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Abstract

The Internet of Things (IoT) is a platform for innovation, allowing people to invest in and use IoT to improve life, business, and society.It will be applicable to all or any industry sectors, verticals, people, machines, and everything.This creates difficult requirements in terms of higher system capacity, extremely low latency, such as for the tactile Internet, extremely high throughput values, a wide range of services, such as IoT and M2M, and a more uninterrupted experience.As a symbiotic confluence of up to date and existing technologies, the IOT architecture will use Hetnet RAN, Cloud enhanced RAN, and SW defined data centres to combine novel and legacy technologies.As a result, IOT will combine next-generation large-area extensible service experiences anytime and anywhere, with ultra-dense installations, near-zero latency, and GB experiences–when and where it matters.Collaboration on research, standardisation, and spectrum sharing with the IT/Internet world, industry verticals, policymakers, and academia is a significant success element.Trillions of dollars in smart ecosystems prospects covering secure connections, digital service enablement, applications and repair provisioning, and a wide range of internet of things and consumer applications are available to communications service providers and enterprises.

Keywords: IoT; Ecosystem; Hetnet RAN; Latency; Smart Healthcare

1. Introduction (Smart Ecosystems: An Overview)

Whether it's a digital consumer or a digital worker, customers' faith is rapidly decreasing.Consumers are now deploying their voices to communicate with digital assistants, which regulate their digital services—from video streaming to social media—in a step-by-step fashion. They aren't going to consider the significance of their contacts in terms of security or fraud liability. They are especially concerned over whether or not their digital assistants get the context of who they are and what they're looking for in a very concrete sense. They're hoping for an experience in which their voices are all that's required to elicit the data they've gathered. They are looking for real-time interactions with no interruptions.

Similarly, today's employees use touch to collaborate digitally with their co-workers. They want to be able to securely collaborate and communicate with their teams in real time via voice, video, or text on any app or device in any location. They also expect their personal preferences, such as data sharing, privacy, and involvement, to be respected. Following that,

smart ecosystems, whether it's a smart home, a smart workplace, or a smart city, where participants and 'things' can engage, accomplish, and exchange information using a shared digital platform, are created. The following are common features of successful smart ecosystems;

- Analytics, Artificial Intelligence (AI), Machine learning (ML), and Deep learning (DL) based network and cloud infrastructure, systems, software, and apps that give a more personalised, smooth, and secure digital experience.
- Customers and partners who can supply shared services employing the same infrastructure and applications.
- Accessibility from a wide range of devices and sensors connected to the Internet of Things (IoT) [3]. "Chicago," one of the world's leading smart cities, is an excellent example of an ecosystem that combines data, information, partnerships, monetization models, cloud, and connectivity infrastructure to improve citizens' lives and the city's reputation. The number of smart services in Chicago is as follows.
    - Snow Removal: Residents in the city use applications to track when their street will be serviced and where snowplows are tracked [4].
    - Residents can track the transit system, and measures are in place to ensure that traffic lights turn green faster when a bus arrives.
    - Smart Lighting: The town has installed Light Emitting Diode (LED) lights that might save up to 60% on energy expenditures, as well as IoT sensors that will notify maintenance staff when the lights go out. This improves security while also saving money [4].
    - Pollution Monitoring: Pollution of a particular area is measured by implementing sensors. Sensors in different places of city monitor the pollution levels and sound an alarm, if pollution label cross the maximum limit.

2. **Smart Ecosystems are Driven by Three Key Innovations:**
   Successful Smart Ecosystems will be built on three major innovations. They include network slices-as-a-service, a Cloud-based digital business engine, and end-to-end security across Cloud & Networks, as well as secure identity management. Fig. 1 depicts the interaction of these advances.

