Intelligent and Stable Next Generation HetNets with Self-aggregated Framework

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Abstract. The malfunctioning of critical infrastructure causes high-quality deterioration, financial effect and loss of life in a town in the present scenario. It is essential to check the cost-effectiveness and reliability of the quality of critical infrastructures in the pandemic situation. Sensitive monitoring of an infrastructure is costly but necessary, in which fault identification and corrective action are needed at service levels to avoid cascading failures with minimal communication latency. With enhanced expense, resource, and process performance, the growing population in smart cities demanded a high living standard, rigorously straining energy, city services, and infrastructure. Intelligent houses, intelligent transport and smart buildings linked with intelligent networks are three pillars of the smart city initiative. In this paper, an improved framework for enhanced Quality of Service with higher performance in a 5G network is presented. A detailed description of reconfigurable intelligent Smart networks and reconfiguration analysis at various layers are also discussed. SDN and NFV, with the help of an intelligent SDN controller, provide the context for managing a multi-objective heterogeneous network. For self-optimization and self-healing, multiple clustering heuristics are useful for managing these networks at the various locations of smart projects.

Keywords: 6th Generation (6G), Software-defined networking (SDN), Self-Optimized Network (SON), quality of experience (QoE), HetNets

Introduction

Present challenge in ad hoc automation for business units, automation, security, activities, developers, and infrastructure provides accessible, efficient, and agentless applications. The efficiency of network and resource utilization for Smart projects in smart cities can be estimated with its demands generated by the customers. The essential attributes of future 6G communication are deep connectivity, intelligent connectivity, Holographic and Pervasive Connectivity. In order to support various business models, a combination of artificial intelligence and wireless mobile communication networks provides an integrated, quick, and efficient open-platform. In order to serve diverse and demanding business models with the help of AI techniques, the future 6G network architecture is increasingly heterogeneous, massive and multi-objective with self-optimization feature. In indoor applications with deep coverage to maximise indoor access requirements, deep networking is used. Deployment and design of future wireless technologies to take into account ITU scenarios of both deep coverage requirements as well as objects and people [1]. The integration of various technologies in the 6G system with the capability of intelligence, dynamic, self-aggregation includes the interconnection of all aspects and IIoTs. A challenge for the next-generation network is the aggregation of various technologies and dynamic versatility and help to achieve complex and varied scenarios and market demands.
1. Background
The goal of 4G when studying human behaviours was people-centered contact, a case of an indoor scenario that uses a wireless communication device of several generations. The need for current industrial applications as well as Smart projects of Smart Societies with mobile and intelligent networks is higher speed communication. An in-depth view of the intellectual architecture for the self-organized network that is intended as the primary technology to fulfil both conventional domain applications of networking as well as novel paradigms of nanoscale communication. The creation and management of highly challenging business model services in the current industry needs an intelligent Smart Network with zero latency. It is difficult to implement and efficiently manage heterogeneous infrastructures with multiple network networks managed by multiple administrative domains [2].

The digitalization process has allowed smarter technology to proactively manage applications, users and systems, to make maximum use of resources and to make physical space more effective for business operations. The Internet of Things and Robotics play an important role in the smart grid or e-healthcare solutions of Smart Cities that increase the gross domestic product with minimal running costs. In Figure 1, the implementation of Smart City was shown to rely on various domains and infrastructures, such as IoT, mobile phones or Big Data Cloud, with analytical steps in real-time scenarios [3]. Traffic congestion is a major problem that causes decreased cost of productivity, loss of life quality, and contamination of the atmosphere. In urban buildings, energy and resource use are strongly occurring, and smart home protection and automation systems are more in demand. Numerous technologies used in the construction of a smart project using various technologies are seen in the Figure 1.

![Figure 1.](image)

2. Research and Technical challenges of 6G communications
Until 6G communication systems can be deployed successfully, many technical issues must be solved. Some of the problems are discussed briefly below.

