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## Defence Projects

**Creating Local Giants: Govt to Go Ahead With Strategic Tieups****Brushing aside concerns, Def Min firmly behind new, radical approach****Manu Pubby**

Aiming to create homegrown private sector giants to take on global competition, the Manohar Parrikar led defence ministry will for the first time identify 'strategic partners' for major defence manufacturing projects, going ahead with a new, radical model for procurement. Top Defence Ministry officials have told ET that concerns by smaller companies and new entrants to the defence sector are ill founded and that the government is going ahead with the 'strategic partnership' model that will identify a handful of Indian companies for major projects worth over Rs.10,000 crore that require a national effort to execute. Making it clear that the strategic partnership model will be central to the defence procurement policy that is expected to be made public early next month, a senior official said that new entrants will also get opportunity to participate in the big defence projects as component manufacturers and suppliers. The strategic partnership model is a tectonic shift in defence acquisition procedures which will make the government a key investor into major private sector contracts, giving it control of the developmental project and ensuring delivery . A defence ministry sanctioned task force, led by former DRDO Chief VK Aatre, has finalized a selection criteria for the 'strategic partners' that will be given key defence projects like aircraft manufacturing, warship production, armoured fighting vehicles and complex weapons systems under the Make in India initiative. "There is consensus within the government that the partnership mode is the only way ahead if we have to create a robust private sector that can stand on its feet and take on competition in the coming years. This is a whole new way of procurement," a senior official told ET. Unlike in the past where private companies would compete with commercial bids and technical proposals for a project, under the new model a particular company will be selected for a big project, for example to manufacture a new line of conventional submarines for the Navy under the P75I plan. The government will select the company based on financial and technical parameters suggested by the Aatre panel. The price for the contract will be determined after going through the company's books by the defence ministry, leaving a reasonable profit for the private entity. This is a complete change from the past when companies would determine a fair price and bid for a contract.



**TASK FORCE IN PLACE**  
 A team, led by former DRDO Chief VK Aatre to set selection criteria for strategic partners

**INS Godavari to sail into the sunset today**

The country's first indigenously designed and built warship IINS Godavari will be decommissioned tomorrow here, 32 years after it was inducted into the Navy. Over the past three decades, Godavari has successfully been deployed in numerous operations, including Operation Jupiter - 1988 (Sri Lanka), Operation Shield and Operation Bolster - 1994 (de-induction of the Army from Somalia) and Patrol of Gulf of Aden (PoG) - 2009 and 2011 (anti-piracy operations in the Gulf of Aden). In 1988, in an operation called Operation Cactus, India successfully thwarted a coup d'état against Maldivian Government, a Navy official said. "With the decommissioning, INS Godavari will complete its life cycle, meeting all responsibilities," he said.