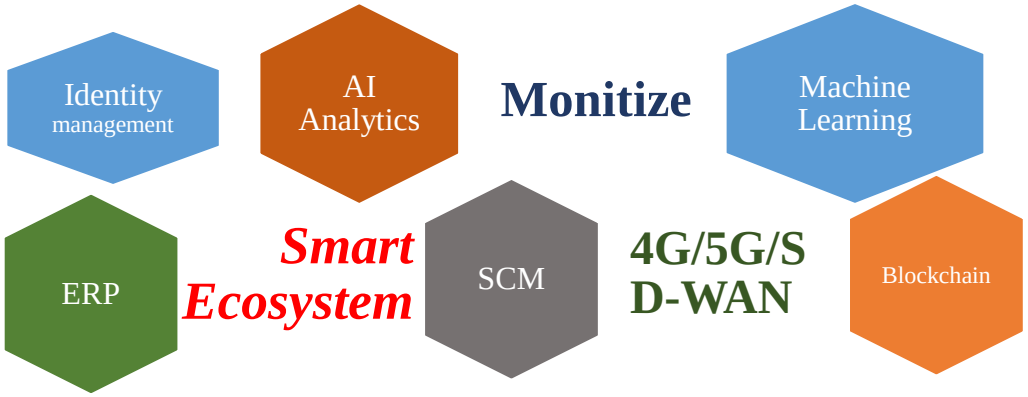

Fig. 1: Innovations in Smart Ecosystems

2.1. Network Slices-as-a-Service with Embedded Cloud and 4G/5G/SD-WAN Networks

Policy-driven network slicing, service-based and cloud-native architectures, and policy-driven network slicing are just a few of the fascinating new concepts that 5G brings to mobile networks. Not to mention SD-WAN technology, which provides secure, application-aware cloud connectivity and IT-centric cloud services. These innovations enable CSPs and enterprises to create new revenue-generating digital services by leveraging purpose-built, dynamic network slices that provide an incremental and cost-effective approach to 5G evolutions while meeting the stringent requirements of vertical applications, devices, users, and customer segments. Below are a few examples:

- For street lights, traffic management, smart metres, and water/waste management, a comprehensive IoT [3] slice with high scalability and enormous data sets is available.
- For sporting events, customer data, payments, and fleet management, a stronger mobile broadband slice with high data speeds, high security, and high mobility is required.
- A private smart factory slice for automated manufacturing with high dependability, low latency, high security, and high data speeds.
- For first responders, autonomous emergency vehicles, and emergency healthcare, a mission-critical applications slice with high reliability, low latency, and high security.
- Using integrated computational techniques like machine learning (ML), deep learning (DL) scale, secure, and analyse billions of transactions and zettabytes of data generated by digital services.
- As more people and "things" become connected and speak with one another, this new technology can be used to manage billions of devices, as well as simplify and automate network and cloud tasks.

2.2. Digital Business Engine (Integrated with Cloud based Technology)

The second new technology, cloud-based digital business engines, will be necessary to profitably monetize 5G and Cloud-based smart ecosystems services, as well as to address the high expectations of today's digital consumers and workers. The Communication Service Providers (CSPs) and businesses will be empowered to use this digital business engine in the following manner;

- The second new technology uses a variety of usage, subscription, transaction, sponsorship, and slice-as-a-service models to build digital services and consumer data.
- It also generates revenue out of digital engagement in order to empower clients and provide a unique brand experience.
- It provides smart cities, smart homes, and smart workplaces with fully integrated applications.

- Cloud-based AI, machine learning, security, and blockchain capabilities were used to create tailored consumer experiences, resulting in new ideas and business strategies.
- It can quickly create, develop, and coordinate new network slice-based solutions that integrate existing physical and virtual network functionalities including 5G and SD-WAN.
- With shared cloud, network, commercial, and customer experience infrastructure and technologies, it also enables extensive partner ecosystems.

2.3. Security aspects across Network, Cloud, and Identity management (An End-to-End approach)

The cloud and network infrastructure have become complicated, making them more vulnerable to cyber-crime and fraud. To manage and secure smart ecosystems and communications, as well as protect against costly outages, loss of sensitive data, fraud, and network breaches, end-to-end security innovation is necessary. This involves four tiers of protection as discussed below;

I. Applying policies and AI-based signalling analytics to detect and act on aberrant events and prevent fraud are all part of core network security.

II. SD-WAN technology enables enterprise network security by providing fail-safe, policy-driven cloud connectivity, as well as session border management to prevent fraud, automatically identify, alert, and block traffic, and analyse call trends. Enterprise policy generation and enforcement that is automated can identify attackers, their locations, and the tools needed to avoid repeat intrusions.

III. To mitigate vulnerabilities, cloud infrastructure security that is highly automated, detective, and predictive is required. Self-managing, tuning, and patching databases with integrated AI, ML, and analytics capabilities check for security threats and apply security updates while running. This could be crucial in preventing cyber assaults and data theft, as well as allowing users to innovate more quickly on a robust security platform.

