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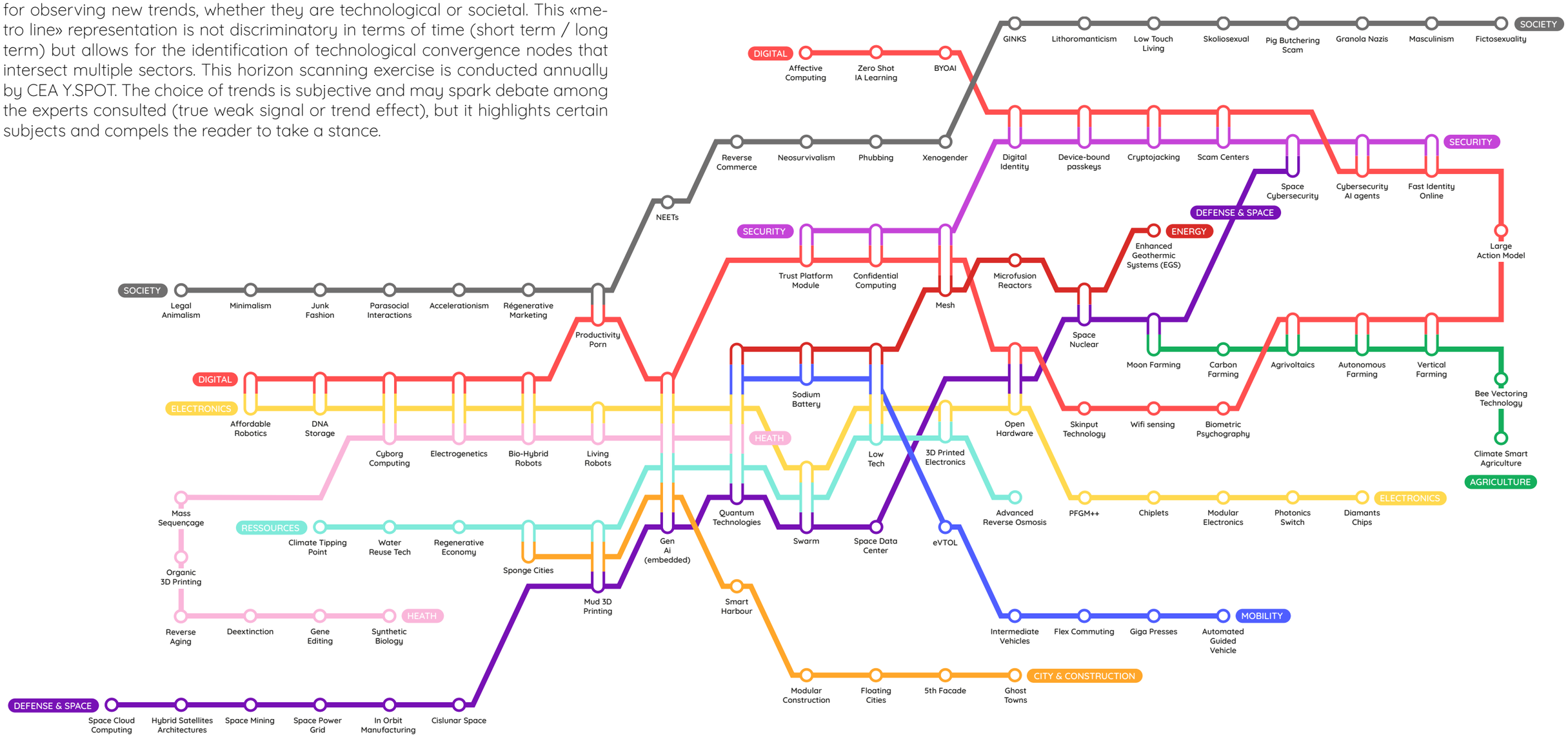
WEAK SIGNALS & EMERGING TECHNOLOGICAL TRENDS 2024

This map aims to identify topics of interest to monitor and include in a radar for observing new trends, whether they are technological or societal. This «metro line» representation is not discriminatory in terms of time (short term / long term) but allows for the identification of technological convergence nodes that intersect multiple sectors. This horizon scanning exercise is conducted annually by CEA Y.SPOT. The choice of trends is subjective and may spark debate among the experts consulted (true weak signal or trend effect), but it highlights certain subjects and compels the reader to take a stance.



Y SPOT

3D Printed Electronics

3D printed electronics is generally defined as an approach that enables the integration of electronics into objects. Numerous technologies are currently being developed with various advantages and disadvantages.