2.1. Connectivity by backhaul of high bandwidth, Interference and Spectrum Regulation

There will be very tightly wired connection between heterogeneous massive IoT devices in 6G networks. Furthermore, these access networks are diverse and widely distributed and two access networks have high
data accessibility for various types of users. In order to connect access nets to a core network to support client high data rating services, 6G backhaul networks will have to manage the huge volume of data; if not, a bottleneck will be created. Optical fibre and FSO networks are possible substitutes for high bandwidth backhaul links, so the overall ability for these networks can hardly be increased by data depth. It is necessary to use the 6G spectrum effectively, including spectrum sharing schemes and creative specimen management methods, due to interference problems and the lack of bandwidth. Effective spectrum management is important for maximum resource usage with QoS maximisation. In 6G, researchers must deal with issues such as how to swap spectral shares and how to handle the spectrum phase in heterogeneous networks at the same frequency. The possibility of cancelling interference with traditional methods, such as simultaneous interference cancellation and consecutive interference cancellation, must also be investigated by researchers.

2.2. The complexity of 3D network resource management and utilization

The 3D networking spread vertically which introduced a new dimension. Multiple opponents can also intercept information which can deteriorate the overall machine efficiency significantly. New techniques are also important for resource management, routing protocol, mobility management, and optimization and multi-access technologies. Timing involves a new configuration of the network.

2.3. The performance of high energy efficient processing elements

There will be several unique features involved in the 6G system. The introduction of new features should be possible for devices such as smartphones, mobiles and processing elements. It is extremely difficult to support 1 Tbps, XR, artificial intelligence, and advanced sensing [8] using individual devices with communication features. The 5G devices will not support only a few of the 6G features and performance enhancement in 6G devices will also increase costs. Millions of devices are going to be connected to 5G, and we have to make sure that they are all 6G technology compatible. Mobile ultra-wide-scale networking has become an integral part of the use of world electricity. Not only does it produce huge carbon emissions, it also takes up a large part of operating expenses. 6G networks will have extraordinarily high performance, very high bandwidth, and an exceedingly high number of omnipresent wireless nodes in the future, which are likely to face unimaginable challenges in terms of energy demand. Spectrum efficiency and spectrum capacity are growing, but the efficiency can be significantly improved. The pervasive and dense sensors of wireless sensing networks packed with output and living space intensify two problems with energy consumption. The enormous number of sensors will lead to high overall energy usage, and it is also a challenge to supply energy for ubiquitous deployment conveniently and efficiently.

2.4. Heterogeneous hardware requirements for Autonomous Wireless Networks

The 6G regime knowingly permits AI-based automation technology, including UAV, Autonomous Vehicles & Industry 4.0. Convergence of various heterogeneous subsystems, including independent systems, interoperable processes, system systems, computer training, independent clouds, system machines and heterogeneous wireless systems, is required to make wireless systems self-sufficient [7]. Thus, the overall development of the system becomes complicated and challenging. To create a truly autonomous driverless system, 6G researchers need extra effort as they need to develop fully automatic driving vehicles that perform better than human-controlled cars. A broad range of heterogeneous forms of communication attributes, such as frequency bands, communication topologies, service delivery, and so on, are included in 6G. In addition, in hardware environments, portable terminals and access points would be substantially different. Massive MIMO technology is being further upgraded from 5G to 6G, and more complex architectures may be required. The communication protocol and algorithm design will also be complicated with Machine Learning and AI technologies. In addition, there are different hardware architectures for different communication systems.

2.5. Frequency bands of THz, Beam forming and Sub-mmWave (THz) frequency modelling

High THz frequencies provide high data rates, while atmospheric absorption and high propagation loss properties challenge THz bands for data transmission over relatively long distances [5], we need to
provide a new design for the transceiver architecture of the THz communication network. The transceiver must run at elevated frequencies and we must ensure that very wide bandwidths are used to the maximum extent possible. Another barrier to THz contact is just a very slight gain and an open area with distinct THz band antennas. It is also important to address the health and security communications infrastructure problems with THz bands. mmWave and submmWave (THz) propagation properties are subject to environment conditions, so the effects are absorbent and dispersive [6]. The state of the environment is changing continuously and is therefore very unpredictable. Therefore, this band's channel architecture is very complex and there is no perfect channel model for this band. Hence the estimation of the beam power of the sub-mmWave, i.e. the THz band, is difficult.

