Show Notes 25 July 2025

Story 1: Japan sets new internet speed record — it's 4 million times faster than average US broadband speeds

Source: LiveScience.com Story by Perri Thaler

Link: https://www.livescience.com/technology/communications/japan-sets-new-internet-speed-record-its-4-million-times-faster-than-average-us-broadband-speeds

See official research team statement here: https://www.nict.go.jp/en/press/2025/05/29-1.html

See also: https://www.digitaltrends.com/computing/japan-shatters-internet-speed-record-can-download-entire-netflix-library-in-a-seconds/

To achieve this new speed, scientists developed a new form of optical fiber to send information over roughly the distance between New York and Florida. (Image credit: Getty Images/Andriy Onufriyenko)

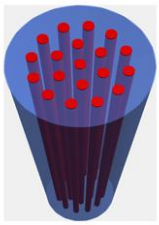


Figure 1 Image diagram of the newly developed 19-core optical fiber

1. Optical fiber transmission system

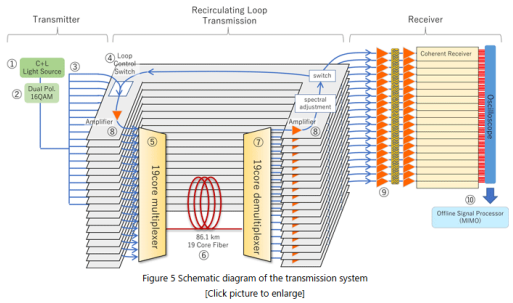


Figure 5 Schematic diagram of the transmission system
[Click picture to enlarge]

- Researchers in Japan have shattered the internet speed record achieving a jaw-dropping data transmission rate of 125,000 gigabytes per second — roughly 4 million times faster than the average U.S. broadband speed.

- The record-breaking internet speed was achieved by researchers at Japan's National Institute of Information and Communications Technology (NICT). They collaborated with Sumitomo Electric Industries to develop the 19-core optical fiber that made the breakthrough possible.

- Here's what made this feat possible:

- Researchers developed a new fiber containing 19 cores packed into a cable just 0.127 mm wide, the ***same size as standard cables***. This design minimizes light fluctuation and data loss.

    - **Side Note** - A cable with a conductor size of **0.127 mm** (which corresponds to **26 AWG**) is typically used in **low-voltage, high-speed data transmission** applications. Here are a few examples of where this size shows up:

    - **Common Cable Types with 0.127 mm Conductors**
    - **Ribbon Cables**
        - Often used for internal connections in computers and electronics (e.g., between a motherboard and a drive).
        - Example: TRU COMPONENTS TC-7638628 — a 64-pin ribbon cable with 7 conductors, each 0.127 mm wide.
    - **Multicore Shielded Cables**

        - Used in signal, voice, and data transmission for industrial and medical equipment.
        - These often feature multiple strands of 0.127 mm conductors bundled together for flexibility and shielding.
    - **Single-Core UL-Style Wires**
        - Found in electronics and prototyping, especially UL-Style 1061 or 10002.
        - These wires use 7 strands of 0.127 mm diameter copper to form a flexible conductor.
    - **Why Use 0.127 mm Conductors?**
        - **Flexibility**: Thin strands allow for tight bends and compact routing.
        - **Signal Integrity**: Ideal for short-distance, high-frequency signals.
        - **Space Efficiency**: Perfect for densely packed electronics.

    - Long-Distance Transmission: The data traveled 1,120 miles — about the distance from New York to Florida — by looping through the system 21 times, showcasing the fiber's strength over vast distances.

    - This speed is more than double the previous record of 50,250 Gbps set in 2024.

    - Because the cable matches existing dimensions, it could be deployed without overhauling current systems.

- **Global Impact:** With data traffic expected to surge, this innovation could revolutionize long-haul, high-capacity internet infrastructure.

- At this speed, you could download the entire Internet Archive in under four minutes.

- **Side note:** The "Internet Archive" refers to a massive digital library hosted at archive.org. It's a nonprofit project founded in 1996 with the mission of providing **universal access to all knowledge**. Here's what it includes:

- **Types of Content**
  - Over **562 billion web pages** via the Wayback Machine
  - Millions of **books**, including rare and out-of-print titles
  - Extensive collections of **audio recordings**, including live concerts and radio shows
  - Thousands of **videos**, from documentaries to vintage TV broadcasts
  - A vast archive of **software**, including playable retro games and emulators
  - Historical **images**, maps, and artwork
  - The total size of the Internet Archive exceeds **70 petabytes** of data.
  - It's one of the largest digital repositories in the world.