## Parrikar's maiden US visit gives fillip to defence ties

Anil Bhat

Manohar Parrikar is the first Indian defence minister to visit the US since 2008, despite the fact that US defence secretaries made six visits to India during the same period. This long gap reflects the difference between the UPA government's indifference on strategic affairs/former defence minister A.K. Antony's lack of drive in modernising/re-equipping India's armed forces. and the Modi government's zeal in boosting the India-US defence relationships. Mr Parrikar is reported to have acknowledged good chemistry and rapport with his counterpart Dr Ashton Carter during his four-day tour, probably because both of them are technocrats and physicists. Dr Carter is a double major in physics and medieval history from Yale and recipient of a Rhodes Scholarship to Oxford University in theoretical physics, while Mr Parrikar is an IIT-Mumbai graduate. Having identified 17 new areas for potential cooperation under Defence Technology and Trade Initiative (DTTI), launched in 2012 to enhance bilateral partnership, particularly in high technology, Mr Parrikar said he and Dr Carter had agreed to closely monitor its progress. Not divulging details of the new areas identified for cooperation, he said these covered radar systems and UAVs among others and that while of the six items that were earlier considered under DTTI, two were found unsuitable but the other four were making good progress. The defence minister's tour included a visit to US Pacific Command (Pacom), the Pentagon, a visit with Secretary Carter to observe flight operations aboard the aircraft carrier USS Dwight D. Eisenhower and interaction with Indian and US defence companies at the US India Business Council (USIBC). Mr Parrikar's visit to Pacom may be seen as meaningful as it is one of the six US armed forces commands with a vast area of responsibility stretching from the US west coast to India and from Antarctica to the North Pole - covering 36 Asia-Pacific countries. "The confidence of American companies to go for a Make in India probably has improved a lot," Mr Parrikar is reported to have said adding that most of the offset problems that America Inc. has consistently complained about had been resolved. "They will tell you that most of the problems have already been attended to and probably only one notification is yet to be issued, which should be coming in the next ten days. Over the last six months, most of the problems of offsets have been addressed. . . One such example is textron. So, I don't think the next two months will be much difficult. The final notification is coming. After that, they do have some demands, but those are not obstructive. . . We are examining them because they are more of an incentive nature. . ." Mr Parrikar reportedly said. Both Mr Parrikar and Mr Carter are reported to have expressed satisfaction over progress made by the two joint working groups - one on aircraft carrier technology cooperation and the other on jet engine technology. A joint statement said "Secretary Carter informed Mr Parrikar that in light of the strengthening relationship between the US and India, the DoD has updated its policy on gas turbine engine technology transfer to India,". According to USIBC president Mukesh Aghi, Mr Parrikar's visit demonstrated the growing trust between the two countries in the sensitive area of defence. Aparna Pande, director of Initiative on the Future of India and South Asia at Hudson Institute in Washington, said, "Mr Parrikar's first trip was a success on form, symbol and generated enough hope on substance. We know the political leadership in both countries wants the relationship to move ahead. But for that to happen the bureaucracies need to come closer together. It also needs closer ties not only between governments but also between the private sectors of both countries. America's closest ties are with countries where the defence relationship is strongest and India would benefit by developing this aspect of the relationship as well." When asked by the media if India would consider being part of the United States-led coalition to fight ISIS, the defence minister reportedly made it clear that India will share intelligence and any anti-ISIS campaign would only be under the auspices of a unanimously approved United Nations programme. There is no doubt that the good vibes and agreements mentioned between the two leaders will fructify only with both countries' bureaucracies cutting or at least considerably loosening the red tape, Indian bureaucracy in particular. When asked by media if India would consider being part of the United States-led coalition to fight ISIS, the Defence Minister reportedly made it clear that India will share intelligence, any anti-ISIS campaign would only be under the auspices of a unanimously approved United Nations programme. "We don't mind a step further in sharing the information," he added. Prior to embarking on the US visit Mr Parrikar had stated that he would take up the matter of US arms aid to Pakistan, and while it was reported that he did so, the fact remains that his tour came two weeks after a high-profile visit by Pakistan army chief Gen. Raheel Sharif, who was wined and dined extensively by the Obama administration. However, this visit is seen as a major path-breaker, thanks much to the efforts of Dr Carter. "We have got a very clear promise and we are experiencing it - our issues are fast-tracked while following the process," said Mr Parrikar and while he is expected to maintain the tempo, it is hoped that the process keeps pace with the government's aim of speeding up the armed forces' modernisation programme.

## PM Modi's Russia visit: New, cheaper deal on Sukhoi fighter planes

The proposal awaits a decision from Prime Minister Narendra Modi, when he meets Russian President Vladimir Putin for the annual India-Russia summit this week.