5th Façade

With more than half of the world's population living in cities and increasing urbanization, buildable and shared spaces are becoming significant urban, energy, and social issues. Consequently, the rooftops of our cities, «offering everything urban dwellers lack – peace, air, space, a horizon, views,» are now the new Eldorado for all city stakeholders.

Accelerationism

An emerging movement gaining popularity in Silicon Valley, «accelerationism» advocates the limitless intensification of capitalism driven by increasingly efficient technologies. Originally stemming from the American democratic left, this philosophy has now been co-opted by some white supremacists.

Advanced Reverse Osmosis

Many water desalination processes exist but require substantial amounts of energy or materials (filters, etc.). Recent advancements in reverse osmosis processes lead to more reliable energy consumption and longer lifespans.

Affective Computing

Automatic recognition of gestures/postures and video avatars. Solutions to capture emotions from images, sound, and wearable or implantable physiological sensors.

Affordable Robotics

Just like drones or personal cameras, China is copying Boston Dynamics robots and providing robot dogs for a few hundred dollars. The use of multimodal generative AI to communicate and enable the robot to recognize its environment allows for imagining varied uses for a range of users. This mass adoption of robotics is a crucial step for user appropriation but will likely lead to misuse (surveillance, terrorism, etc.).

Agrivoltaics

Agrivoltaics is a layered system that combines photovoltaic electricity production with agricultural production underneath the same surface. A study by the Fraunhofer Institute showed that for certain types of crops (vineyards, etc.), the shade provided during the hottest days can be beneficial by limiting dehydration.

Autonomous Farming

While autonomous cars in cities are not imminent, agriculture provides a more suitable deployment ground for these technologies (private plots, single users). We are witnessing a change in agricultural practices to automate labor-intensive and machine-heavy tasks through the adoption of autonomous systems.

Bee Vectoring Technology

Biological fungicides are mixed with a powder, placed in bumblebee or honeybee hives, which then disseminate them while foraging flowers, protecting crops against botrytis, for example.

Bio-Hybrid Robots

The last decade has seen the rapid expansion of the biohybrid robotics field. By combining synthetic components and living biological materials, new robotic solutions have been developed that exploit the adaptability of living muscles, the sensitivity of living sensory cells, and even the computing capabilities of neurons.

Biometric Psychography

Biometric psychography relies on a set of bodily data (such as those generated by facial scanners, eye-tracking, and electromyography) that are as unique to an individual as a fingerprint. This technology, related to virtual reality, can be used for identifying a person, as well as understanding their emotions and mental state by detecting and analyzing involuntary micro-expressions and brain waves.

BYOAI (Bring Your Own Artificial Intelligence)

Unlike standardized AI systems provided by employers, BYOAI allows individuals to use AI solutions tailored to their specific work methods to increase productivity.

Carbon Farming

A set of agricultural practices aimed at preserving and enhancing the soil's ability to absorb and sustainably store carbon.

Chiplets

Small integrated circuits containing well-defined subsets of functionalities, which can be combined in mix-and-match «Lego-type» assemblies. The idea behind this is a modular design that allows many small components to perform the work of a much larger system, with improved performance, reduced power consumption, and increased design flexibility.

Cislunar Space

Cislunar space refers to the area surrounding Earth, extending up to the Moon's orbit, approximately 400,000 kilometers away. Cislunar space will play a crucial role in supporting missions to the Moon and enabling transportation, fuel depots, communication satellites, and space stations that can serve as waypoints for deep space missions.

Climate Smart Agriculture

A set of agricultural practices and technologies that simultaneously boost productivity, enhance resilience, and reduce greenhouse gas emissions.

Climate Tipping Point

The climate system responds like a non-linear system, inducing tipping points which are thresholds that, when crossed, lead to significant, often irreversible changes (points of no return) that qualitatively alter the state or trajectory of a system.

Confidential Computing

Confidential computing is a cloud computing technology that isolates sensitive data in a processor enclave protected during processing. The contents of the enclave—namely, the data being processed and the techniques used to process it—are accessible only to authorized programming code. They remain invisible and inaccessible to everyone, including the cloud provider.

Cybersecurity AI Agent

AI agents are autonomous entities that can make decisions and perform tasks independently. In cybersecurity, these include systems such as advanced intrusion detection systems, automated response protocols, and proactive threat-hunting tools.

Cyborg Computing

In recent years, advancements in electronics have emerged to interface with neural cells. A new approach being developed uses the plasticity of brain organoid cells directly for learning and solving simple mathematical problems.

