



PRELIMS EDGE 2026

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REGIONAL RAPID TRANSIT SYSTEM

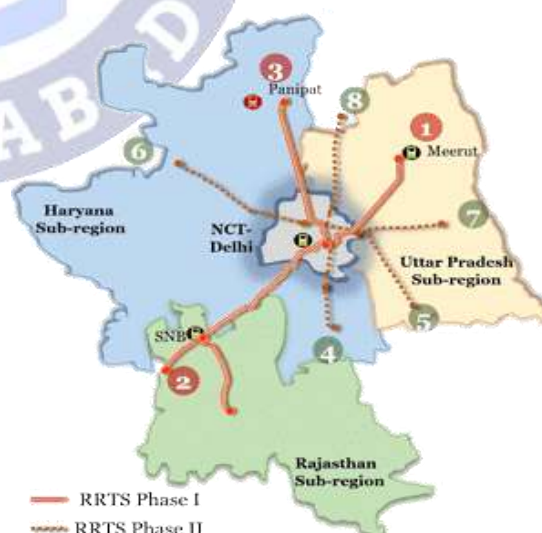
Context; The NCR RRTS connectivity is getting expanded phase by phase



About RRTS

- It is **semi high-speed rail connectivity** at its core; the RRTS is an **integrated, mass transit network**.
- It aims to ensure “**balanced and sustainable urban development**” through better connectivity and access across the National Capital Region (NCR).
- It is constructed by the **National Capital Region Transport Corporation (NCRTC)**, which is a joint venture company of the Central government and the governments of Delhi, Haryana, Rajasthan and Uttar Pradesh.

- It is modelled on systems such as the **RER in Paris**, **Regional-Express trains in Germany** and **Austria** as well as the **SEPTA Regional Rail in the United States**, among others.
- These trains will travel significantly faster than metro trains. These will operate at a speed of 160 km/hour but are designed to be able to run at speeds up to 180 km/hour.
- Eight corridors will be developed under the project, of which three are being constructed under phase I: the 82-km Delhi-Ghaziabad-Meerut, the 164-km Delhi-Gurugram-SNB-Alwar, and the 103-km Delhi-Panipat corridors.



Significance of this system

- When compared with metros, the RRTS network is **faster**. It will cater to commuters who want to

travel relatively longer distances across the NCR in a short time.

- Compared with the Indian Railways, though the **RRTS train will cover relatively smaller distances**, it will do so at higher frequency and provide relatively more comfort than the average Railways coach.

Source; Prime Minister launches full Delhi-Meerut RRTS corridor-The Hindu

TERMS IN NEWS

The Linear No Threshold Model



- The Linear No-Threshold (LNT) model is the **internationally accepted standard used to estimate the health risks—specifically cancer—from ionizing radiation.**
- It assumes that any exposure to radiation, no matter how small, carries a proportional risk of biological harm. Because it posits no "safe" dose threshold, it serves as the foundation for the **ALARA principle (As Low As Reasonably Achievable)** in radiation protection regulations.

- **Core Assumption:** The model suggests a linear relationship between radiation dose and biological effect. As the dose increases, the probability of stochastic effects (like cancer or hereditary damage) increases linearly, with no safe lower bound.
- **Scientific Basis:** The model was developed by extrapolating data from high-dose exposures—such as those experienced by atomic bomb survivors in Hiroshima and Nagasaki—down to low-dose levels.
- **Regulatory Importance:** It is the primary model used by major international organizations, including the International Commission on Radiological Protection (ICRP), to set safety standards for nuclear power plants, medical facilities, and industrial radiation usage.
- **Ongoing Debate:** While widely used for its conservative approach (emphasizing safety), the model is controversial. Critics argue it may overestimate risks at very low doses and ignore biological defense mechanisms (like DNA repair or radiation hormesis), while proponents maintain it remains the most practical and ethical basis for public safety when definitive data at low doses is uncertain.

