnes of propellant A cluster of six strap-ons attached to the first stage motor, four of which are ignited on the ground and two are air-lit

The reliability rate of PSL V has been superb, With its varian! configurations, PSLV Has proved its multi-payload, multi-mission capability in a single launch and. its geosyn-chronous launch capability, In' the, Chandrayaan-mission, another variant of PSLV with an extended version of strap-on motors, PSOM-XL, the payload haul was enhanced to 1750 kg in 620 km SSPO, PSLV has rightfully earned the status of workhorse, launch vehicle of ISRO.

GSLV Mk I & II: Geosynchronous Satellite Launch Vehicle, (GSLV)-Mark I&II, is capable of placing INSAT-II ctassot satellites (2000 - 2,500 kg) into Geosynchronous Transfer Orbit ***(GTO),*** GSLV 'is a three stage vehicle GSLV is 49 m tall, with 414 t lift off weight It has a maximum diameter of 3.4 m at the payload fairing: First stage comprises S125 solid booster with four liquid (L40) strap-ons. Second stage (GS2) is liquid engine and the third stage (GS3) is a cryo- stage, The vehicle develops a lift off thrust of 6573 KN,

GSLV Mk III: The GSLV-III or Geosynchronous Satellite Launch Vehicle Mark III is a launch vehicle' currently under development by the Indian Space Research Organization, GSLV Mk III is conceived and desiqned to make ISRO fully self reliant in launching heavier communication satellites of INSAT-4 class, which weigh 4500 to 5000 kg, It would also .enhance the' capability of the country to be a competitive player in the multimillion dollar commercial launch market The vehicle envisages multi-mission launch capability for GTO, LEO, Polar and intermediate circular orbits.

GSLV-Mk III is'designed to be a three stage vehicle, with 42,4 m tall with a lift off weight of 630 tonnes. First stage comprises two identical S200 Large Solid Booster (LSB) with 200 tonne solid propellant, that are strapped on to the second stage, the L110 re-startable liquid stage. The third stage is the C25 LOX/LH2 cryo. stage, The large payload fairing measures' 5 m in diameter and can accommodate a payload volume of 100 cu m.

Satellites

Communication Satellites: Supports telecommunication, television broadcasting, satellite news gathering, societal applications, weather forecasting, disaster warning and Search and Rescue operation services.

Earth Observation Satellites:' The largest' civilian remote sensing satellite constellation in the world - thematic series of satellites supporting multitude of applications 'in the areas of land and water resources; cartography; and ocean & atmosphere.

Navigation Programme: Satellites foe navigation services to meet, the emerging demands of the Civil Aviation requirements and to meet the user requirements of' the positioning, navigation and timing based on the independent satellite navigation system.

Experimental Satellites: Spacecraft for research in areas like astronomy, astrophysics, planetary and earth sciences, atmospheric sciences 'and theoretical physics.

A host of small satellites mainly for the experimental purposes. These experiments include Remote Sensing, Atmospheric Studies, Payload Development, Orbit Controls, recovery technology etc.

Small Satellites: Sub 500 kg Class satellites - a, platform for' stand-alone payloads, for earth imaging and science missions within a quick turnaround time.

Student Satellites: ISRO's Student Satellite programme is envisaged to encourage various Universities and Institutions for the development of Nano / Pico Satellites.

NUCLEAR POWER PROGRAMME

India's three-stage nuclear power programme was formulated by Homi Bhabha in the 1950s to secure the country's long term' energy independence, through the use of uranium and thorium reserves found in the monazite sands of coastal regions of South India".

The ultimate focus of the programme is on enabling the thorium reserves of India to be utilised in meeting the country's energy requirements.

Thorium is particularly attractive for India, as it has only around 1-2% .of the global uranium reserves, but, one of the largest shares of global thorium reserves at 'about 25% of the world's known thorium reserves. However" thorium is not economically viable 'because, global uranium prices are much lower.

The Indian nuclear establishment estimates that the country could produce 500 GWe for at least four centuries using just the country's economically extractable thorium reserves.

Stage I - Pressurised Heavy Water Reactor

In the first stage' of the programme, natural uranium fuelled Pressurised Heavy Water f3eactors (PHWR) produce electricity while generating plutonium-239 as by-product. Natural uranium contains only 0.7% of the fissile isotope uranium-235. Most of the remaining '99.3%, is uranium-238 which is not fissile but can be converted in a reactor to the fissile isotope plutonium-239. Heavy water (Deuterium Oxide, DP) is used as moderator and coolant.

Stage II - Fast Breeder Reactor

In the second stage, Fast Breeder Reactors (FBRs) would use a Mixed Oxide (MOX) fuel made from plutonium-239, recovered by reprocessing spent fuel from the first stage, and natural uranium.

In FBRs, plutonium-239 underqoes fission to produce energy, while the uranium-238 present in the mixed oxide fuel transmutes .to additional plutonium-239.

Thus, the Stage II FBRs are designed to "breed" more fuel .than they consume.

Once the inventory of plutonium-239 is built up thorium can be introduced as a blanlfet material in the reactor and transmuted to' uranium-233 for use in the third stage.

The surplus' plutonium bred in each fast reactor can be used to set up more, such reactors, and might ***thus*** grow the Indian, civil nuclear power capacity till the' point where the third stage reactors using thorium as fuel can be brought online, which is forecasted as being possible once 50 GW of nuclear power capacity has been achieved.

The uranium in the first stage PHWRs that

yield 29 EJ of energy in the once-through fuel cycle' can be made to yield between 65, and,.128 times more energy through multiple cycles in fast 'breeder reactors.

Stage III - Thorium Based Reactors

A Stage III reactor or an advanced nuclear power system involves a self-sustaining series of, thorium-232-uranium-233 fuelled reactors.

This would be a thermal breeder reactor, which in principle can be refuelled - after its initial fuel charge using only naturally occurring thorium"

According to the three-stage 'programme, Indian nuclear energy could grow to about. 10 GW through PHWRs fuelled by domestic uranium, and the growth above that would 'have to come from FBRs· till about 50GW. The third stage is to be deployed only after this capacity has been achieved.

NATIONAL INTELLECTUAL PROPERTY RIGHTS POLICY'

Creativity and innovation have been a constant in growth arid development of any knowledge economy. There is an abundance of creative and innovative energies flowing in India. India has a TRIPS compliant, robust, equitable and dynamic IPR regime. An, all-encompassing IPR Policy will promote a holistic and, conducive ecosystem to catalyse 'the full potential of intellectual property for India's economic growth and socio-cultural development; while protecting public interest The rationale for the National IPR Policy lies in the need to create awareness about the importance of IPRs as a marketable financial' asset arid economic tool.