Story 2: Breakthrough US thermal coating cools buildings by 36°F, slashes AC bills, power use

Source: TimesofInnovation.com Story by Kir Birkin

Link: https://timesofinnovation.com/energy-efficiency/breakthrough-us-thermal-coating-cools-buildings-by-36f-slashes-ac-bills-power-use/

- A new AI-enhanced thermal coating can cool buildings up to **36°F** [approximately 2.2° Celsius], significantly reducing reliance on air conditioning.

- The technology was developed by an **international team of researchers** from:
    - University of Texas at Austin
    - Shanghai Jiao Tong University
    - National University of Singapore
    - Umeå University in Sweden

- The [building] coating reflects a large portion of solar heat and adapts in real time to environmental conditions.

- One of the most remarkable aspects of this breakthrough thermal coating is its integration of artificial intelligence (AI) technology in its development.

    - Through the use of AI algorithms [in the development phase], the coating is able to adapt to changing environmental conditions in real-time, optimizing its performance based on factors such as outdoor temperature, sunlight intensity, and building occupancy.

    - The AI in the University of Texas at Austin's thermal coating project isn't controlling the material in real time—it was used in the design phase [of the thermal coating] to engineer the coating's properties before application.

    - Here's how AI played a role in the creation of the material:

        - Researchers developed a machine learning framework to create thermal meta-emitters — materials that can selectively emit heat at specific wavelengths.

        - The AI explored over 1,500 material combinations, optimizing for cooling performance and energy efficiency.

        - Instead of manually testing materials, the AI used inverse design: it started with desired thermal properties and worked backward to find the best structure and composition.

        - This approach dramatically expands the design space, allowing for complex 3D geometries that outperform traditional thin-film coatings for buildings.

- The key to the effectiveness of this thermal coating lies in its advanced composition, which is designed to reflect a significant portion of the sun's heat away from the building.

    - By leveraging the principles of heat reflection and dissipation, this technology ensures that the interior spaces remain cool even in the hottest weather conditions.

    - As a result, occupants can enjoy a comfortable indoor environment without the need for excessive air conditioning, leading to lower electricity bills and reduced carbon emissions.

- **Applications**:
    - Residential and commercial buildings.
    - Potential use in textiles, vehicles, and even spacecraft for thermal regulation.

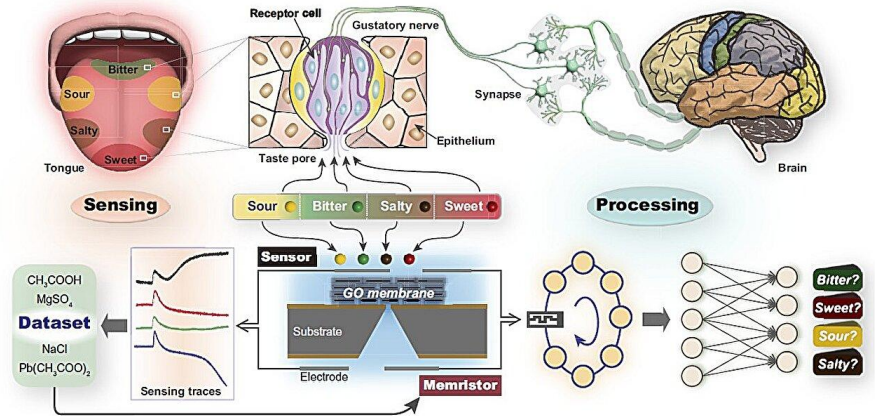
- **Performance Recap**: In tests, buildings coated with this material stayed up to **36°F cooler** than those with standard white or gray paints.

Story 3: Graphene-based artificial tongue achieves near-human-like sense of taste

Source: Phys.org Story by Charles Blue

Link: https://phys.org/news/2025-07-graphene-based-artificial-tongue-human.html

Research paper here: https://www.pnas.org/doi/10.1073/pnas.2413060122



- Scientists from several Chinese universities have developed a graphene-based "artificial tongue" that uses AI to mimic human taste perception with remarkable precision.

- Here's the essence of the innovation:

- Core Features & Functionality

    - Graphene Oxide Sensor: Built within a nanofluidic structure to detect chemical signals in moist environments—just like the human mouth.

    - Integrated Design: Combines both sensing and computing on one platform for real-time analysis.

    - Machine Learning: Trained on 160 chemicals to recognize flavor profiles by tracking changes in electrical conductivity.