by Sushant Singh

Russia has made a new offer on the delivery of Sukhoi T-50 (PAK FA) fighter jets to India under the joint fifth-generation fighter aircraft (FGFA) initiative. Under the new offer, India will have to pay \$3.7 billion, instead of \$6 billion, for the technological know-how and three prototypes of PAK FA fighters. The proposal awaits a decision from Prime Minister Narendra Modi, when he meets Russian President Vladimir Putin for the annual India-Russia summit this week. India and Russia had signed an inter-governmental agreement to co-develop and co-produce the FGFA in 2007, which was followed by the \$295 million preliminary design contract in December 2010. Modelled on the successful Brahmos missile project, the project involves Russia's Sukhoi Design Bureau and the Hindustan Aeronautics Limited (HAL). The overall FGFA project cost for making 127 single-seat fighters in India has been estimated to be around \$30 billion. The final design contract, under which both sides were to contribute an initial \$6 billion each for prototype development and production, has not been signed between India and Russia so far. Meanwhile, Russia has gone ahead with the development of PAK FA and claims that it will enter service with the Russian Air Force in 2016, and enter serial production in 2017. "Now that they already have the fighter, the Russians have made a revised offer to us. For \$3.7 billion, they will give us all the technological know-how of making the fighter. We will also get three prototypes from them in that amount," a senior defence ministry official said. But the Indian Air Force (IAF) remains opposed to the idea. A senior IAF official said, "We are not in favour of the FGFA. The PAK FA fighter is too expensive at even this rate, and we are not sure of its capabilities." Sources said the Russian offer is driven by Moscow's cash crunch and lack of firm orders with its defence industry.

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## Indo-US ties won't affect Russia: Foreign Secretary

Even as Prime Minister Narendra Modi leaves for the visit to Russia on Wednesday afternoon, foreign secretary S. Jaishankar on Tuesday said that India's bilateral ties with the US and Russia's ties with Pakistan should "not be seen as a zero sum game" and that it was "not a great positional shift". He was responding to a question on whether India was aware of Russian concerns regarding the strengthening of strategic ties between India and US. President Putin will host a private dinner for PM Modi on Wednesday evening. After formal talks on Thursday morning, the two "time-tested" partners are likely to ink a number of pacts in a range of sectors including nuclear energy and defence. "We expect to sign a number of agreements covering a very broad range of fields. Final touches are being given on some of them," Mr. Jaishankar told reporters. The two leaders will also interact with a group of Indian and Russian CEOs at the Kremlin on Thursday. The PM's engagement in Moscow will also include addressing a gathering of "Friends of India" in Moscow on Thursday evening and about 3,000 people are expected to attend the event. He will also visit Russia's EMERCOM facility which deals with disaster management. "Russia has been a very major military and strategic partner of India. There will be a lot of discussions on that," Mr Jaishankar said. Last week, the MoD's Defence Acquisition Council had cleared the purchase of Russian S-400 Triumf air defence missile systems at an estimated cost of Rs.40,000 crore. Asked whether India was supplying three Mi 25 helicopters to Afghanistan through Russia, the Foreign Secretary said "Technically these were not Russian acquisitions. What you are referring to, I assume anything that we would look at with any country would be something which we would look at from our resources." India is likely to offer a site in Andhra Pradesh to set up units five and six of the Kudankulam nuclear power plant by Russia in sync with broad principles of Make in India initiative. The two countries are likely to sign an agreement for the two units with provisions for involvement of India's private sector in the project including in supply of various components.