Vision Statement: An India where creativity and innovation are stimulated by Intellectual - Property for the benefit of all: an India where intellectual property promotes advancement in science and technology, arts and culture, traditional knowledge and biodiversity resources; an India where knowledge is 'the main driver of development, and knowledge owned is transformed into knowledge shared.

Mission Statement: Stimulate a dynamic, vibrant and balanced intellectual property rights system in India to:

- Foster creativity and innovation and thereby, promote entrepreneurship and enhance socio-economic and cultural development, and
- Focus on enhancing access to' healthcare, food security and environmental protection, among other sectors of vital social, economic and technological importance.

Objectives

1. IPR Awareness: Outreach and Promotion - To create public awareness about the economic, social and cultural benefits of IPRs among all sections of society
2. Generation of IPRs - To stimulate the generation of IPRs
3. Legal and Legislative Framework - To have strong and effective IPR raws, which balance. the interests of rights owners with larger public interest
4. Administration and Management - To modernize and strengthen service oriented IPR administration
5. Commercialization of IPR - Get value for IPRs through commercialization.
6. Enforcement and Adjudication - To strengthen the enforcement and adjudicatory mechanisms for combating IPR infrigements.
7. Human Capital Development- To strengthen and expand human resources, institutions and capacities for teaching, training, research and skill building in IPRs.

TECHNOLOGY VISION DOCUMENT 2035

At the congresss PM unveiled a 'Technology Vision Document 2035. The document foresees the Indians of 2035, and technologies required for fulfilling their neds. It is not a visualization of technologies that will be available in 2035, but a vision of where our country and its citizens should be in 2035 and how technology should bring this vision to fruition. The document was prepared by Technology Information, Forecasting and Assesment Council, (TIFAC), an autonomous body under Department of Science and Technology.

The 12 identified sectors of Vision Document are:

- Educaiton
- Medical Science and Healthcare
- Food and agriculture
- Water
- Energy
- Environment
- Habitat
- Transporation
- Infrastructure
- Manufacturing
- Materials
- Information and Communication Technolgoy

The document dwells upon the grand, "challenges in the field of Technologies which; it says, we should resolve as a nation. The challenges are:

- Guaranteeing nutritional security and eliminating female and" child 'anemia
- Ensuring quantity and quality of, water ,in, all rivers and aquatic bodies
- Providing learner, centric, language neutral Clod holistic education to all
- Developing commercially viable decentralized and distributed energy for all
- Making' India non-fossil fuel based
- Securing critical resources commensurate with the, size of our country
- Ensuring universal eco-friendly waste mangement
- Taking the railway to Leh and Tawng
- Understanding national climate patterns and adapting to them
- Ensuring location independent electoral and financial empowerment.

In order to overcome these challenges, the: Vision Document 2035' envisages a rational assessment of the capabilities, and constraints of the Indian Technological Landscape, It categorizes technologies into a six-fold classification from an Indian perspective which is as follows:

- Technology Leadership– niche technologies in which we have, core competencies, skilled manpower, infrastructure and a traditional knowledge base eg., Nuclear Energy, Space Science.
- Technology Independence - strategic technologies that we would have to develop on our own as they may not be obtainable from elsewhere eg., Defense sector.
- Technology Innovation - linking disparate technologies together or making a breakthrough in one technology and applying it to another ego, solar cells patterned on chlorophyll based synthetic pathway are a potent future source' of ,renewable energy.
- Technology Adoption - obtain technologies from else- where, modify them according to local needs and reduce dependence 'on other 'sources e.g., foreign collaboration 'in the 'sectors of rainwater harvesting agri-biotech, desalination, energy efficient buildings.
- Technology Constraints - areas where technology, is, ' threatening 'and problematic i.e.' having a negative" 'social for

environmental impact" because of serious legal and ethical issues eg., Generically Modified(GM) 'Crops.

NANOTECHNOLOGY APPLICATIONS

Nanotechnology is science, engineering and technology conducted at he nanoscale, which is about 100 nanometers.

Medicine

Researchers are developing customized nanoparticles the size of molecules that can deliver drugs directly to diseased cells in your body. When it's perfected, this method should greatly· reduce the damage treatment such as chemotherapy does to. a patient's healthy cells.

Electronics

Nanotechnology holds some answers for how we might increase the capabilities of electronics devices while we reduce their weight and power consumption.

Nanotechnology is having an .impact on several aspects of food science, from how food is grown to how it is packaged. Companies are developing nanomaterials that will make a difference not only in the. taste of food, but also in food safety, and the health, benefits that food delivers.

Fuel Cells

Nanotechnology is being used to reduce the ·cost of catalysts used in fuel cells to produce hydrogen ions from fuel such as methanol and to improve the efficiency of membranes used in fuel cells to separate hydrogen ions from other gases such as oxygen.

Solar Cells

Companies have developed nanotech solar cells that can be manufactured at significantly lower cost, than conventional solar cells.

Batteries

Companies, are currently developing: batteries using nanomaterials. One such battery will be a good as new after sitting on, the shelf Tor decades. Another, battery can be recharged significantly faster than conventional batteries.

Space

Nanotechnology may hold -the key to making space-flight more practical. Advancements in nonmaterial's make lightweight spacecraft and a cable for the' space elevator possible. By significantly reducing the amount of 'rocket fuel required, these advances could lower the cost of reaching orbit and travelling in space.

Fuels

Nanotechnology can address the shortage of fossil fuels such as diesel and gasoline by making the production of fuels from low grade raw materials economical, increasing the mileage of engines, ***and'*** making the production of fuels from normal raw materials more efficient.

Better Air Quality

Nanotechnology can improve the performance of catalysts used to transform vapours escaping from cars or industrial plants into harmless gasses. That's because catalysts made from nanoparticles have a greater surface area to interact with the reacting 'chemicals than catalysts made from larger particles. The larger surface area allows more chemicals to interact with the catalyst simultaneously, which makes the catalyst more effective.

Cleaner Water

Nanotechnology is being used to develop solutions to three very different problems in water quality. One challenge is the removal of industrial wastes, such as a cleaning solvent called TCE, from groundwater. Nanoparticies can be used to convert the contaminating chemical through a chemical reaction to make it harmless. Studies have shown that this method can be used successfully to reach contaminates disperses in underground ponds and at 'much lower cost than methods which require pumping the water' out of the ground for treatment.

Chemical Sensors

Nanotechnology can enable sensors to detect very small amounts of chemical vapours, various types of detecting elements, such as carbon nanotubes zinc oxide nanowires of palladium nanoparticles can be used in nanotechnology-based sensoers. Because of the small size of nanotubes, nanowires, ornanoparticles, a few gas molecules ar sufficient to change the electrical properties ofthe sensing elements. This allows the detection of a very low concentration of chemical vaours.