Satellite Phones



- **Cost:** Both the handsets and service plans are significantly more expensive than traditional cellular phones.
- **Reliability:** Highly reliable during natural disasters or infrastructure failures because they do not rely on local, ground-based networks.
- **Restricted Use:** Unauthorized possession or use is illegal under the Indian Telegraph Act, 1885 and the Indian Wireless Telegraphy Act, 1933.

- A satellite phone, or satphone, is a **mobile device that connects directly to orbiting satellites rather than ground-based cellular towers**, enabling voice and text communication from almost anywhere on Earth, including remote oceans, mountains, and disaster zones.

Key Features and Characteristics:

- **Connectivity:** It uses satellite constellations (LEO or GEO) to transmit signals, allowing for communication in desolate areas, polar regions, or at sea.
- **Appearance & Design:** Generally bulkier than modern smartphones, equipped with a prominent external antenna to catch signals directly from space.
- **Functionality:** Designed for essential voice and text (SMS) communication, with some models offering low-bandwidth data services.
- **Usage Limitations:** Requires a clear line-of-sight to the sky; they generally do not work indoors or in dense, covered areas.

Nebula

- A nebula is a **giant cloud of dust and gas in space**.
- Some nebulae (more than one nebula) come from the gas and dust thrown out by the explosion of a dying star, such as a **supernova**.
- Other nebulae are regions where new stars are beginning to form. For this reason, some nebulae are called “**star nurseries**.”

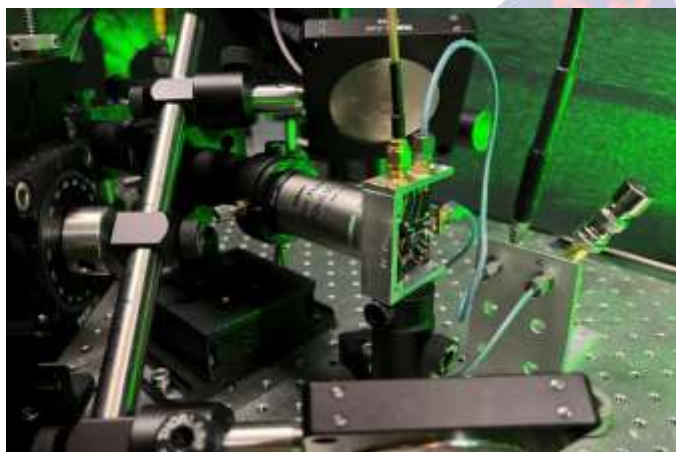


How do stars form in a nebula?

- Nebulae are made of dust and gases—mostly **hydrogen and helium**.

- Nebulae exist in the space between the stars—also known as **interstellar space**.
- The closest known nebula to Earth is called the **Helix Nebula**. It is approximately 700 light-years away from Earth.
- Nebulas come in many shapes and sizes and can be further divided into several subcategories, including planetary nebulas, supernova remnants, dark nebulas, and emission nebulas.
- **Healthcare:** They facilitate early disease detection and precise medical diagnostics through advanced imaging techniques.
- **Earth Observation & Resource Exploration:** Tools like the Quantum Gravity Gradiometer (QGG) can map subterranean features, including aquifers, minerals, and hydrocarbons, while tracking climate-related shifts in ice and land mass.
- **Fundamental Science:** They act as essential tools for studying quantum phenomena and testing theories like general relativity.

Quantum Sensors



- Quantum sensors leverage quantum mechanical phenomena—such as superposition and entanglement—to measure physical quantities like magnetic fields, gravity, and time with unprecedented precision.
- By analyzing changes at the atomic level, they surpass the sensitivity of classical sensors.

Key Applications

- **Defense & Navigation:** Quantum sensors enable GPS-free navigation and the detection of underwater objects or landmines, enhancing national security.