## Old friend and new script

### Modi's Russia visit can energise bilateral ties

Prime Minister Narendra Modi's first state visit to Russia - for the annual India-Russia summit - comes at a time of changing geo-political realities. Its success will be gauged from how effectively the two nations respond to these changes. Western sanctions in the aftermath of the Crimea crisis and nose-diving oil prices have had a severe impact on the Russian economy and also pushed Moscow a little too close to Beijing for New Delhi's comfort. One side-effect of these two developments has been the sudden warmth in Russia's ties with Pakistan. Last June, Russia lifted its decades-old, self-imposed informal embargo on arms sales to Pakistan, with the sale of four Mi-35M attack helicopters. In August this year, Russian Defence Minister Sergei Shoigu visited Islamabad, which was followed by reports of joint Russia-Pakistan military exercises and, importantly, news that Russia may sell Pakistan its top-of-the-line Sukhoi 35 platform. The Russia-Pakistan matter was discussed during Defence Minister Manohar Parrikar's recent Moscow visit and is expected to come up during Mr Modi's trip as well. That said, there's no need to take an alarmist approach to Russia's relations with Pakistan, which is hardly a threat to India-Russia ties. Moreover, Moscow's flirting with Islamabad must be viewed in the context of India's consistently-improving relations with the US. For more than two decades, New Delhi and Washington, DC, have steadily upgraded ties, including defence cooperation, which was the core of India-Russia bilateral, even as the Delhi-Moscow partnership has somewhat stultified. So much so, that last year, Russia lost its position to the US as India's top defence supplier. The question now is: Where does the India-Russia bilateral go from here? Defence will remain an important part of the relationship for at least another decade - hence, days before Mr Modi's trip, the purchase of five units of the S-400 air defence missiles from Russia at an approximate cost of Rs30,000 crore was cleared. However, the relationship is also being recast for the long term. Last year's India-Russia summit, for instance, focussed on economic ties, with diamond diplomacy emerging as a new motif. This year, the spotlight is expected to be on energy. Mr Modi will reportedly take the Kudankulam partnership with Russia further by offering a site in Andhra Pradesh for units five and six of the nuclear plant. Last year, the agreement for units three and four, which will come up in Tamil Nadu, had been signed. Additionally, an old India-Russia oil and gas pipeline plan may also get some traction, as Russia looks to diversify its energy customers and India more sources of clean energy. Also, ONGC Videsh, which recently bought a 15 per cent stake in Russia's second largest oil field, will continue its investments in the Russian energy sector, while talks are on for India-Russia collaboration in oil and gas explorations and in exploring the Arctic region.

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## Defence, trade, tourism pacts in pipeline

Modi and Putin are also likely to deliberate on a number of global issues having political dimensions including the situation in Syria and terrorism. In an effort to strengthen economic ties between India and Russia, Prime Minister Narendra Modi will embark on a two-day visit to Russia on Wednesday for annual summit talks with President Vladimir Putin. Foreign Secretary S Jaishankar said, "We expect to sign a number of agreements covering a broad range of fields. Final touches are being given to some of them." The pacts are expected to cover nuclear, defence, trade and tourism among others. Modi and Putin are also likely to deliberate on a number of global issues having political dimensions including the situation in Syria and terrorism. Jaishankar said India was looking at deeper engagement in Russia's oil and coal sector besides stepping up cooperation in some other areas like diamond trade and agro-business. India is also likely to push for a Free Trade Agreement with the Eurasian Economic Zone and is sharing details of a study it conducted in this regard.

## India-Russia ties: The next step

**Commerce, defence and nuclear cooperation will form the crux of the next chapter of the India-Russia bilateral, which Prime Minister Narendra Modi will have to script during his tour to Moscow**