- Performance & Accuracy

    - 98.5% accuracy with known flavors (sweet, salty, sour, bitter).

    - 75–90% accuracy with 40 unfamiliar flavors.

    - Capable of interpreting complex flavor blends like those found in coffee and cola.

- Potential Applications

    - Restoring taste perception in individuals affected by stroke, viral infections, or degenerative diseases.

    - Future uses in food safety, quality control, and even robotics—any field needing intelligent taste recognition.

- Challenges & Next Steps - Currently too bulky and energy-intensive for real-world use.

- Researchers aim to miniaturize and optimize power consumption for broader applications.

Story 4: Scientists Found the Staggering Natural Switch That Could Bring Back Your Eyesight - *Millions of people live with vision loss that we thought was permanent. This may change the equation.*

Source: Popular Mechanics Story by POPMECH Editors

Link: https://www.popularmechanics.com/science/health/a65438356/restoring-eyesight-breakthrough/

See also: https://scitechdaily.com/breakthrough-drug-restores-vision-researchers-successfully-reverse-retinal-damage/

KAIST researchers have developed a groundbreaking drug that restores vision by inducing retinal nerve regeneration, marking the first long-term neural regeneration in mammalian retinas. This treatment works by blocking the PROX1 protein, a key inhibitor of retinal regeneration, and has shown lasting effects in mouse models of retinal disease.

- Researchers at KAIST (Korea Advanced Institute of Science and Technology) have developed a groundbreaking drug that restores vision by regenerating

retinal nerves — marking the first long-term neural regeneration in mammalian retinas.

- How It Works
    - The drug targets PROX1, a protein that blocks retinal regeneration.
        - **Side note** - PROX1 (Prospero Homeobox 1) is a homeobox transcription factor—a type of protein that binds DNA and regulates gene expression, especially during development.
    - In mammals, PROX1 accumulates in Müller glia cells after retinal damage, preventing them from becoming regenerative stem cells.
        - **Side note** - **Müller glia cells** are the principal support cells of the retina—think of them as the retina's built-in maintenance crew and emergency responders.
        - Key Characteristics
            - **Location**: Found throughout the vertebrate retina, spanning its entire thickness from the inner to outer limiting membranes.
            - **Structure**: Radially oriented, making contact with nearly every retinal cell type—photoreceptors, bipolar cells, ganglion cells, and blood vessels.
            - **Origin**: Derived from neuroepithelial progenitors during retinal development.
    - By using an antibody to neutralize PROX1, researchers enabled these cells to regenerate retinal neurons.
- Results in Mice
    - In mouse models of retinitis pigmentosa, the treatment restored the photoreceptor layer and significantly improved vision.
    - The effects lasted over six months, a major milestone in retinal therapy.
- What's Next

- The therapy is being developed by Celliaz Inc., a biotech startup from the KAIST lab.

- Clinical trials are expected to begin by 2028.

- This could be a game-changer for millions affected by degenerative retinal diseases like macular degeneration and glaucoma.

Honorable Mentions

Story: Scientists extracted water and oxygen from moon dust using sunlight. Could it work on the lunar surface?

Source: Space.com Story by Keith Cooper

Link: https://www.space.com/astronomy/moon/scientists-extracted-water-and-oxygen-from-moon-dust-using-sunlight-could-it-work-on-the-lunar-surface

An artist's impression of a moon base. (Image credit: ESA - P. Carril)

- Chinese scientists have developed a one-step method to extract water and oxygen from lunar soil using **sunlight**, potentially revolutionizing how future moon missions sustain life.

- The process uses photothermal catalysis, where sunlight heats lunar regolith (soil) to release water vapor.

- That vapor is then combined with **carbon dioxide** (like what astronauts exhale), and catalyzed by **ilmenite**, a mineral in moon dust, to produce oxygen and methane —the latter being a stable rocket fuel.

- Transporting water from Earth to the Moon costs about $83,000 per gallon, and astronauts need ~4 gallons daily.

- This method could drastically reduce costs and infrastructure complexity for lunar bases.

- Tests used simulants based on samples from China's **Chang'e 5 mission**.

- Experts caution that lunar regolith is a strong thermal insulator, making uniform heating difficult.

- The Moon's extreme temperature swings and dust could complicate machinery reliability.

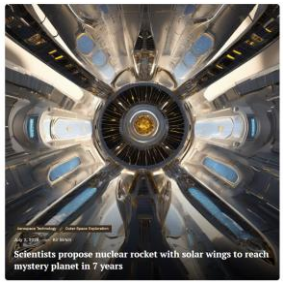
- Astronauts may not produce enough CO_2 to sustain the reaction, possibly requiring supplemental sources.
- Researchers aim to scale the technology and test its viability under actual lunar conditions.