Sporting Goods

In Your's a tennis of golf fan, you'll be glad to hear that even sporting goods has wandered into the nano realm. Current nanotechnology applications in the sports arena include increasing the strength oftennis recquets, filling any imperfections in club shaft materials and reducing the reate at which air leaks from tennis balls.

Fabric

Making composite fabric with nano-sized particles or fibres allows improvement of fabric properties without a significant increase in weight, thickness, or stiffness as might have been the case with previously-sued techniques.

NANOPARTICLES

A nanoparticle (or. nanopowder or nanocluster or nanocrystal) is a microscopic particle with at least one of its dimensions less than 100 nanometres (nm), One nanometre is'- a billionth of a metre. Typically, a 'nano-particle would be about thousand times .srnaller than the tip of human hair.

Its properties

These materials· exhibit very. different properties, when they are reduced to nano-sizes. For exarnple.ia nanoparticle of gold does not have golden colour. It exhibits very different colours depending on the size of the particle in the nano-range. So a 4 nm gold particle has a different colour than a 50 nm or a 200 nm gold particle, and none of them is golden. Similarly, white gold, as we see it, melts at about 1100.degrees Celsius, while nanoparticles 'of gold can melt at 100 degrees Celsius.

At nano-sizes, particles also start exhibiting some quantum properties, like super-paramagnetism. Quantum properties are associated with sub-atomic particles like electrons or neutrons that behave very differently than objects of sizes that we are familiar with. Such special properties open up a variety of possibilities for use of known materials for novel. applications.

As of now, nanoparticles are created either by .breaking down larger normal sized materials to nano size, or by assembling atoms or molecules in building-block fashion to reach nano sizes. The reductionist approach involves chemical reactions. For example; .gold nano-particles can be synthesised by reacting gold chloride and sodium borohydride..

While both methods of synthesis of nanopartlcles work fine, neither of them produces

evenly-sized nano p~icles. Rather, randomly sized particles in the nano-ranqe are achieved. This is called polydisperse preparation.

Scientists' for long have been trying to develop methods that produce nanoparttcles of a specific size, or to achieve monodispersity.

To exhibit a specific property it becomes very. important to create a nanoparticle of uniferm size. A 'random mixture of all 'sixes will be of no use if we have to use a particular property of the particle.

Kishore Paknikar and his team from Agharkar research institute, Pune, achieved some success in developing uniform nanoparticles.

Nanoparticles prepared using chemical reactions lead to. polydisperse preparations. To achieve monodispersity the reaction parameters like temperature, rate of reaction, time, concentration of reactants etc. need to be very precisely controlled and monitored. But this is very difficult to achieve in normal reactions.

For the experiment the research team decided produce nanoparticles 6fchitosan, an' FDA-cleared biodeqradable and biocompatible natural polymen that is already being used as drug-delivery agent, for gene therapy and other processes, They used the reactant, chitosan, as micro-droplets.' With such confinement, they were able to control factors like temperature, rate of reaction, time etc.

This reaction did indeed produce nanoparticles of uniform size. And unlike normal reactions, which take, between 20 and 60 minutes to produce chitosan nano-particles, they were able to, produce .the nanoparticles in just seconds.

For the experiment, they designed and fabricated a micro-reactor .that can be operated in a continuous flow mode so that large quantities of monodisperse nanopal'ticles can be produced in a sequential manner. The cylindrical micro-reactor has an inlet channel and an outlet channel. The reactants are introduced in a continuous flow and nanoparticles are also synthesised continuously. Using this method, they have been able to produce chitosan nanoparticles of any size between 50 nm within an accuracy error of below 10 percent.

NANOSCALE DIODE

- The need for .more computing power is pushing the limitations of the present day methods 'and making researchers to, look for molecules with interesting. properties and find ways to establish reliable contacts between molecular' components and bulk materials in' an electrode, in order to mimic conventional electronic elements at the molecular scale.
- As a result scientists from University of Georgia; USA, have developed the world's tiniest diode, of nanoscale-, the size of a Single molecule - a breakthrough that may help develop molecular electronic devices.
- The nanoscale diode. (or molecular' rectifier), operates like a valve to facilitate electronic current flow in one direction. A collection of the these nanoscale diodes, or molecules, has properties that resemble traditional electronic. components such as a wire, transistor or rectifier.
- The emerging field of single molecule electronics may provide a way .to overc0"1e Moore's Law the observation that over the history of computing hardware the number of transistors in a dense integrated circuit has doubled approximately 'every two years - beyond the limits of conventional silicon integrated circuits.
- Researchers took a single DNA molecule' constructed from 11 base pairs and connected it to an 'electronic circuit only a few nanometres in size.

- When they measured the: current through the molecule, it did not show any special behavlour, However, when layers. of a molecule called "coralyne," were inserted (or intercalated) between layers of DNA, the behaviour of the circuit changed drastically.
- The current jumped to 15 times larger negative vs positive voltages a necessary feature for a nano diode.
- Researchers constructed a theoretical model of the DNA molecule inside the electric circuit, to better understand the results of tile experiment.
- The model allowed them, to identify the source of the diode-like feature, which originated from breaking spatial symmetry inside the DNA molecule after coralyne was inserted.

CASPOL: THE SPINOFF MATERIAL FROM VSSC

Ceramic-polymer hybrid (CAPSOL), a spin-off product could protect public transport systems and poor men residing in thatched homes from fire accidents. The technology was developed by the scientists of the Vikram Sarabai Space Centre (VSSC), Thiruvanathapuram. It protects rockets launch vehicles from high-temperature fire.

Caspol is a indigenously developed, easy-to-use flame-proof coating, from the '(SSC stable, The water-based ready-to-coat product was originally developed to protect the rockets from high temperature and fire to which they are exposed during the initial moments of launch. It can withstand up to 800 degree Celsius. Caspol is eco-friendly as it is free of toxic materials.

Uses

- Seats in automobiles, public transport system and seat cushions of railway coaches cal'\' be made fireproof when Caspol is applied.
- The ceramic-polymer hybrid will affect the cushioning characteristics significantly Qf seats once it is applied.
- Besides its ability to protect against fire and high temperature, Caspol can also make surfaces waterproof.
- When applied over the concrete surface of buildings, fill up the micro cracks and holes on concrete to' prevent water from seeping in.
- When applied over concrete surface of buildings, the: high emissivity of the product reduces the temperature inside the building by at least 5 to 6 degree Celsius.
- It can be used on a variety of substrates such as masonry surfaces, textiles, paper, thatched leaves and wood to advanced materials like polyurethane and phenolic-based thermal insulation foam pads.
- It could be applied .either by brushing or spraying on the desired surface.
- The economic, water-based formulation with self-extinguishing properties could cure in room temperature and has good adhesion and 'water repellent characteristics.
- The materials coated with. Caspol will be' self-extinguished within four seconds after removal of flame. It can adhere well with the substrate surface both in dry condition and after exposing the coated foams to water. Foam materials can be impregnated with Caspol by dip coating.
- Technology transfer is yet to be commenced.