**Sumit Kumar**

Prime Minister Narendra Modi will embark on his first state visit to Russia from December 23 to 24, to hold an annual summit with Russian President Vladimir Putin in Moscow. The meeting between the two leaders will provide an opportunity to review bilateral relations between the two countries and is expected to take India-Russia ties to a new level. Expanding economic ties between the two countries should be on top of the agenda. Remember, during last year's summit in New Delhi, both leaders set a target of \$30 billion bilateral trade by 2025. To achieve this, a study group for free trade agreement had been set up. Besides prospective investments from Russia in the National Infrastructure Fund, there is a possibility that a joint innovation fund will be created. The two leaders will also review sectoral cooperation on trade, commerce and economic cooperation, priority investments etc. Both India and Russia have reasons to deepen their economic ties. Russia is undergoing a severe economic crisis, augmented by the imposition of Western economic sanctions. The sharp decline in oil prices has also made matters worse, and so has Moscow's termination of several joint projects with Ankara following the shooting down of a Russian fighter jet by Turkish forces. India can play an important role in boosting Russia's economy. From India's point of view, initiatives like Make in India and Skill India can benefit from Russian investment. Many Russian firms have shown their willingness to invest in Indian construction and infrastructure projects. At the same time, Indian companies are also ready to explore major investment options in Russia, especially in the sectors of coal, fertilisers, hydrocarbons, minerals and rare earth metals. Another sector that's on the cards is defence cooperation - an important pillar of India-Russia ties. Recently, the Government of India has cleared the purchase of an estimated Rs40,000 crore Russian S-400 Triumf air defence missile systems and also decided to purchase 120 trawls from Russia at the cost of Rs450 crore. These deals will be formally sealed during Mr Modi's visit. Also, during Mr Modi's trip, Moscow will set up a production line for 200 light helicopters for India, which are to be jointly manufactured. Over the last decade, Russia's position as India's top-most defence exporter to India has been eclipsed by the US and Israel. Russia has lost many important Indian contracts. This has generated much heartburn among Russian strategists and diplomats. On the other hand, Russia's decision to supply to Pakistan Mi-35 Hind attack helicopters and Klimov RDP93 engines for the JF-17 has alarmed the Indian defence establishment. Pakistan and Russia are also holding talks on the possible sale of the Sukhoi Su-35 fighter jet. India has witnessed a sharp rise in Russia-China defence ties as well. The assertive foreign policy of a rising China in the Indo-Pacific, the US-Pakistan relationship, and the China-Pakistan nexus require India to take initiatives to improve ties with Russia. It is expected that during Mr Modi's trip, India and Russia will take substantive steps to cement nuclear cooperation as well. Minister of State in the Prime Minister's Office Jitendra Singh has already informed Lok Sabha as much. India will offer Russia a site in Andhra Pradesh to build six nuclear reactors of 1,200 megawatts each. New Delhi's efforts to seek Moscow's help in this lies in the fact that US firms, General Electric and Westinghouse, are still enthusiastic to enter India's nuclear energy sector but unable to do so because of the liability law that makes reactor suppliers liable in case of an accident. Thus, deeper engagement with Russia in the civil nuclear area will help India expedite the building of nuclear reactors for generating clean energy - which is crucial for sustaining robust economic growth rate. Also, by selling nuclear reactors to India, Russia will be able make some amount of compensation for the loss caused by the refusal of European countries to buy gas from it after the Ukraine crisis. The above-discussed issues make it necessary for India and Russia to take concrete steps towards re-instating confidence and trust into the time-tested friendship. Thus, the upcoming visit of Prime Minister Modi is very timely in shaping the relationship between the two countries in the emergence of a new strategic environment in the Indo-Pacific where close engagement between India and Russia has become as important, if not more than ever in the past, for achieving their national interests.

## With eye on China, India seeks 100 armed drones from US

India has sought from the US 100 latest unmanned aerial vehicles, both armed and surveillance versions, worth \$2 billion to bolster its arsenal amid recurring incursions by Chinese soldiers. Industry sources familiar with New Delhi's interest and ongoing talks between the two governments said, "India has requested for the latest Avenger drones, which is basically an unmanned combat air vehicle, and is mainly being sought with an eye on China." It has also sought Predator XP category which is a surveillance version for internal security issues and terrorist threats. According to industry sources, India is looking for about 100 drones worth \$2 billion. However, while talks in this regard have accelerated in the past few months, the US has not made any formal commitment or given a public indication pending India's application to joining Missile Technology Control Regime (MTCR). Italy, which is upset with New Delhi's treatment to its marines, appears to have currently blocked India becoming a member of MTCR. However, both Indian and US officials are confident that they will be able to get through the last hurdle in the next few months, thus making them possible to take the defence trade, which will include armed drones, to the next level. "Yes, General Atomics Aeronautical Systems Inc (GA-ASI) is aware of India's interest in Predator-series Remotely Piloted Aircraft (RPA)," said Vivek Lall, Chief Executive of the US and International Strategic Development of General Atomics.