- If successful, it could support in-situ resource utilization (ISRU)—using local materials to sustain human life and exploration.

Story: Scientists propose nuclear rocket with solar wings to reach mystery planet in 7 years

Source: Timesofinnovation.com Story by Kir Birkin

Link: https://timesofinnovation.com/aerospace-technology/scientists-propose-nuclear-rocket-with-solar-wings-to-reach-mystery-planet-in-7-years



- Scientists have proposed two advanced spacecraft designs to explore Sedna, one of the most distant objects in our solar system, within a timeframe of seven years. Here's a breakdown:

- Target: Sedna
    - Sedna is a cold dwarf planet discovered in 2003, located well beyond Pluto.
    - It has an extremely long orbit, taking 10,000 years to circle the Sun.
    - Its next close approach (perihelion) to the Sun is in 2076, making it a prime opportunity for exploration.

- Two Spacecraft Concepts
    - Nuclear Fusion Rocket (Direct Fusion Drive):
        - Under development at Princeton Plasma Physics Lab.
        - Provides both thrust and electrical power.
        - Promises high-speed travel with potential orbital insertion around Sedna.
        - Faces engineering challenges like plasma stability and radiation resistance.

    - Solar Sailcraft:
        - Uses sunlight for propulsion via large reflective sails.
        - Lightweight and fuel-free, could reach Sedna in seven years.
        - May include a thermal desorption upgrade to boost propulsion.
        - Could only perform a flyby, not orbital operations.

- Sedna's 2076 perihelion brings it within a relatively reachable 7 billion miles from the Sun. This distance makes exploration feasible using these novel technologies.

Story: US firm's reactor [NuScale Power Corporation] to supply hydrogen, electricity for 400,000 homes, water for 2.3 million people

Source: InterestingEngineering.com Story by Aman Tripathi

Link: https://interestingengineering.com/energy/us-firm-reactor-supply-hydrogen-electricity

NuScale is looking to broaden the impact of its SMR technology, moving beyond just generating electricity. NuScale

- US-based NuScale Power Corporation has initiated research programs to develop an integrated energy system capable of concurrent clean water desalination, energy-efficient hydrogen production, and carbon-free power generation.

- The announcement signals the company's strategy to expand the application of its small modular reactor (SMR) technology beyond electricity production to address industrial and environmental challenges.

- The proposed system would couple a NuScale Power Module (NPM) with a reverse osmosis desalination facility. According to company projections, a single NPM could yield approximately 150 million gallons of clean water daily without carbon emissions.

- "12 NPM's would be able to provide desalinated water for a city of 2.3 million residents and also have surplus power to provide 400,000 homes with electricity," said the company in a press release.

Story: Researchers [at MIT] create AI-based tool that restores age-damaged artworks in hours

Source: The Guardian

Link: https://www.theguardian.com/science/2025/jun/11/researchers-create-ai-based-tool-that-restores-age-damaged-artworks-in-hours?CMP=share_btn_url

The first step in the process is to scan the painting to create a damage map to show where restoration is needed. Photograph: Alex Kachkine, MIT

- Researchers at MIT have developed a revolutionary method to restore age-damaged paintings using artificial intelligence and polymer film technology. Here's a structured summary of the key points:

- How It Works
    - A damaged painting is scanned and digitally reconstructed using AI tools.
    - The restoration is printed onto a thin, transparent polymer mask.
    - This mask is carefully aligned and adhered to the original artwork using conservation-grade varnish.
    - The process is **fully reversible**, allowing future conservators to remove the mask without harming the original.

- Speed & Precision
    - The technique restored a 15th-century oil painting in **just 3.5 hours**, compared to months or years using traditional methods.
    - It identified **5,612 damaged regions** and matched them with **57,314 distinct colors**.
    - The digital file of the mask serves as a permanent record of the restoration.

- Who’s Behind It
    - Developed by Alex Kachkine, a mechanical engineering graduate student at MIT.
    - Inspired by his own experiences restoring art and visiting galleries with large collections of damaged, unseen works.

- Ethical Considerations
    - The method is designed to preserve the artist’s original intent and style.

    - Experts emphasize the importance of involving trained conservators to guide its use.
    - Best suited for lesser-known or lower-value works that might otherwise remain in storage.

- Broader Impact - Could dramatically increase public access to art by reviving neglected pieces. Offers a scalable, cost-effective alternative to traditional restoration.