SILICA AERO GEL

- Researchers of the Indian Space Research Organization at its Vikram Sarabhai Space Centre, (VSSCL), Thiruvanathapuram had developed a near-invisible silica gel that would serve as a thermal 'barrier in cryogenic fuel tanks, boot soles and sun films.

- The hydrophobic silica aero gel has low thermal conductivity and density and high specific surface area and can be applied on any surface.
- With its "exotic properties," silica aero gels have many unique thermal, optical, acoustic, catalytic and chemical applications and are best known for their "super-insulating property."
- According to VSSC, Silica aero gels can be made in chunks (granular), beads, powder and tape or sheet form, and may be used as the application demands.
- As air fils the gel up to 95 per cent of its size, it comes as super lightweight material.
- The air molucules trapped inside the gel would act as insulators, and its heat conductivity is close to zero.
- They could be used for coating the windows of houses and vehicles as they would let in 95 per cent of the light that falls on th surface and fully deflect the heat.
- As the gel acts as a thermal barrier, it could be used as a protective component of clothes and boots of soldiers stationed in extremely cold regions such as Siachen and Kargil.
- The weight of military clothes could be brought down 'to ordinary dresses after applying' the gel over it thus giving the much required freedom of movement for the soldiers.
- To coat a jacket may require around 500 grams of gel.

Its other applications Include:

- Heavy duty dresses' used by researchers working in Arctic/Antarctic expeditions.
- Acoustic insulations
- Building and pipeline Insulation and window facades as translucent panels which allow natural light but not heat for hot areas where air conditioners are and trapping heat in cold places
- For controlling oil spills and vibration
- Acoustic damping materials andinsulation in refigerators
- Fillers or additives in paints
- Sealants, adhesives, coment, coatings, foams, and for increasing the heat resistance of the material etc.
- ISRO has already offered the knowhow of the technology to suitable entrepreneurs in India and the benefits from the transfer of technology would go to the country.

SYN3.0 - TINIEST LIFE FORM

- A breakthrough development had occurred in synthetic biology when genomics pioneer Craig Venter and more than 20 colleagues had engineered a living microbe with a genome simpler than any seen in nature.
- In other words, they created a life form whose relative simplicity and modular design make it a platform that one day may be as easily manipulated as. say, software,
- The breakthrough may hold promise for -new applications - from medicine to biochemicals, biofuels, nutrition, and agriculture.
- Ultimately, the group wants to understand the tiny genetic framework well enough to use it as a biological foundation for more' complex organisms that could address many of the world ills.
- Once each essential gene's function is identified, scientists can build an effective computer model of it, from there, they can simulate how best to go about adding pathways for the production of useful products.
- Scientists have long theorized how many genes might be required for a simple, viable organism that could be used as a universal template.

- Many studies have tried to estimate the rock-bottom number by knocking out individual genes; they have settled on 250 to 300 or so.
- The original bacteria species that the group worked on is already pretty tiny: M; mycoldes is found' in cow stomachs and has about 985 genes.
- The human genol11e has more than 20,000 genes. Golden Delicious apples have more than 57,000 genes. The new organism, nicknamed Syn3.0. by researchers has 473.
- Using the sacterta M. mycoides, scientists started to. determine. which genes the organism needed.
- For the group' a particularly time-consuming process were lessons in' how different genes work together.
- One gene might seem nonessential-until removing a companion proved it indispensable.
- It is like losing an engine on a 777: The plane can still fly, unless you lose the second one. Redundancy, it turns out, is essential to survival.
- · The.new accomplishment, may not, instantaneously transform synthetic biology. For one thing, it's hard.
- Venter may have difficulty getting other researchers to build off his work, a time-honoured way of advancing discovery.
- While others have made progress tinkering with yeast and E. coli genomes, the advent of easy-to-use gene editing technology may make the laborious rewriting of entire genomes, as Venter has, done, less appealing.

GERMLINE EDITING

- A green translucent test tube, with a baby floating in it, is a rather literal interpretation of the test tube baby, and perhaps also a celebration of 'humankind's triumph over infertility.
- Through IVF, cells from embryos are being screened tor specific genetic disorders. The genetically defective ones are eliminated. In principle, we can erase an inherited genetic disorder from a single generation of family.
- Now, the scientific community has the technology that can, in principle, be developed to make specific and targeted genetic' alterations in embryos, which Will be ..: carried by all the cells of a resulting child and passed on to his/her offspring, a part of the human' gene pool. In scientific jargon, it's called germline editing.
- World over, laboratories have been conducting experiments and altering the genome to get the required results.
- It is tempting to imagine permanently erasing of say BRAC1, the breast-cancer causing gene from the human genome. But the risk is too high. We are not ready to play god.
- At the heart of the debate is a powerful gene-editing technology, CRI~PR-Cas9, which is relatively inexpensive, accessible and effective.
- It brings the idea of designing a perfect human who is healthy and intelligent many, steps closer to becoming a reality.
- But even if we do develop more accurate ways to edit our DNA, we do not, have the means to predict the kind of damage that we could be causing.
- With germ line editing, the consequences would be felt for generations.

GENOME PROJECT-WRITE (HGP-WRITE)

A group of scientific, business and policy leaders announced their intent to launch The Genome Project-write (HGP-write) in 2016.

The goal of HGP-write

- To reduce the costs of engineering and testing large genomes, including a human genome, in cell lines, more than 1,000-fold within ten years, while developing new technologies and an ethical framework for genome-scale engineering as well as transformative medical applications.
- The overarching goal of this effort is to understand the blueprint of life provided by the Human Genome Project (HGP-read).
- The goal is to launch HGP-write in 2016 with $100 million in committed support from public, private, philanthropic, industry, and academic sources globally.
- HGP-write will be implemented through a new, independent non-profit orqanization, the Center of Excellence for' Engineering Biology.
- GP-write will build on the knowledge gained by The Human Genome Project' (HGP-read), biology's first large-scale project that has sparked scientific and medical transformation, especially in genomic-based discovery, diagnostics" and therapeutics. Whereas HGP-read "read" DNA to understand its code, HGP-write will use the cellular machinery provided by nature to "write" code, constructing vast DNA chains.