### No formal commitment from US

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## In Russia, PM Modi likely to discuss nuclear energy, Syria and terror

While there has been some speculation recently over Russia's position on expansion of UN Security Council permanent membership, India said on Tuesday it doesn't doubt Moscow's commitment to supporting India's bid for the same. Ahead of Prime Minister Narendra Modi's two-day visit to Russia for the annual summit with President Vladimir Putin, the government said the 2 countries were "time-tested" partners with great trust and confidence in each other. "We do not at all doubt Russia's commitment to see India as a permanent member of the UNSC," said foreign secretary S Jaishankar. The India-Russia summit has been taking place alternately in Moscow and New Delhi since 2000. While the two countries are expected to sign a number of agreements, including in defence and nuclear energy, the situation in Syria and international terrorism are other issues likely to be discussed in detail. Jaishankar said both India and Russia believed that the Syrian issue could be resolved through political and diplomatic means. India believes there is no reason to believe that Russian airstrikes are not targeting Islamic State. "We expect to sign a number of agreements covering a very broad range of fields. Final touches are being given on some of them," Jaishankar told reporters. He said expanding economic ties would be a "very big priority" as the two countries were aiming at enhancing annual bilateral trade to \$30 billion over the next 10 years from current \$10 billion. On whether India will request Russia to share details on Netaji Subhas Chandra Bose, he said the issue had figured during external affairs minister Sushma Swaraj's recent visit to Moscow. "Let's wait and see what happens. I will not prejudge the Russian response till we get it," he said. Asked whether India was supplying three Mi 25 helicopters to Afghanistan through Russia, the foreign secretary said, "Technically these were not Russian acquisition. What you are referring to, I assume anything that we would look at with any country would be something which we would look at from our resources."

# Russia to build 2 nuclear reactors in Iran

Ali Noorani

Russia will start constructing two nuclear reactors in Iran next week, as Tehran seeks to reduce its reliance on oil and gas with 20 facilities over the coming years, an official said Tuesday. The start of construction follows a historic deal between Iran and world powers in July that ends a decade-long standoff over Tehran's nuclear programme. And it comes a year after Tehran signed a contract with Moscow to construct two reactors at the existing Russian-built Bushehr power plant. A series of agreements signed between the two countries last year foresees eventually increasing the total number of Russian-built reactors in the country to nine. Work on the two facilities "will commence next week," state television's website quoted atomic energy agency spokesman Behrouz Kamalvandi as saying. Iran plans to build 20 more nuclear plants in the future, including four in Bushehr. The accord does not limit Iran's development of civilian nuclear sites. The two reactors will be financed by Iran, Sergei Kiriyenko, head of Russia's state nuclear company Rosatom, said last year. The two countries are allied in supporting Syrian President Bashar al-Assad against Opposition and jihadist groups, mainly the Islamic State (ISIS) group. And they plan to boost trade volume, as they signed several joint development documents last month during Russian President Vladimir Putin's first visit to Iran in eight years. On Monday, Iran's minister of industry, mining and trade Mohammad Reza Nematzade, and his Russian counterpart, Denis Manturov, opened an industrial exhibition in Tehran. The three-day fair by Russian industrial holding Rostec State Corp, along with hundreds of business leaders, aims to introduce Russian industries to Iran, state television's website reported. Rostec owns 700 enterprises, organised into 14 holding companies, and nine of which are focused on the military. Russia is "not afraid" of Western economic delegations trying to dominate Iranian markets after the lifting of sanctions, a Rostec official said Tuesday. "Everyone is waiting for the sanctions to be lifted and every one wants to be the first" to enter Iran, international cooperation department chief Victor Klavov said.