IV. Secure identity management for smart ecosystems that integrates mobile device, network information, 'know your customer' attributes, and fingerprints to securely verify, authenticate, and permit individuals and things for digital services.

3. Case Studies on Smart Ecosystems

As shown in Table 1, certain organisations, such as Oracle, are currently collaborating with customers and partners to successfully deliver digital services and smart ecosystems. Many of these smart ecosystems will be enabled by IOT via 5G in the coming years.

Table 1: case study of Smart Ecosystem

Services based on IoT	Description
Smart Home	Smart home services such as streaming events with augmented and virtual reality, and consumer robotics that control cleaning, utility usage, outdoor servicing, and security surveillance will be enabled by partnerships between CSPs, entertainment providers, utilities, and residential maintenance and appliance suppliers.
Smart City	Smart city [1,5] services link traffic, public safety, weather, parking, and automobiles, using cloud-based analytics and artificial intelligence to make them more efficient, safe, and entertaining. CSPs, cities, Cloud and network solution providers, and car firms all supply these services. Chicago might be a great example of a savvy city that offers Oracle-enabled intelligently connected services. Dedicated 5G network slices will advance smart cities in the long run, allowing for real-time lossless video surveillance and mobile environmental drones (high data rates/priority/Quality of Service (QoS), low latency) as well as smart-meter readings (low data rates/priority/QoS, higher latency).
Smart Learning	Today, smart learning options such as online courses, digital book subscriptions, and study help are available. Real-time video transmission through mobile and fixed networks, as well as sophisticated subscriptions, are frequently required for these services. Oracle has partnered with Chegg to supply cutting-edge digital subscription services through its connected learning platform.
Smart Health	Connected health - monitoring trackers that analyse and transfer data to health centres and first responders to reinforce care are being developed by health care institutions, first responders, medical device manufacturers, and CSPs [6,7]. These services are offered with high reliability/priority/QoS and low latency thanks to an obsessive 5G network slice. [Fig 2]
Smart Cars	Connected autonomous vehicles that are using AI, machine learning, and analytics to gain enhanced data insights promise a more personalised driving experience.Vehicle ownership will be reshaped by new subscription service models.Low latency, high data speeds, and high priority/QoS 5G network slices for smart cars are critical for real-time transmission of auto data for efficient, safe, and secure transportation. For Hyundai, Kia, and Ford, Bell Canada and Concentrix are utilising Oracle to monetize and offer connected vehicle services.
Smart Manufacturing	To enhance operations and security, manufacturers, agricultural industries, device and sensor providers, and CSPs are providing real-time connected device monitoring and control on and off-site. For example, data-driven machine learning is being used by automated sensor-driven harvesters to enhance agricultural yields in support of environmental conditions [3, 5].
Smart Finance System	Using emerging cloud-based Blockchain and AI technologies, financial institutions, software vendors, systems integrators, and

	CSPs are collaborating to enable safe, mobile, real-time currency, payments, and banking transactions.