Hence, the new effort is expected to lead to a massive amount of information connecting the sequence of nucleotide basesin DNA with their physiological properties and functions. As a result, HGP-write promises to have a significance impact on human health and other critical areas such as energy, agriculture, chemicals, and bioremediation.

STEM CELL THERAPY

Haematopoietic "stem" cells a special type of cells present in the bone marrow, the soft tissue inside bones. These cells have the potential to develop into any kind of cells based on physiological tiggers for differentation.

- They may be used in the treatment of many difficult-to-treat disease including cancers, and disorder of the blood and the immune system.
- Skin stem cells have for long been used to grow skin grafts where large parts of the body have been burnt. However, it remains very specialised form of treatment.
- In planning stem cell therapy, proteins present on white blood cells, called human leukocyte antigens (HLA), are matched.
- If HLA is not matched, healthy cells from the transplant could attack the host cells - a condition known as "graft versus host disease", or GVHD.
- The closest HLA matches are usually between siblings, as humans get one half of their HLA from the mother and other half from the father. This means that a parent is half a match - and every sibling has a 25% chance of being a match.
- There may be unrelated matches too, which is where a stem cell donor registry comes in. In case no donor "is available, there is the option of cord- blood transplant, where stem cells from the umbilical cord may be used.
- In case of a relative, a haplotype mismatched transplant is also an option. In some conditions, autologous stem cells, that is, stem cells from the recipient may be used.
- There' is no conclusive proof of safety or therapeutic efficacy of stem cells in any condition yet. Unfortunately, some, clinicians have started exploiting hapless patients by offering unproven stem cell treatments prematurely,
- Such fraudulent practices need to be stopped urgently while' ensuring" that scientifically designed and responsible research on stem cells is not hindered.

- Stem cell therapy is allowed for haematological conditions like thalassaemia and sickle cell anaemia, and some forms, of blood-related cancers. However, all other applications are as per the government's position; trials need all the necessary clearances for a clinical trial and, in case it is being marketed, also a nod from the Drug Controller General of India.

TARGETFINDER

- It is a new technology to understand genome.
- The novel technology allows the scientists to read and interpret the human genome. The breakthrough has the potential to form new drug targets to treat many genetic diseases.
- TargetFinder, a computational methodology, can predict. where non-coding DNA or the DNA that does not code for proteins - interacts with genes., This technology helps researchers connect mutations in the so-called genomic "dark matter" with the genes they attect potentially. showing new therapeutic targets for genetic disorders.
- Researchers' at the Gladstone Institutes in U.S. looked at fragments of non-coding DNA called enhancers. Enhancers act like an instruction manual for a gene, dictating when and where a gene is turned on. Most genetic mutations that are associated with disease occur in, enhancers.
- Genes can be separated from their enhancers by long stretches of DNA that contain many other genes.
- Previously scientists struggled to understand how enhancers find the distant genes they act upon.
- Scientists originally believed that enhancers mostly affect the gene nearest to them. The new' study showed that, on a strand of DNA, enhancers can be millions of letters away from the gene they influence, skipping over the genes in between.
- When an enhancer is far away from the gene it affects, they connect by forming a three-dimensional loop. Using machine learning technology, the researchers analysed hundreds of existing datasets from six different cell types to. look for patterns in the genome that identify where a gene and enhancer interact.
- They discovered several patterns that exist on the loops that connect enhancers to genes. This pattern accurately predicted whether a gene-enhancer interaction occurred 85 per cent of the time.
- The new computational approach is a much cheaper and less' time-consuming way to identify gene-enhancer connections in the genome. The technology also provides insight into how DNA loops form and how they might break in disease.

GOS FOR GM PULSES

- · A 'Group of Secretaries (GoS) on "Farmer Centric Issues in Agriculture and Allied Sectors' - one of the eight constituted to deliberate on "important themes" following a meeting called by Prime Minister Narendra Modi on December 31st 2015 - had' recommended "promotion and time-bound deregulation" in the case of two transgenic insect pest-resistant pulses.
- The first one is a GM chickpea (chana) developed by Assam Agricultural University, Jorhat. This transgenic crop, incorporating two genes (Cry1Ac and Cry2Aa) isolated from the Bacillus thuringiensis or Bt soil bacterium, is claimed to be resistant to the pod borer insect pest.
- In the greenhouse trials / field trials the technology had shown' a yield gain of 20-25% by... minimising pod borer damage.

Apart from this yield increase, reduction in cost of chemical pesticides application by 50% would add to the profitability of the farmer.

- The second GM crop is a pigeon-pea (arhar) developed by the Interactional Crops Research Institute for Semi-Arid Tropics (ICRISAT) near Hyderabad. Containing a synthetic Bt Cry1Ab gene, it is resistant to the same Iegume pod borer, whose larvae feed on both arhar and chana.
- The commercialization of the crops was suggested by the GoS citing India's growing dependence on pulses imports.
- In 2014-15, the country's pulses Imports of 4.58 million tonnes (mt) were valued at $2.79 billion. In the cur current fiscal, imports have already touched 4.41 mt for the April-December period, entailing a foreign exchange outgo of $2.96 billion.
- The GoS report has estimated that the GM chickpea technology can potentially increase domestic production by 2 mt, just as ICRISAT's Bt pigeon pea can reduce imports by another 0.75 mt.
- India's total pulses production peaked at 19.25 mt in 2013-14, before falling to 17.15 mt in 2014-15 and an estimated 17.33 mt this year.
- The group had also backed the suggestion to set up an Office of Biotechnology Regulations (OBR) to strengthen the regulatory mechanism and proposed the establishment of Crop Genetic Enhancement Network (CG Net) to access gl09al knowledge in integrated molecular research and advanced breeding practices and use these to improve productivity of crops.
- The important crops to be targeted by the CG Net initially would include black gram, green gram, mustard, groundnuts, pigeon pea, chickpea, finger millet, wheat and rice.

GN GENOME SEQUENCED

- A research team at International Peanut Genome Initiative (IPGI) led by University of Georgia (the US) completed sequencing of the ancestral genomes of peanut (also called groundnut (GN)).
- The cracking of protein and oil rich peanut genome means opening avenues for agriculture researchers to come out with better varieties.
- The crop is grown in an extent of about 25.70 million hectares, with an estimated production of 42 million tonnes.
- It is central to the financial and nutritional well-being of millions of farmers and consumers across the semi-arid tropics of Asia and sub-Saharan Africa.
- To map the peanut's genome structure, IPGI researchers sequenced the two ancestral parents, because together they represent the cultivated peanut.
- Promises accelerated gene discovery and development of improved peanut with enhanced pod and oil yield, greater disease resistance, drought and heat tolerance and oil quality.
- The new peanut genome sequence will be available to researchers and plant breeders across the globe 'to aid in, the breeding of more productive peanut varieties.
- Will help peanut farmers to tackle the emerging challenges of climate change better.
- Genome map can be used to harness genetic diversity by broadening the genetic base of cultivated peanut gene pool.
- "The researchers traced the roots of the original wild genomes of Arachis duranensis (V14167, A-genome ancestor) and A. lpaensis (K30076, B-genome ancestor) to a wild plant from Bolivia, which is considered to be a living relic of 'the prehistoric origins of the cultivated

peanut Specie," ICRISAT (International Crops Research Institute for Semi-Arid Tropics) had said in a statement.