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## **Bengaluru start-up prints 3D tissue that functions like human liver**

**Pandorum is funded by the Department of Biotechnology and incubated at the Centre for Cellular and Molecular Platforms, Bangalore Bio-Cluster**

A Bengaluru-based biotech start-up, Pandorum Technologies, has become the first Indian firm to develop artificial living tissue, which performs the function of a human liver, and can lead to affordable, full-scale transplantable organs in few a years. These 3D printed tissues, with reduced animal and human trials, would also make it possible to develop new medicines and vaccines. "This is a significant milestone," said Tuhin Bhowmick, co-founder of Pandorum. "Development of artificial organs has numerous clinical uses. Cell based organoids can be used to develop bio-artificial liver support systems for preserving life in patients who have developed liver failure. In the near future, such bio-printed organs will address the acute shortage of human organs available for surgical transplantation," said Bhowmick, who holds a PhD from the Indian Institute of Science. Another achievement is that Pandorum has been able to keep the cells alive for four weeks. Pandorum is funded by the Department of Biotechnology and incubated at the Centre for Cellular and Molecular Platforms (C-CAMP), Bangalore Bio-Cluster. In India, thousands of lives are lost every year because of unavailability of organs. More than 75,000 livers, 200,000 kidneys and 50,000 hearts are needed in hospitals across the country. The current availability through organ donation and cadaver transplants is around 1,500 livers, 7,000 kidneys and just 50 hearts. "Liver toxicity and drug metabolism are the key hurdles, and contributors to failed human trials. Our 3D bio-printed mini-livers that mimic the human liver will serve as test platforms for discovery and development of drugs with better efficacy, less side-effects and at lower costs," said Arun Chandru, co-founder and managing director of Pandorum. Pharma giants on an average spend more than \$10 billion on R&D to get a single new drug to market with the Food and Drug Administration (FDA) approval. The global market for in-vitro toxicity testing alone is expected to reach \$4 billion by 2018. Pandorum says its technology could reduce costs of drug R&D and testing by as much as 30 per cent. "Technologies like these can reduce the cost of drug development and testing," said Sonal Asthana, multi-organ surgeon at Aster Integrated Liver Care.

## X-ray vision? Software eyes can pierce walls

**It uses variations in radio signals to recognise human silhouettes and track movement**

X-ray vision, a comic book fantasy for decades, is becoming a reality in a lab at the Massachusetts Institute of Technology (MIT). A group of researchers, led by Professor Dina Katabi, has developed software that uses variations in radio signals to recognise human silhouettes through walls and track their movements. Researchers say the technology will be able to help health-care providers and families keep closer tabs on toddlers and the elderly, and it could be a new strategic tool for law enforcement and the military. "Think of it just like cameras, except that it's not a camera," said Fadel Adib, a researcher on the MIT team developing the device. "It's a sensor that can monitor people and allow you to control devices just by pointing at them." Work began in 2012 to determine how wireless signals could be used to "see" what's happening in another room, said Professor Katabi, who directs the MIT Wireless Centre. "At first, we were just interested ... can you at all use wireless signals to detect what's happening in occluded spaces, behind a wall, couch, something like that," Professor Katabi said. "It turned out that we were able to detect that. And when we figured out we could detect that, we started asking more advanced questions - Could we use it to detect exactly how people are moving in a space if they are behind a wall?" The device displays the signal on a screen, where the person's movements can be tracked in real time. It depicts the target as a red dot moving around the room, occupying a chair and speeding up or slowing down. A company set up to market the technology, now dubbed Emerald, will spin out of the MIT lab next year, with a goal of marketing the device early in 2017 at \$250-300, Mr. Adib said.

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## Giant comets may threaten Earth: astronomers