3. Vision of 6G and future core technologies

The primary requirement is the flexibility of 6G wireless networks to handle huge amounts of data and high-data accessibility per machine. The objective of 6G (2030-) would be to serve the information needs of society, so 6G ought to be the demand that 5G is unable to serve and that need to be further developed [9]. Based on the demand that 5G will satisfy and the growth trend in the 6G vision of other related areas. Smart Homes, Towns, and Villages can be enabled by ultra-quick Internet connectivity with 10-11 Gbps data speeds. S2S networking makes it possible to access 6 G networks to space for global connectivity.

3.1. Intelligent Connectivity

Artificial Intelligence (AI) is one of the best ideas today, and almost all areas are exploring the use of such AI technologies. The convergence of cellular mobile communication networks and AI to make AI a better-enabling network is also becoming an inevitable development. At present, attempts are being made to use AI technology in 5G, but the current 5G and AI combination can only be seen as optimising traditional network design via AI instead of using a new smart communication network. Second, in the 5G network, the use of AI technology is comparatively late [10,11]. We have just recently begun our research and attempts to apply AI technology to a 5G network, and the 5G network architecture has already been finalised. Secondly, while AI technologies are rapidly emerging and have shown strong capacity in some areas, in other sectors they are still exploratory. Research studies into the combination of AI and wireless communication technologies have just begun and a long-term research phase is required before actual technologies come to fruition. The trend for AI indicates, however, that the next decade will have a technical maturity.

3.2. Dynamic Network Slicing in 3D networking

The 6G solution combines ground and aerial networks to enable vertical expansion of connectivity to users through 3D base stations, UAVs and low orbit satellites. The incorporation of new altitude dimensions and related degrees of freedom varies significantly from 3D networking to conventional 2D networks. At the same time, dynamic network slicing allows a service provider to enhance the efficient delivery of any service to a wide range of clients, cars, equipment and industries across dedicated virtual networks. It is one of the most important management elements when a wide variety of users are connected to a number of heterogeneous networks in 5G communication systems[6,7].

3.3. Universal Connectivity

Concerning the connectivity plight of customers, the 5G system would dramatically broaden the space and form of data on the Internet of Things anytime and anywhere. The range of activities would massively extend the geographical space for connectivity, including detectors in the deep, deep sea and high altitude human/unmanned aircraft, autonomous robots in harsh environments, smart remote control, etc.. Besides, human aerospace activity is also increasingly expanding with the rapid advancement of technologies in the fields of aerospace engineering, deep-sea exploration, and other sectors, and the enhancement of survival capability in certain extreme natural environments [11,12]. For instance, in 2030–2040, people will reach the deep space more likely than specific communication needs to be limited to a few skilled scientific exploratory fields, and signs of human activity on earth would likely be more popular and more frequent between satellites and spacecraft.
3.4. Blockchain

Blockchain is a distributed architecture to handle vast volumes of data in future communication networks. A distributed directory is a database that is spread over several nodes or processing elements. For every node, an identical copy of the ledger is replicated and saved. P2P manages the blockchain without a server or centralized authority. Data is stored and organized into blocks on a blockchain that is interlinked and cryptographically encrypted. The blockchain technology therefore can provide a range of facilities, such as software interoperability, mass data traceability, autonomous IoT-systems interactions, and reliability for 6G communications system mass connectivity.

3.5. Optical wireless technology with FSO backhaul network

In comparison to RF-based communications for every future mobile-to-access network, optical wireless systems are intended for 6G communications, as well as network-to-backhaul/fronthaul network services for such networks. Established technologies for OWC technologies include visual light connectivity, automatic camera information exchange, and light fidelity and FSO optical band communication. Companies are working to enhance the reliability of these innovations and to overcome their problems. Using LiDAR, which is a revolutionary technology for high-resolution 6G 3D mapping, optical wireless technology-based communication can provide low latency, very high data rates, and secure communications [13, 6]. FSO is an excellent technology for providing 6G backhaul connectivity over a very long distance of more than 10,000 km. FSO promotes high-power backhaul connectivity for remote and non-remote areas such as sea, ground, underwater or isolated islands; FSO also promotes BS cellular connectivity. Huge multiple inputs and multiple output techniques: the application of the MIMO technique is one of the main techniques for increasing spectral efficiency.