- Comparisons of the DNA sequences of one of the wild species and the cultivated peanut showed that they are almost exactly the same; in fact, they are 99.96 per cent identical. It's an unprecedented similarity.
- The International Peanut Genome Initiative (IPGI) is a multi-national group of crop geneticists working in cooperation for several years with 39 scientists from 26 organisations in six countries along with the Hyderabad-based ICRISAT.
- ICRISAT was involved in project planning defining the strategy and also contributed to data analysis for the discovery.

Significance to India

- India is the second largest producer of groundnut in the world. In India it is grown mostly under-rain-fed conditions.
- It is a major oil seed and helps plug the vegetable oil deficit of the country. The genome map helps our scientists to develop new groundnut varieties that raises yields and reduces the vegetable oil import bill.

Major Growing States

- Gujarat,' Andhra Pradesh, Tamil' Nadu, Karnataka, Maharashtra, Rajasthan, Madhya Pradesh, Orissa, and Uttar Pradesh.

GM MUSTARD

- A team of scientists at Delhi University led by former vice-chancelloer Deepak Pental has bred DMH-11, a genetically modified (GM) mustard hybrid.
- Hybrids are normally obtained by crossing', two genetically diverse plants from the same species.
- The first-generation offspring resulting from it has higher yields than what either of the parents is. Individually capable of giving. But there is no natural hybridization system in mustard, unlike in, says cotton, maize or tomato.
- · This is because' its flowers contain both the female (pistil) and male (stamen) reproductive organs, making the plant naturally self-pollinating.
- To the extent that the egg cells of one plant cannot be fertilized, by the pollen discharged' from the stamen of another, it restricts the Scope for developing hybrids.
- What Pental's team, has done is create a, viable hybridization system in mustarc using GM technology.
- The resulting GM mustard hybrid, it is claimed; gives 25-30 per cent more yield than the best varieties such as 'Varuna' currently grown in the country.
- Hybrid technology is a potential technique to boost yields, as has been successfully demonstrated in a host of crops.
- Hybrid mustard has been created using' GM technology" involving incorporation of alien genes.
- Pental's team has used a "Barnase" gene isolated from a soil bacterium called Bacillus amyloliquefaciens.
- It codes for a protein that impairs pollen production and renders the plant into which it has been introduced male-sterile.
- This male-sterile plant is crossed with a fertile parental line, containing, in turn, another gene; "Barstar" from the same bacterium that blocks the 'action of the "Barnase" gene.
- The resultant progeny, having both the foreign genes, is a hybrid mustard plant that is not only high-yielding, but also fertile and capable of producing ,seed / grain (thanks to the "Barstar" gene ,in the second fertile line).

- With the country's own annual edible oil production stuck at below 7.5 million tonnes, of Which mustard's share is roughly a quarter, the need is to raise domestic crop yields and cut dependence on imports.

AN INDIGENIZED GYROTON

- A global effort is underway to produce electricity through nuclear fusion, in which' nuclei of two small atoms are fused to release a massive amount of energy. It is a process similar to the release of energy in the sun. Our current nuclear power plants use the fission process, in which the nucleus of a large atom is broke", to produce energy. A fusion reactor though, is about 20-30 years away from reality.
- For nuclear fusion, India would' need gyrotrons. Crucial devices in fusion reaction, gyrotrons produce very 'high-energy, high-frequency microwaves which are used for generating the plasma.
- Gyrotrons have been used in the past few decades for other industrial and scientific applications
- However, India has never build gyrotrons. The country has only three gyrotrones – all have been imported and are being used at the Institute for Plasma Research, Gandhinagar.
- · In 2006, the Department of Science, and Technology sanctioned a multi-institutional research project. to develop the design and technology for an Indian gyrotron. '
- The project was given to the CSIR-CEERI (Council of Scientific and Industrial Research-Central Electronics Engineering Research Institute) in collaboration with other institutes.
- The CSIR-CEERI is currently working on gyrotrons that can produce up t01 MW power, something that has not been achieved till now, and, frequency levels in terahertz (1012) region for various applications such as plasma research, fusion power, surveillance, quality growth and assurance of material, etc. under various government-funded projects.
- India had to start 'from the drawing board' as countries that manufacture gyfotrons the United States, Russia, Japan, European Union, etc don't disclose their designs or technology. We have some experience of having used imported gyratons for high-temperature plasma generation research,
- India is an, important member of the global effort to build an International Thermoriuclear Experimental Reactor (ITER) in France.
- If the global thermonuclear experiment succeeds, India can build fusion reactors, around 2040.
- Fusion reactors would be more efficient and produce several times more energy than the current fission reactors with no radioactive hazardous effect as well.
- The development of the first Indian gyrotron is now complete and it is ready to, be tested.
- The testing will happen later this year (read 2016) at the Institute' for Plasma Research, Gandhinagar, which is a partner institute' on' this project.
- This will help India to become power efficient nation and will serve the purpose' of "Electricity for all".

MADE IN CHINA: AN 'ARTIFICAL SUN'

Scientists at Hefei Institute' of Physical 'Science 'in China have moved a step closer to creating an 'artificial Sun' through nuclear fusion, a 'breakthrough, they claim, can end our energy woes and reliance on fossil fuels.

What is Nuclear Fusion?

- It is a reaction in which two or more atomic nuclei collide at a very high speed and join to form a new nucleus, in the process releasing a vast amount of energy:
- It is this energy that scientists have been trying to harness since 1905, when Albert Einstein derived the equation E=mc2.
- The Sun, with a core temperature of 15 million degrees Celsius, generates its energy from a similar reaction.
- Nuclear fission on the other hand relies on splitting of atoms, usually uranium, to produce energy.
- Scientists at the Hefei Institute of Physical, Science produced hydrogen gas more than three times hotter than the core of the Sun.
- They did this inside the Experimental Advanced Superconducting Tokamak (EAST) fusion device, also referred to as the 'Artificial Sun'.
- The scientists managed to maintain the extremely high temperature - 50 million 0C - for 102 seconds, a feat not achieved anywhere in the world yet.
- The scientists were aiming for 100 million Kelvins for over 1,000 seconds (nearly 17 minutes).
- They believe it will take another decade to generate enough sustainable renewable, energy through 'the nuclear fusion process.