Cryptojacking

A contraction of «cryptocurrency» and «hijacking,» cryptojacking refers to the act of hijacking an electronic device to mine cryptocurrencies without the user's consent, via websites or computer viruses.

Deextinction

The process of resurrecting extinct species. Once considered a fanciful notion, the possibility of reviving extinct species (mammoth, thylacine, dodo, etc.) has been raised by advancements in selective breeding technologies, genetics, and reproductive cloning. George Church, a geneticist at Harvard University and co-founder of Colossal Laboratories, recently revealed that he has successfully converted Asian elephant cells into induced pluripotent stem cells (iPSCs). The startup now aims to convert these iPSCs into eggs and sperm carrying selected genetic traits. From there, the plan would be for a surrogate elephant mother to carry a fertilized egg.

Device-bound Passkeys

Based on FIDO standards, non-exportable passkeys tied to a device replace passwords and allow faster, easier, and more secure logins to websites and applications on a user's devices.

Diamond Chips

In an increasingly energy-conscious world, the demand for high-power applications with superior efficiency and power density is booming. As silicon approaches its physical limits, the semiconductor industry is exploring other avenues for better energy efficiency, including diamonds, which are ideal candidates for high-voltage operations, high-temperature applications, or high-frequency switching.

Digital Identity

Digital identity is defined as a technological link between a real entity and virtual entities. It allows for the identification of individuals online and connects them with all virtual communities on the web. By 2024, all EU member states must offer all their citizens a digital identity wallet that includes all identification documents.

DNA Storage

DNA data storage refers to the process of encoding and decoding binary data to and from synthetic DNA strands. Information is not coded in binary with the digits 0 and 1 but using the genome's alphabet. This type of storage is suitable for archiving but not for frequent access. Recent advances in genomic and proteomic sequencing are advancing the field.

Electrogenetics

A combination of electronics and genetics, it is an emerging field in mammalian synthetic biology where electrostimulation is used to remotely program user-designed genetic elements in engineered cells to generate desired outcomes.

Enhanced Geothermal Systems (EGS)

An enhanced geothermal system that generates geothermal electricity without natural convective hydrothermal resources. Fervo Energy tested one of these systems last year in Nevada and proved its commercial viability.

eVTOL (electric Vertical Take-Off and Landing)

Electric vertical take-off and landing aircraft born from major advances in electric propulsion and the growing need for new vehicles for urban air mobility (air taxis). Many aircraft have received certifications to fly, and some are announcing their first commercial flights.

Fast Identity Online

The Fast Identity Online (FIDO) Alliance is a consortium of leading technology companies, government agencies, service providers, financial institutions, payment processors, and other sectors aiming to eliminate the use of passwords on websites, applications, and devices. The consortium was launched 10 years ago and has gained increasing influence in recent years.

Fictosexuality

A generic term for anyone who experiences exclusive sexual attraction to fictional characters, a general type of fictional characters, or whose sexuality is influenced by fictional characters.

Flex Commuting

Following COVID and the adoption of remote work, many employees are adjusting their work schedules and changing their means of transportation to avoid time losses and reduce their carbon footprint (electric micro-mobility, etc.). Flexible mobility services are thus being offered to companies to adapt to these new behaviors.

Floating Cities

In response to rising ocean levels that will affect many coastal cities, numerous floating city projects are emerging in different countries (Maldives, United Arab Emirates, Netherlands, Germany, etc.).

Gene Editing

In a world first, researchers at the University of Amsterdam have succeeded in eliminating the human immunodeficiency virus (HIV) from infected cells using CRISPR. Other gene therapies have been approved in the USA for sickle cell disease.

Generative AI

Digital

Unlike discriminative AI (image recognition, etc.), generative artificial intelligence (generative AI) is a type of AI capable of creating new content and ideas, including conversations, stories, images, videos, and music. It generally uses Large Language Models (LLMs) and requires training through neural networks.

Electronics

The rise of generative AI has been fueled by Nvidia and its advanced GPUs. As demand far exceeds supply, a race is underway by players such as Microsoft, Meta, OpenAI, Amazon, and Google to develop their own AI processors. Recently, Microsoft is considering creating a supercomputer with OpenAI called Stargate, with a budget of $100 billion and millions of accelerators, consuming 5 gigawatts of power.

Health

One of the most striking applications of generative AI in EEG analysis is the translation of brain waves into text. This involves using deep learning models to interpret EEG data patterns, correlating them with specific thoughts or words.