Planet Earth could be at higher risk of a space rock impact than widely thought, according to astronomers who suggested on Tuesday, keeping a closer eye on distant giant comets. Most studies of potential Earth-smashers focus on objects in the asteroid belt roughly between Mars, Earth's outside neighbour, and Jupiter on its other flank, said the researchers. But they noted that the discovery in the last two decades of hundreds of giant comets dubbed centaurs, albeit with much larger orbits, requires expanding the list of potential hazards. These balls of ice and dust, typically 50-100 kilometres (31-62 miles) wide, have unstable, elliptical orbits that start way beyond Neptune, the most distant planet from the Sun. Their orbits cross those of the giant planets Jupiter, Saturn, Uranus and Neptune, whose gravity fields occasionally deflect a comet towards Earth-once about every 40,000-100,000 years. As they draw closer to the Sun, the comets would gradually break up, which is what causes the trademark cometary debris tail- "making impacts on our planet inevitable". "The disintegration of such giant comets would produce intermittent but prolonged periods of bombardment lasting up to 100,000 years," the research team wrote in the Royal Astronomical Society journal, *Astronomy and Geophysics*. And they argued, "Assessment of the extraterrestrial impact risk based solely on near-Earth asteroid counts, underestimates its nature and magnitude." They added that a single centaur contains more mass than the entire population of Earth-crossing asteroids discovered to date. "In the last three decades, we have invested a lot of effort in tracking and analysing the risk of a collision between the Earth and an asteroid," said co-author Bill Napier of the University of Buckingham. "Our work suggests we need to look beyond our immediate neighbourhood too, and look out beyond the orbit of Jupiter to find centaurs. "If we are right, then these distant comets could be a serious hazard, and it's time to understand them better." Scientists believe a comet bombardment may have kickstarted life on Earth by bringing water and organic molecules. A comet strike is also a leading contender for having ended the reign of the dinosaurs 65 million years ago.

# IISc makes big impact on small world of chips

By J Vignesh

Scientists at the Indian Institute of Science (IISc) have devised a method to lay circuits in electronic chips that is both cost-effective and energy-efficient, rare in a country known mainly for its software prowess. A team of three - Ph D candidate Santanu Talukder and his professors Praveen Kumar and Rudra Pratap - found a way to etch nano-circuits on silicon chips at room temperature, which could potentially accelerate research efforts at the fundamental chip level. Talukder began his doctoral research in 2012. Nano-circuits, several thousand times thinner than a strand of hair, are the basic building blocks of any high-end device - be it mobile phones, television sets or even aircraft. Experts say the new technology, once in the market, could accelerate the growth of connected devices, which are dependent on lower power consumption and faster speeds. "This is a game-changer because this makes the whole patterning technique affordable to a larger audience," said Pratap, chairperson of the Centre for Nano Science and Engineering, IISc, Bengaluru. "Most universities cannot even afford the available techniques for the sake of research." Currently, electric circuits are etched using two methods: Electron-beam lithography and photolithography. But these, which came about during the semiconductor revolution in the 1960s, etch the circuit on polymer. The IISc team has devised a way to do the same on metal, making it easier to etch. The researchers outlined their technology in a paper published online by international scientific journal Nature. com on December 4. "Patterning is one of the hardest tasks. The method we have developed could bring down the cost by a few millions on a single run. Moreover, it is energy-efficient and reduces the operating cost too," said Pratap.

**LOWER PATTERNING COST** - The team pegs the current patterning cost at Rs 2.5-3 crore, which they expect could drop to Rs 10-25 lakh with their technology. Pratap estimated that the completed product will be in the market in two years. "We certainly want to market it," said Kumar. "But before that, we want to make this more user-friendly and develop the technology further. We are also looking for funding from the government." Currently, companies such as Intel, Qualcomm and MediaTek incorporate nano-circuits in the chips they manufacture. All large companies are researching to pack more capacity into the chips even as they aim to reduce chip size. This new pattern of drawing circuits could give them some time until the former technology matures. The team filed for a patent in December 2014. "The science is all sorted out, but the tech and engineering needs to be done," said Pratap. "Nano-electronics is a very promising field," said Chinnu Senthilkumar, chief technology officer at Exfinity Ventures, the venture capital firm floated by ex-Infosys veterans Mohandas Pai and V Balakrishnan. "If this method actually works, it can be a game-changer in the Internet of Things industry due to the industry's need for low power and small form requirements." Senthilkumar holds nine patents in the domain of semiconductors and was formerly employed with Intel, Texas Instruments and SanDisk.