Process

- Inside the EAST device, a large metallic' doughnut-shaped chamber, hydrogen isotopes (radioactive form of an element) 'deuterium' and 'tritium' are collided at high speeds to produce helium. This produces a large amount of energy, akin to almost a medium-scale 'thermonuclear explosion. The heat produced inside the EAST device is 8,600 times that of the Earth's core.
- The scientist carried out the, fusion using magnetic confinement one of the two branches of nuclear fusion— which involves the generation of power using magnetic fields.
- To keep the helium gas suspended in the fusion chamber the scientists created a magnetic field using superconducting coils fitted across the structure.

Hurdles

- While, theoretically, the set-up should work and in this case the temperatures could be sustained for 102 seconds, it will take a while for the core of a device to sustain the high temperatures for a long period of time.
- The costs involved in building commercial power plants, which have a core that can sustain the extremely high temperatures, are very high.
- The apparatus, and temperatures needed to ensure high-speed collision of nuclei are 'not 'easy 'to put together. It is difficult to get the positively charged hydrogen isotopes to come, close enough to collide.
- At times, it can also be difficult to contain the high amount of energy produced. Many safety layers need to be put in place.

Efforts

- Countries across the world have been trying to carry out nuclear fusion for producing clean, renewable energy for decades. But most of these efforts have not been too successful.
- The International Thermonuclear Experimental Reactor (ITER), being built in the south of France, is an international nuclear fusion research and engineering mega-project, for the future production of electricity from fusion energy. The European Union, India, Japan, China, Russia, South Korea, and the United States are all partners in the project.

- In Germany, a device called 'stellarator', which aims to harness power through nuclear fusion, manged to produce a temperature of 1 million degres Celsius for one-tenth of a second, in December last year.
- Research on generating power through nuclear fusion is also under way in Brazil, Korea and Canada.

SHALE GAS

Shale gas refers to natural gas that is trapped within shale formations, Shales are fine-grained sedimentary rocks that can be rich sources of petroleum and natural gas.

It is a cleaner-burning than coal or oil., From economic growth point of view, domestic availability of shale gas will reduce dependence on fuel import like crude oil, coal, etc.

Technologies Used:

Horizontal Drilling

- Horizontal drilling is used to' provide greater access to the gas' trapped deep in the producing' formation,
- A vertical well' is drilled to the targeted rock formation. At the desired depth, the drill bit is turned to bore a well that stretches through the reservoir horizontally, exposing the well to larger source, of shale gas.

Hydraulic Fracturing

- Hydraulic fracturing (commonly called "fracking" or "hydrofracking") is a technique in which water, chemicals, and sand are pumped into the well to unlock the hydrocarbons trapped in shale formations by. opening cracks (fractures) in the rock and allowing natural gas to flow from the shale into the well,
- When used in conjunction with horizontal' drilling, hydraulic fracturing enables gas producers to extract 'shale gas, at reasonable cost. Without these techniques, natural gas does not flow to the well rapidly, and commercial quantities cannot be produced from shale.

Environmental Concerns

- The drilling and fracturing of wells requires large amounts of water. It may affect the availability of water for other uses, and can affect aquatic habitats.
- Drilling and fracturing also produce large amounts of wastewater, which may contain dissolved chemicals and other contaminants .that require treatment before disposal" or reuse.
- If mismanaged, the' hydraulic fracturing fluid can be released- by spills, leaks etc.

Present Scenario of Shale Gas Exploration

Around the year 2000, the United States developed' technologies to extract shale gas and in the last 15 years, increasing extraction of, shale' gas has totally' transformed the energy economics in that country. It has triggered shale gas extraction in Canada as well. Many other countries, including India, have significant amounts of shale gas.

Major shale gas reserves in India:

- Cambay basin
- Assam-Arakan basin
- Krishna- Godavari basin
- Damodar basin

Challenge before India

- The technology developed in the United States is proprietary. It is not shared with anyone. The US proprietary software is hugely expensive and increases the cost of exploration and production steeply.
- They provide little opportunity to, modify them as required.

- The shale rocks in India are different from the shale rocks in the United States. It is, therefore, important that we develop the technology to extract shale gas on our own.
- For the last three years, Rock' Science and Rock Engineering laboratory at IIT Bombay are working on a project to develop the right technology for fracking.

NEW FORM OF LIGHT DISCOVERED

- In a breakthrough, scientists have discovered a new form of light, which will impact our understanding of the fundamental nature of light.
- One of the measurable characteristics of a beam .of light is known as angular momentum. Until now, however, it was thought that in all forms of light the angular momentum would be a' multiple' of Planck's constant the physical constant. that sets the scale of quantum effects.
- Now, researchers have demonstrated a new form of light where the angular momentum of each photon (a particle of visible light) takes only half of this value.
- Through this result researchers have proven that the fundamental property of light, which physicists have always thought was fixed, can be changed. This difference though small is profound, researchers said.
- In the 1830s, mathematician William Rowan Hamilton and physicist Humphrey Lloyd found that, upon passing through certain crystals, a ray of light became a hollow cylinder.
- The team used this phenomenon to generate beams of light with a screw-like structure.
- Analysirig these beams within the theory of, quantum mechanics they predicted that the angular momentum of the photon would be half-integer, and devised an experiment to test their prediction.
- Using a specially constructed device they were able to measure the flow of angular momentum in a beam of light. They were also able, for the first time, to measure the variations in this flow caused by quantum effects.
- The experiments showed a tiny shift, one-half of Planck's constant, in the angular momentum of each photon.
- Theoretical physicists since the 1980s have speculated how quantum, mechanics works for particles that are tree to move in only two of the three dimensions of space.

New Possibilities

- They discovered that this would enable strange new possibilities, including particles whose quantum numbers were fractions of those expected. This work shows, for the first 'time, that these speculations can be realized with light.
- The impact of this discovery will be on areas such as optical communlcatlon where light waves are studied.

GOOGLE AND FACEBOOK PLANS 'INTERNET FOR AII"

- The Internet is supposed to. be the big leveller of our times, taking, information and knowledge to the people who need it the most. But only a third of the world's population is online - the three' major obstacles to everyone getting the Internet are:
- technology (that is good, enough)
- affordability (that makes services and devices cheaper, even free)
- connectivity (that can I take the Internet everywhere that people are)
- The two major Internet companies, Google and Face book, are now working on removing these obstacles. Their most ambitious project is to try to beam the Internet down from the

skies, making it ubiquitous around the globe.