Giga Presses

Injection Giga Presses for manufacturing aluminum parts are starting to appear on the market, with Tesla at the forefront of their use. Such presses aim to reduce the number of parts needed to manufacture a vehicle and shorten the assembly line due to the reduced number of component manipulations and lower production costs. However, a component made in one piece becomes inherently more difficult to repair.

GINKS

An acronym for «Green Inclination No Kids,» an English term for people who choose not to have children for ecological reasons. In the absence of a French equivalent, they are referred to as a gink, or ginks. They constitute a portion of the «childfree by choice» community.

Ghost Towns

With the current economic real estate crisis in China, as well as other real estate crises such as the one in Spain in 2019, ghost towns—either uninhabited or in the process of depopulating—are emerging. Faced with accelerating societal and economic changes, a study by researchers from the University of Chicago predicts that by 2100, the population of some 15,000 towns across the country could shrink to just a fraction of what it is today.

Granola Nazis

A growing group of «right-wing hippies» who combine a reactionary desire for a return to a «natural» hierarchy with practices rooted in values referring to the «ecofascism of the Third Reich» and the «green wing» of the Nazi party, which was closely interested in ecology, celebrating agriculture, health, and organic food.

Hybrid Satellite Architectures (HSA)

A program launched by the USA that aims to integrate commercial and government satellites to maintain an ultra-resilient communication infrastructure. The architecture will link multiple ground communication systems to various satellite networks, using all available links, including laser links, radiofrequency, military tactical data links, and existing and future ground segment networks.

In Orbit Manufacturing

Whether it's the manufacturing of medicines or 3D printing of polymers, space manufacturing is gaining new momentum with Artificial Intelligence enabling autonomous production. Increasingly, projects for autonomous assembly platforms are emerging in space, notably NASA's projects (OSAM-2) or ISAM (In-Space Assembly and Manufacturing).

Intermediate Vehicles

Intermediate vehicles refer to all vehicles under 600 kg situated between the traditional bicycle and the car, capable of carrying 1 to 2 people. Due to their much more modest and lighter size compared to cars, intermediate vehicles are also much more resource-efficient than cars (about 1,250 kg). These resource savings become crucial for the critical metals of the energy transition.

Junk Fashion (Fast Fashion)

Derived from the term «junk food,» which represents poor-quality food that is harmful in the long term, this term refers to low-quality ready-to-wear clothing found at Chinese retailers (Shein, etc.). In contrast, there are «Junk Kouture» movements, a recycled fashion competition challenging high school students to create wearable fashion from unwanted materials.

Large Action Model (LAM)

LAMs are designed to understand and execute complex tasks based on user wishes. This is done by analyzing a sequence of performed actions and then reproducing those actions.

Legal Animalism

A movement advocating for animals and elements of nature (rivers, forests, etc.) to have their own legal code, considered as subjects of rights similar to persons.

Lithoromanticism

A person who seeks romantic love but does not wish for their feelings to be reciprocated: «it's a desire for one-sided romance that delights in the absence of return.»

Living Robots

Xenobots are programmable living forms generated by computer and created from stem cells harvested from the African frog, Xenopus laevis. These «organisms» can swim in their culture medium, find single cells, or assemble together. Potential applications could be in regenerative medicine, leveraging their self-replication and self-healing properties.

Low Tech

Low tech does not oppose high tech but proposes simplifying technologies to make them more accessible, easily repairable, and reliant on commonly available and locally sourced materials.

Low Touch Living (& Economy)

An economic model that encourages minimal or no contact between people and prioritizes the digitalization of businesses.

Masculinism

Masculinism is most often defined as a reactionary, misogynistic, androcentric, and anti-feminist movement. Its supporters consider the term derogatory and prefer to speak of «hominism.»

Mass Sequencing

While the first human genome sequencing project completed in 2003 required $2.4 billion and several years of work, new sequencing methods are disrupting the field. Recently, companies like Illumina claim the ability to sequence an entire genome for $200 in less than a day.

Mesh

A meshed electrical network system that connects off-grid homes to a network of solar and battery systems on rooftops, which can intelligently share energy among themselves without the need for centralized infrastructure or vast solar panel fields. Companies like Australia's OKRA SOLAR or Japan's HITACHI offer such services.

Microfusion Reactors

In addition to historic initiatives like the ITER project, numerous startups around nuclear microfusion have emerged in recent years, adopting the view that less complex systems can more quickly achieve electricity production from fusion.