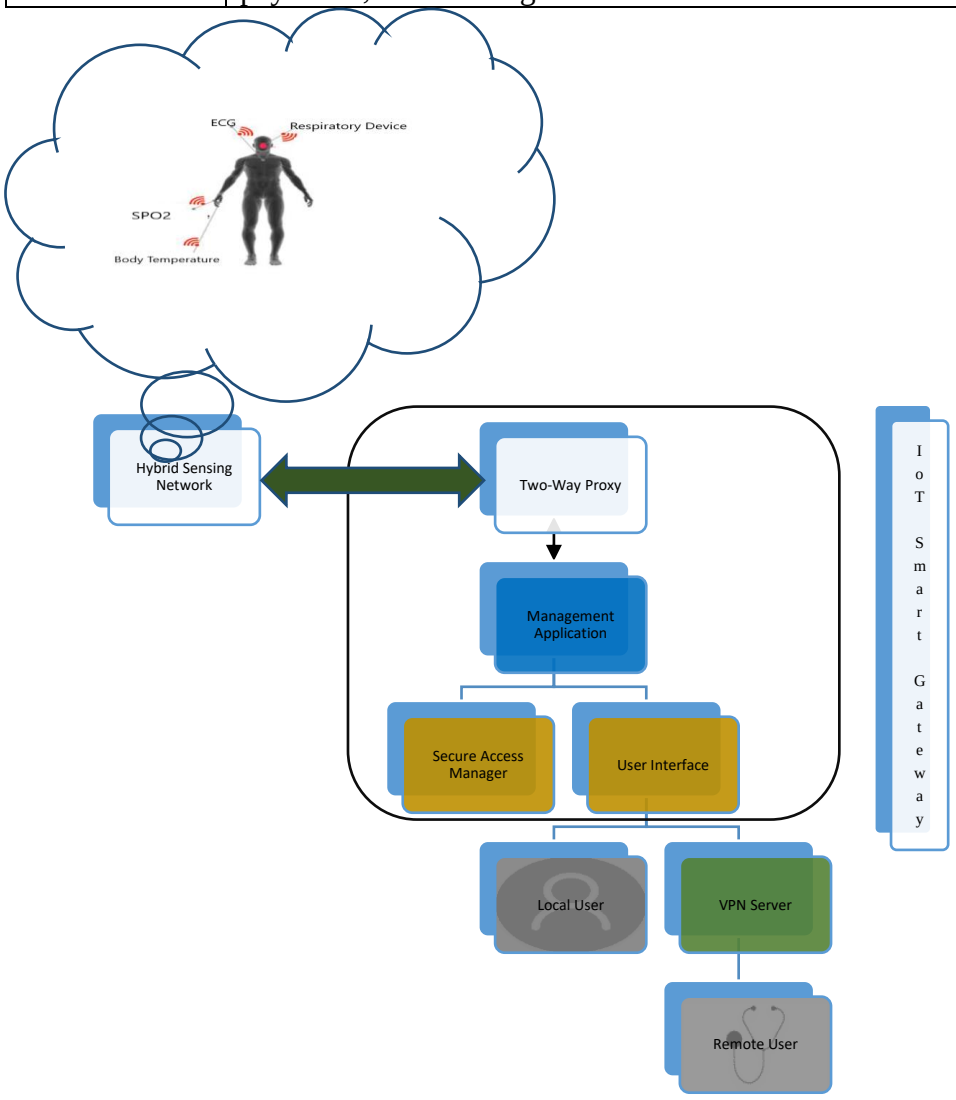

Fig 2: IoT in Smart Health care System

The Internet of Things (IoT) for smart health care is a network of wireless, interconnected, and networked digital devices that can gather, send, and store data without the need for human or computer interaction [8,9].The Internet of Things (IoT) promises a slew of advantages for streamlining and improving health-care delivery, including the ability to forecast health issues ahead of time and diagnose, treat, and monitor patients both in and out of the hospital as shown in Fig. 2.The ability of IoT-based health care is explored further to theorise how IoT can increase access to preventative public health services and help us migrate from our existing secondary and tertiary health care systems to a more proactive, continuous, and integrated approach [9,10].The deployment of IoT in health care, on the other hand, will be dependent on a clear and rigorous code of practise for data management, privacy, confidentiality, and cybersecurity in relation to the supply and use of IoT devices in health care.

4. Conclusion

Service providers and businesses that can capitalise on the trillions of dollars in 5G and Cloud prospects in Smart Cities, Smart Homes, Smart Workplaces, and other areas will be the winners in the future. Service providers and enterprises can exceed their customers' digital experience expectations and grow their businesses by leveraging three key innovations: network slices-as-a-service using integrated Cloud and 4G/5G/SD-WAN network infrastructure, a cloud-based digital business engine, and end-to-end security across Cloud and networks.

As previously stated, an IoT ecosystem is a complicated notion that defies straightforward categorization due to the fact that its properties differ from deployment to deployment. The IoT world, like ours, is made up of a variety of ecosystems that evolve and adapt. The idea and the people who make it happen are what they have in common: device makers, service providers, application developers, and businesses. Despite this, there is still a lot of variation in this ever-changing scene – technology, as represented by gadgets, networks, and platforms, is continually improving. This is especially important to remember because the one thing residents of an IoT ecosystem should never do is take it for granted. Stagnation and lock-in are toxic to that landscape, therefore you should always be on the lookout for newer, better technology that will help you thrive.

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