4. Innovative taxonomy of STATE OF ART

Content-centered networking (CCN) was initially considered for solving the problems of existing Internet Protocol (IP) communication. The current host-centered internet architecture has been changed by CCN into a data-centered architecture. In the form of interest packets, the conventional CCN uses the broadcasting system to submit requests for content. However, today's broadcast/flooding of the packet in either direction is not ideal for large-scale networks because this creates the network bottle. To remedy this shortcoming, a new CCN approach was proposed in order to find out from local controllers if the content is available on the local network [16], software defined network controller. We also introduced an improved SDN-based CCN forwarding scheme to decrease both existing vulnerabilities and network traffic. The security problems facing the network and its devices are very significant with the ongoing growth in various technological scenarios. Due to the wireless existence of WSN, its protection is a major concern. Some WSN applications are highly critical in nature and result in a catastrophe as a result of the intrusion.

As computers are changed by a few generations, they are disposed of in failure, but they can become very powerful when all of them are put together and share each other's computing power. A cluster is one type of parallel computer system made up of a group of separate, interconnected computers that function together as a single integrated system. Clusters use a communication interface, and fragments of code must be explicitly configured to use the distributed hardware underlying them. More computing nodes based on needs will be included in the cluster. In the design of parallel clusters, we mainly use open source and Linux-based system components [17]. A parallel cluster is a way that similar computers can be combined and can do a job by sharing the workload. The function is shared in partnership by master and slave nodes in a group collaboration. Parallel computing clustering enables a community of hardware-setting computers to work together to solve various computational problems. In a cluster computing environment, resources such as memory, storage, and CPU core are combined into a single device.

5. Heterogeneous Network Scenario
Mobile ad hoc networks (MANETs) and hybrid optical-wireless networks have historically been taken as distinct and separate, without any synergic management solutions, often referred to as FiWi. The first main focus of FiWi is on the distribution of mobile nodes in extremely complex and infrastructure-less settings, the second offers high-bandwidth and low-latency connectivity to cellular nodes. Recent developments and penetration of SDN techniques have also encouraged the adoption of versatile SDN monitoring and control for the MANET and FiWi sectors, including the use of software-defined networking. It is possible to identify VANET applications as Emergency & Safety apps and other on-demand and entertainment apps. Protection technologies are linked to the emergency broadcast of any accident and traffic conditions that have occurred. There are two kinds of security messages; periodic messages contain substantial data used to minimize hazardous situations [18a]. The current location, path, vehicle speed, and other information transmitted in V2V contact by other vehicles. These messages can often lead to a problem with broadcast storms. An incident led notification takes precedence over the current location, the incident, and time of the vehicle that could be used in an emergency.

It is difficult to supervise the building or area when there are a wide building or area and fewer guards. In this case, the protection of and life of guards is more fragile, so we present with this article an idea of a modifiable vehicle for protection and surveillance. This vehicle is modifiable and is useful in the fields of protection, monitoring, and security. As a car, it is mobile in nature and can be remotely controlled from a base station. Since the vehicle can be changed, it can be fitted with any desired module, in which case the vehicle is installed with a module consisting of a camera, a sensor, and a siren. When the sensors sense a moving target, the camera shifts in that direction. If an intruder or suspicious activity is detected, prompt action can be taken to prevent a problem [19a]. The main goal of this mobile device is to minimize the risk to life and to protect a significant portion of the city or building with limited manpower. The mobile system's slogan is one-time work and all-time use.

In several towns, traffic congestion is a major problem, and traffic signals are essentially used to monitor the movement of weak law enforcement vehicles and bad traffic congestion. One of the big problems with many cities is that we cannot extend the current infrastructure further, so better traffic management is just one solution open to us. The efficacy of the traffic control system depends on its ability to adapt to the conditions of real-time traffic. Conventional traffic control systems, however, are not capable of doing this. Whatever the high or low traffic density, the signals are all timed and run only at that time [20a]. This leads to increased road congestion, contributing again to substantial air pollution, increased safety
risk, and negative impacts on the economy and overall living standard. Advance the Internet of Things (IoT)-based traffic management framework in this need for expected innovations. The control of traffic lights is suggested and planned to help the decision-making of traffic offices. Based on the density of the vehicles, the device can detect the congestion level of each road at the crossing.