Minimalism

Born in Japan, minimalism is a lifestyle where you limit what you own to the absolute minimum needed to live.

Modular Construction

Modular construction refers to a mode of building popularized after World War II. This construction method involves manufacturing and assembling standardized structures in a factory, which are then transported and installed on the construction site. The main advantages are faster construction, reduced waste, and compatibility with «Design for Disassembly.»

Modular Electronics

Modularity in electronics allows for more system reparability and design flexibility. Some smartphone brands have launched concepts like the FairPhone, which allows most parts of the phone to be changed, or more recently, the Framework 16 laptop brand. In the realm of electronic chips, the concept of chiplets brings more modularity to design, moving towards more modular electronics.

Moon Farming

To consider long-term missions on the moon, it will be necessary to grow food on-site, and American researchers have managed to grow plants on regolith.

Mud 3D Printing

Instead of buildings and structures made of wood, concrete, or steel, the company 3D WASP has developed a 3D printer that uses clay for the construction of houses.

NEETs (Neither in Employment nor in Education or Training)

A person who is neither employed nor in education or training (formal or informal).

Neosurvivalism

An evolution of survivalism that differs by aiming for independence from society, not just preparing for a disaster. It is no longer about preparing for a crisis, but simply living autonomously and detaching as much as possible from modern dependencies.

Open Hardware

Just as Open Source has enabled the development of communities with support dynamics and software development libraries, an emerging movement in hardware is taking shape. The advantage of open hardware will be to provide shareable standards among different hardware manufacturers, making electronics more modular, repairable, and providing more freedom for end customers. There are many obstacles, such as finding a viable economic model, but many actors are already interested, especially in the military sector, to offer more flexibility in the maintenance of weapon systems.

Organic 3D Printing

In recent years, significant advances have been made in the construction of various vascularized tissues through 3D printing, greatly promoting the development of biological tissue engineering.

Parasocial Interactions

A parasocial relationship or interaction is a type of one-sided social relationship that a person may experience towards a public figure or fictional character.

PFGM++ (Poisson Flow Generative Model)

A new family of physics-inspired generative models that unify diffusion models and Poisson Flow Generative Models (PFGM) for better shape recognition and the ability to generate complex models, such as creating realistic images and replicating real processes.

Photonics Switch

To meet the growing needs of AI, supercomputers face a bottleneck in data transfer speeds, as the demand for faster data transfer has exceeded the capabilities of electronic switching. Optical switching technology, which uses light to transmit data (faster, less latency, and more energy-efficient), is set to become prominent in the next decade for interconnecting electronic chips.

Phubbing

«Phubbing» is a portmanteau of «phone» and «snubbing.» Phubbing is the act of ignoring people physically present by looking at your phone instead of communicating with them.

Pig Butchering Scam

A trust and investment scam in which the victim is gradually persuaded to make increasing contributions in the form of cryptocurrency to an apparently solid investment before the scammer disappears.

Productivity Porn

In English, the term «productivity porn» refers to the practice or even addiction to reading articles, books, or watching videos about people who have changed the world or on techniques to be more productive.

Quantum Technologies

Quantum technologies are segmented into several categories: quantum computing, quantum sensors, quantum communication, and post-quantum cryptography. The latter are more advanced, while quantum computing faces many challenges (stability and scalability). Applications of quantum computing are expected in many fields: mobility, energy, finance, security, etc., allowing the acceleration of certain types of problems (optimization, simulation, etc.).

Regenerative Economy

What separates the regenerative economy from standard economic theory is that it considers and attributes real economic value to primary and original assets—land and the sun.

Regenerative Marketing

Regenerative marketing opposes short-sighted growth marketing, focusing on rebuilding trust, nurturing lasting relationships, and having a positive impact on both society and the environment.

Retconning

The concept of retroactive continuity (commonly referred to as «retcon») refers to the alteration of established facts in a previous work of fiction by adding new explanatory elements. This kind of process is used to stay faithful to the canon of a fictional universe, for explanatory or improvement purposes.

Reverse Aging

A study by scientists at Harvard Medical School has demonstrated that a combination of drugs administered to mice can reverse the aging process. The treatment not only rejuvenated the skin but also revitalized muscles and vital organs in a remarkably short time.

Reverse Commerce

Recommerce or reverse commerce refers to the resale of second-hand goods between two entities via the internet or through physical distribution networks.

Scam Centers

Organized call centers specializing in fraudulent schemes aimed at extracting funds from citizens. Fraudsters may call individuals, posing as bank security personnel or mobile phone operators, to obtain card information and SMS codes to divert victims' funds.