- Facebook: Free Internet projects are part of its Internet. org initiative. It has begun to set up terrestrial Express Wi-Fi services in hundreds of locations across India; announced plans to launch a satellite with France's Eutelsat Communications to take the Internet to large parts of sub-Saharan Africa in ,2016. The big plan, however, is Aquila.
- Facebook has revealed its first full-scale drone, which it plans to use to provide internet access in remote parts of 'the world. Code-named, "Aquila", the solar-powered drone will be able to fly without landing for three m9nths at a time, using a laser to beam data to a base station on the ground. The company plans to use a linked network of the drones to provide internet access to large rural areas. However, as with its Internet org project, Facebook will not be dealing with customers directly, instead partnering with Local ISPs to offer the services.
- It will climb to its maximum height during the day, before gliding slowly down to its lowest ebb at night, to conserve power when its solar panels are not receiving Charge. The Aquila program which was first tested in Britain in March this year, is geared towards bringing internet access to the 10% of the population who do not have it.
- Google: has already rolled out Google Fibre, a fibre-to-the-premises service: which includes' a free Internet option. But 'what' could really be the game changer is Project Loon, or affordable balloon-powered Internet.
- Google calls it a "network of balloons travelling .on the edge of space, designed to connect people in rural .and remote areas, help fill coverage gaps, and bring people back online after disasters".
- Project Loon balloons will travel in the stratosphere, approximately 20 km above the Earth's surface, latching on to layers of wind as, directed - by software algorithms to determine where they need to go. In the end; they will form one large. communications network.
- The inflatable envelopes are made, 'from sheets of, polyethylene plastic, 15 metres wide and 12 metres tall when fully inflated. They are designed to stayup for at least 100 days in one go.
- The electronics 'are powered by an·, array of solar panels mounted at a steep angle to effectively 'capture sunlight on' short winter days at higher latitudes. The panels can produce about 100 Watts of power in full sun, enough to keep the electronics running along with charging a battery for use at night.
- The small box under the balloon will contain circuit boards that control the system, radio antennas to communicate with other ballocns and with Internet antennas on the ground and lithium ion batteries, to store solar power so the balloons can operate throughout the night.
- Each ballon can provide connectivity to a ground area about 40 km in diameter. Project Loon partners with telecom companies to share cellular spectrum.
- In June 2013, Project Loon was tested in New Zealand. Google says the result of this pilot test and several tests elsewhere in the world "are being used to imporve the technology in preparation for the next stagtes of the projects".
- Sri Lanka will be the first country to the covered by Loon, though no launch date is known Aquila is 3 years away from taking flight.
- Both Facebook and Google have said they don't want to become service providers.

- But according to experts, when free Wi-Fi (or affordable Internet) starts covering the globe' in 3-4 years traditional telecom service providers are' bound to feel threatened.
- They will start telling governments that they will go , bankrupt if everyone' have Wi-Fi, everywhere, as no one is going to use their services. One can see regulatory battles ahead as these developments can wipe out the entire telecom industry.

RFID & GPS FOR CHECKING PILFERAGE

- Trucks leaving mines with Coal will be fitted with global positioning system (GPS) modules. Each consignment will have a radio-frequency identification (RFID) code (the magnetic strip attached to products in malls and retail stores.)
- In a first, some 2,000 trucks will be brought under such monitoring, in the Ranchi-based Central Coalfieids (CCL), beginning this month. The project is also under implementation in the Sambalpur-based Mahanadi Coalfields (MCL).

Live Monitoring

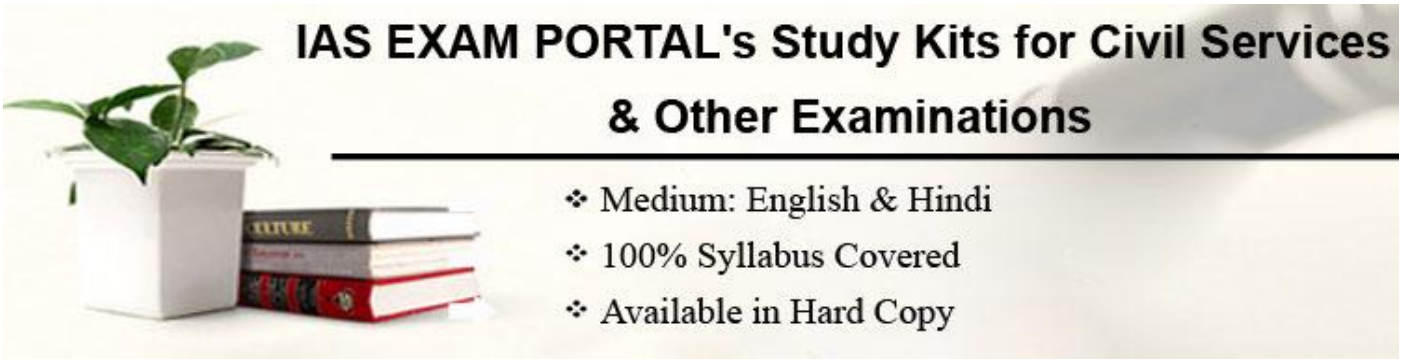
- Both CCl and MCl are CiIL's (Coal India Ltd) mining arms
- It will bring every consignment under live monitoring. If a truck makes' any deviation from the scheduled route, exception reports will be autocratically generated.
- All trucks evacuating fuel from major mines will hence forth be asked to pass through a geo-fenced single entry / exit point, ensuring complete monitoring over the fleet and preventing entry of unauthorized vehicles.

Data Discrepancy

- Each weigh bridge will have RFID readers, so that even the smallest discrepancy in weight, will be recorded.
- The idea is to remove human interference, as much as possible and bring the entire fleet under a three-layered monitoring system spread out right from the mine area ,to the headquarters.
- Any discrepancy in data will be screened at the headquarters, where IT engineers will be keeping a hawk's eye on the monitoring system.
- The project was originally scheduled for completion in 2013. CCL sources blame the vendor for the two-year delay.

GOTPass: For More Secure Online Banking

- A new system that uses images and a .one-time numerical code may provide a secure, inexpensive and easy to use alternative to current password systems used in online banking and other such services, a new study suggests.
- Researchers at the Plymouth University in UK believe-their new' multi-level authentication system GOTPass can be effective in protecting personal online information from hackers.
- It could also be easier for users to remember, and be less expensive' for providers to implement since it would not require the deployment of potentially costly hardware Systems.
- Researchers say the system would be, applicable for online banking and other such services where users with several accounts would struggle to carry around multiple devices, to gain – access.
- They also publish the results of a series of security tests, demonstrating that out of 690 hacking attempts -using a range of guesswork and more targeted methods there were just 23 successful break-ins.
- "Traditional passwords are undoubtedly very, usable but regardless of how safe people might feel their information is, the



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