A challenging research field in Intelligent Transportation Systems (ITS) is vision-based automatic detection and monitoring of on-road vehicles. Several research studies are available in the literature in this area of research using various machine learning (ML) techniques. This article proposes a method for on-road vehicle detection and tracking under varying weather conditions by changing the configuration of a single-look vehicle (YOLO), a recently established deep-learning computer vision object detection model. A single convolutional neural network, CNN, predicts the identification of bounding boxes and the probabilities for classes in YOLO models together in a complete evaluation from the full images. A single, convertible neural network is used to detect vehicles [21a]. The detection mechanism can be interpreted as end-to-end systems since the full detection is achieved through a single network. 16 convolution layers of YOLO and 2 fully connected layers were used at the end of this work. In various weather conditions, the vehicles have been found. To assess device performance, two separate public datasets, namely CDNet 2014 and LISA 2010 were used.

Owing to the increased number of cars, road accidents also cause thousands of lives to be put at risk. This resulted in the need for controlled vehicle contact between the various vehicles in the network. The key issue related to VANET is its complex existence. The network is constantly evolving, creating high mobility and difficulty in controlling all the nodes within the network [22a]. However, researchers have identified various routing protocols to resolve this question, but the problem arises when it comes to network stability. In this paper, a stable routing algorithm called 'CP-PSO' is proposed and optimized using the PSO optimization technique. In terms of better throughput, high packet delivery ratio, and low energy consumption, the Matlab simulator is used for simulation, and results are shown. Pedestrian crossing may be a part of the road where the pedestrians have the right to cross the road. The intersections with cross-country tracks are also the maximum distance in many regions as a kilometer away. A foot traffic study that can significantly help reverse and prevent pedestrian accidents is a very important part of pedestal crossing. The main goal is to detect the footpath in the signal path and build an intelligent wagon to prevent fatal deaths and traffic. The use of ultra-sensors for vehicle detection and crash avoidance.

6. PROPOSED SYSTEM MODEL

The increased use of mobile devices, machine learning, and cloud computing provides an inconvenient basis for multi-domain IoT growth. Numerous processing elements, specifically IoT sensors that are linked to a server cluster and machine learning technology, comprise the proposed model system. The cloud provides services such as software, data collection and network server computing, open databases for easy and flexible use of resources across the internet. The cloud data centre is also a major component of the device being proposed, and is used to store the vast amount of sensory data generated by the sensors. The following are briefly mentioned.

6.1. Cloudlet

It offers cloud services on mobile devices such as intelligent phones, tablets and IT sensing, as well as servers connected for job storage and processing [12-13a]. Cloudlet is able to reduce the response time of applications running on IoT sensors as well as the hosting of cloud computer services through the use of low latency and high bandwidth wireless networking [14a]. This reduces long-distance contact latency delays between the IoT sensing system and the cloud data centre.

6.2. Compatibility and global vision with OpenFlow

OpenFlow was developed to show the feasibility of forming a centralised SDN control and administration system controller. For example, load monitoring, the quickest way to find the routing network, and the provision of a network flow control are several OpenFlow features currently available. New OpenFlow extensions, however, are needed to allow advanced technologies, such as advanced bandwidth allotment.
strategies based on traffic preview schemes as discussed. SDN controllers should be given a global perspective on the MANET topology (lightweight coordination between the MANET islands). In real-time, traffic flows inside the MANET domain could also be tracked.

6.3. MANET-domain SDN-based traffic control system

Smartphones and tablets consume 40% of data traffic and 99% of signal traffic is generated [15a]. Therefore, to ensure a global and precise backhaul (optical network) traffic status, SDN capabilities need to be strengthened for real-time traffic management in the MANET networks. In terms of SDN controllers, the global network view should be capable of handling topology, up-/down-link traffic flows and specifications, permitted and acceptable traffic per domain, and traffic and latency monitoring. In fact, it will allow them to gain full knowledge of the current network status and traffic of upcoming applications, allowing them to make proper traffic management decisions.

7. Conclusion

For hundreds of IoT devices, a smart urban network needs a secure system as well as a stable data storage system. A detailed analysis is provided of self-optimization, intelligent heuristic, virtualization of network functions, and heterogeneous networks and their possible advantages, use cases, and B5G research challenges. Heterogeneous network scenarios used in B5G and their specifications are discussed with the key drivers of B5G applications and technologies. In fact, it will allow them to make full knowledge of the current network status and traffic of upcoming applications, allowing them to make proper traffic management decisions.

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