Smart Harbour

The concept of a smart harbor is gradually emerging as an unprecedented and vital challenge for the future of maritime trade. It can significantly reduce costs thanks to new technologies that will enable much more dynamic and just-in-time management.

Sodium Battery

Although heavier, sodium-ion batteries offer an alternative to lithium-ion batteries, with advantages such as lower cost and better performance in cold conditions. BYD and Huaihai have partnered to jointly build a sodium-ion battery plant with an annual capacity of 30 GWh.

Space Cloud Computing

Increasing amounts of data are generated by observation satellites and sent to Earth for processing. The need for processing directly by satellite edge computing and storing data at the core of a satellite network is growing. Numerous programs are emerging in Europe and the USA to build data clouds and computing power in space.

Space Cybersecurity

One of the greatest threats in space cybersecurity is the hacking of spacecraft and satellites. The war in Ukraine saw the use of jamming and other cyberattacks on SpaceX's Starlink terminal.

Space Data Center

The principle involves installing data center stations in orbit powered by solar plants to reduce the carbon footprint of computing by using solar energy outside Earth's atmosphere. The European Union is considering space-based processing and storage installations through a project called ASCEND.

Space Mining

Although still a relatively distant prospect, increasing capital is being invested in startups in the extraterrestrial mining sector (asteroids, moon, etc.).

Space Nuclear Power

The recent renewed interest in space exploration offers fertile ground for the application of nuclear technologies. Examples include the French Atomic Energy Commission (CEA) and ArianeGroup developing a thermonuclear propulsion engine, or Framatome partnering with Qosmosys to develop Radioisotope Thermoelectric Generators (RTG).

Space Power Grid

Space-based solar power (SBSP, SSP) is the concept of collecting solar energy in space using solar power satellites (SPS) and distributing it to Earth. Its advantages include greater energy collection since there is no atmospheric absorption of solar rays and little night time. The goal is to create a network of satellites capable of exchanging energy among themselves to form an energy grid in space.

Sponge Cities

A sponge city, or permeable city, is a type of resilient city capable of absorbing rainwater into the soil and wetlands to regulate urban flooding and reduce vulnerability during drought periods.

Skinput Technologies

An input method that allows users to interact with electronic devices through touch input on their skin. This technology uses bioacoustic detection to interpret acoustic signals generated by tapping or sliding fingers on the skin, mapping these signals to various device inputs.

Swarm

Swarm technologies are increasingly developing, whether in the military domain with swarm drone development or in the mining industry with autonomous vehicles developed by the company OFFWORLD. Advances in swarm technology are closely tied to progress in electronics, allowing sensor miniaturization, reduced power consumption, and AI integration at the hardware level. Future developments to watch include heterogeneous swarms.

Synthetic Biology

Synthetic biology aims to design and develop in the laboratory biological systems that do not exist in nature or to rebuild existing systems by modifying them. It seeks to create standardized components that can be assembled, in a controlled process, into standard systems capable of performing a given function. Although this trend is quite old (the first Synthetic Biology 1.0 conference was organized at MIT in 2004), progress in researching minimalist synthetic bacteria is increasingly highlighting this discipline.

Trusted Platform Module

A microcontroller or computer chip that can securely store artifacts used to authenticate the platform (your PC or laptop). The chip includes several physical security mechanisms to make it tamper-proof, and malware cannot tamper with the TPM's security functions.

Vertical Farming

Vertical farming allows vegetables and herbs to be grown in vertically stacked layers with yields up to 200 times higher and water consumption up to 250 times lower than open-field farming. The economic model, however, relies on high-value-added plants because these farms are highly dependent on the cost of energy for lighting.

Water Reuse Tech

The main objective of wastewater reuse is not only to provide additional quantities of high-quality water by accelerating the natural water purification cycle but also to ensure the balance of this cycle and protect the surrounding environment. Increasing research is being conducted to find more economical and efficient systems.

WiFi Sensing

WiFi sensing uses existing WiFi signals to detect events or changes such as movements, gesture recognition, and biometric measurements. Orange is developing a system based on this technology that could be integrated into Liveboxes.

Xenogender

The neologism xenogender comes from the Greek xeno (the other). Xenogenders are individuals who identify with an «other» gender: animal, plant, inanimate object, or even «mood.»

Zero Shot Learning (ZSL)

Zero-shot learning is a machine learning method where a model can recognize objects or concepts it has never seen during training.