Large Language Models



- An LLM is a **type of artificial intelligence (AI) program that can recognize and generate text, among other tasks**.
- LLMs are **trained on huge sets of data—hence the name “large.”**
- LLMs are built on machine learning: specifically, a type of neural network called a transformer model, which excels at handling sequences of words and capturing patterns in text.
- In simpler terms, an LLM is a computer program that has been fed enough examples to be able to

recognize and interpret human language or other types of complex data.

- Many LLMs are trained on data that has been gathered from the Internet—thousands or millions of gigabytes' worth of text.
- But the quality of the samples impacts how well LLMs will learn natural language, so LLM's programmers may use a more curated data set.
- LLMs use a type of **machine learning called deep learning** in order to understand how characters, words, and sentences function together.
- Deep learning involves the **probabilistic analysis of unstructured data**, which eventually enables the deep learning model to recognize distinctions between pieces of content without human intervention.
- LLMs are then further trained via tuning: they are **fine-tuned or prompt-tuned** to the particular task that the programmer wants them to do.

What are LLMs Used For?

- LLMs can perform various language tasks, such as answering questions, summarizing text, translating between languages, and writing content.
- Businesses use LLM-based applications to help improve employee productivity and efficiency, provide personalized recommendations to customers, and accelerate ideation, innovation, and product development.
- LLMs serve as the **foundational powerhouses behind some of today's most used text-focused generative AI (GenAI) tools, such as ChatGPT, Claude, Microsoft Copilot, Gemini, and Meta AI.**
- Since LLMs are now becoming multimodal (working with media types beyond text), they are now also called "**foundation models**".

- Though they are groundbreaking, LLMs face challenges that may include computational requirements, ethical concerns, and limitations in understanding context.

PRACTICE QUESTIONS

Q1; The term, The Linear No Threshold Model sometimes seen in the news is related to which of the following

- A. Radiation Safety
- B. Extra Terrestrial Life
- C. Deep Sea Mining Missions
- D. Quantum Computers

Q2; It is a giant cloud of dust and gas in space. The dust and gases are very spread out, but gravity can slowly begin to pull together. As these clumps get bigger and bigger, their gravity gets stronger and stronger. Eventually, the clump of dust and gas gets so big that it collapses from its own gravity. The collapse causes the material at the center of the cloud to heat up-and this hot core is the beginning of a star.

Identify the correct option from the following that fits the above description

- A. Nebula
- B. Pulsars
- C. Event Horizon
- D. Black Hole

Q3; Consider the following statements regarding Quantum Sensors

1. Quantum sensors leverage quantum mechanical phenomena—such as superposition and entanglement—to measure physical quantities like magnetic fields, gravity, and time with unprecedented precision.

2. By analyzing changes at the atomic level, they surpass the sensitivity of classical sensors.
3. They facilitate early disease detection and precise medical diagnostics through advanced imaging techniques.
3. Unauthorized possession or use of satellite phones is illegal under the Indian Telegraph Act, 1885 and the Indian Wireless Telegraphy Act, 1933.

How many of the above statements are incorrect

- A. Only One
- B. Only Two
- C. All of the Above
- D. None of the Above

Q4; Consider the following statements regarding Regional Rapid Transport System

1. It is semi high-speed rail connectivity at its core; the RRTS is an integrated, mass transit network.
2. It aims to ensure “balanced and sustainable urban development” through better connectivity and access.
3. When compared with metros, the RRTS network is slower but will cater to commuters who want to travel relatively longer distances

How many of the above statements are incorrect

- A. Only One
- B. Only Two
- C. All of the Above
- D. None of the Above

Q5; Consider the following statements regarding Satellite Phones

1. A satellite phone, or satphone, is a mobile device that connects directly to orbiting satellites rather than ground-based cellular towers.
2. It uses high earth orbit to transmit signals, allowing for communication in desolate areas, polar regions, or at sea.

How many of the above statements are incorrect

- A. Only One
- B. Only Two
- C. All of the Above
- D. None of the Above

Answers

1. A
2. A
3. D
4. A
5. A