The IBN Networks for 6G Technology to Optimize Investments in Telecommunications Infrastructure

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Abstract

The development of the telecommunications structure for digital data transmission is taking place concurrently with the development of telecommunications services. New services generate demand for transmission with higher quality parameters. Achieving them makes it possible to create new services with a demand for transmission with even higher parameters. The 2020-2030 decade is dominated by 5G networks and SDN. A decade after 2030, it is predicted that these will be 6G networks and IBN. The 6G standard describes the equipment used to build the network in line with geographic conditions, optimized for performance. The IBN network will flexibly adapt to the needs of end users. In areas where a 5G network is being built, after 2030 it is enough to adapt it to the 6G standard, and in other areas, 6G networks should be built immediately. Obviously, this approach will not solve the interdependence of infrastructure and service development in telecommunications, but will provide clear guidance over a period of time to investors, end-users and market regulators.

Keywords

6G, IBN, investment, market, telecommunication infrastructure

1. Introduction

Optimizing investments in telecommunications infrastructure on the basis of knowledge and data obtained before the start of the investment is not sufficient to gain a competitive advantage. The income for the investor is generated by satisfied end-users and their satisfaction varies over time. Dissatisfied end-users shift their services to a competing operator. Today's telecommunications systems cover land, air, oceans and space, and end-users are moving faster and longer. There is no stabilization on the services market either. Improving the capacity and quality of digital data transmission generates new services, and their owners, in turn, report their needs for transmission with even higher quality parameters. In military systems, the development of the enemy base forces the development of your own base. The most costly in all these processes turns out to be a human, designer, technician, and administrator. On the one hand, a person deserves remuneration for the work he has done, on the other hand, he falls ill, goes on strike, and may even sabotage. Also in terms of security, man is the weakest element. In terms of investment profitability, the world is divided into 3 zones: white, gray and black. The black zone brings income both in the area of investment and operation. The gray area brings income only in the area of exploitation and loss in the area of investments. The white zone generates losses both in the area of investment and operation. The world is divided into zones by people working, teaching and living in these zones. If there is a low population density and people do not need access to digital data transmission, there is a white zone in this area. If there is a high population density and end-users need high-quality digital data transmission, there is a black zone in this area. The division into zones can be stationary, e.g. cities, forests, lakes or dynamically changing e.g. stadiums, districts: day-adults at work, children at school, night-

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everyone at home. All these parameters are also influenced by changes in the ecosystem, e.g. wars, pandemics, earthquakes, fires, floods.

The development of network architectures and methods of their design described by the author in publications [1], [2], [3], [4] leads to the next generation of telecommunications infrastructure and intent-based networks. The author proposes using 6G technology to eliminate the division into white, gray and black zones. On the other hand, IBN technology to optimize the constructed network in terms of increasing the efficiency of funds already invested in building a digital data transmission network. Replacing humans with elements of artificial intelligence in the design, construction and operation process predicts that it will increase the competitiveness of these investors in relation to the others who will use classical methods.

Resignation from Computer Aided Design systems in favour of Artificial Intelligence Aided Design systems and from manual network management in favour of Intent Based Networking is proposed because we are heading toward a society of fully automated remote management systems. Autonomous systems are becoming popular in all areas of society, including industry, health, roads, oceans, and space. In this regard, millions of sensors are integrated into cities, vehicles, homes, industries, food, toys, and other environments to provide a smart life and automated systems. Hence, a high-data-rate with reliable connectivity will be required to support these applications. It is proposed to implement the 6G paradigm, because 5G networks will not have the capacity to deliver a completely automated and intelligent network that provides everything as a service and completely immersive experiences. Although the 5G communication systems will offer significant improvements over the existing systems, they will not be able to fulfil the demands of future emerging intelligent and automation systems after ten years (2020-2030). [3] New items that may require sixth-generation (6G) system include: massive man-machine interfaces, ubiquitous computing among local devices and the cloud, multi-sensory data fusion to create multi-verse maps and different mixed-reality experiences, and precision in sensing and actuation to control the physical world. [6]

2. The Role of 6G Technology in Optimize Investments

To reach the goal of 6G and to overcome the constraints of 5G for supporting new challenges, B5G wireless systems will need to be developed with new attractive features. The 6G communication networks will fulfill the laggings of 5G system by introducing new synthesis of future services such as ambient sensing intelligence and new human-human and human-machine interaction, a pervasive introduction of AI and the incorporation of new technologies such as terahertz (THz), 3-dimensional (3D) networking, quantum communications, holographic beam forming, backscatter communication, intelligent reflecting surface (IRS), and proactive caching [10]. The key drivers of 6G will be the convergence of all the past features, such as network densification, high throughput, high reliability, low energy consumption, and massive connectivity. The 6G system would also continue the trends of the previous generations, which included new services with the addition of new technologies. The new services include AI, smart wearable, implants, autonomous vehicles, computing reality devices, sensing, and 3D mapping. [4] The most critical requirement for 6G wireless networks is the capability of handling massive volumes of data and very high-data-rate connectivity per device [1].

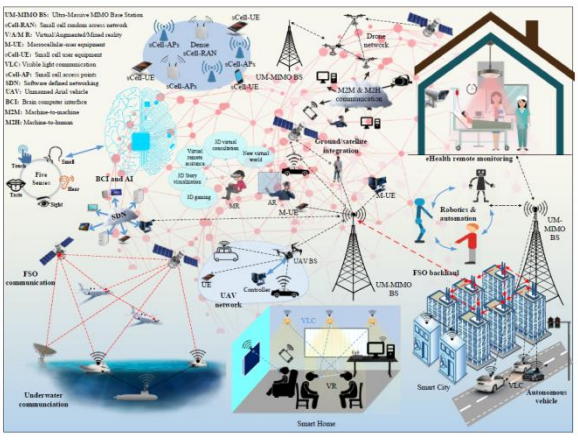

Figure 1: Possible 6G communication architecture scenario. [6]

It is proposed to optimize investments in telecommunications infrastructure - the design and construction should be based on the 6G

technology paradigm and the operation on the IBN paradigm.

3. The Role of IBN Technology in Optimize Investments

Intent-based networking is a software-enabled automation process that uses high levels of intelligence, analytics, and orchestration to improve network operations and uptime. When operators describe the business outcomes they wish to accomplish, the network converts those objectives into the configuration necessary to achieve them, without individual tasks having to be coded and executed manually. Traditionally, networking has been driven by manual, command-line interface (CLI)-based operations, basic element management systems (EMSs), or automation scripts. Most network outages result from human errors that occur during these network operations. Intent-based networking slashes errors and risk while improving operational efficiencies in a number of ways. Validates intent objects before applying them to the network. Intent objects are high-level representations of the desired properties or outcomes to be achieved with the network. Validation is syntactic and includes semantic checks against network wide policy.[7] Operators simply apply the appropriate versioned intent object to return to a known good state if something goes wrong during a deployment push. Limits the impact and scope of failures during new intent rollout through well-defined policy. Intent-based fallback. As the system knows the desired outcomes for a specific configuration, it can maintain those outcomes even in the face of outages or device errors by reconfiguring other network elements or using different mechanisms to achieve the same results. Modern network orchestration systems have made commercial, intent-based network systems for mission-critical and scaled deployments possible. Intent-based networks dramatically reduce the time to deliver reliable services from days or weeks to minutes and help address operational challenges once the infrastructure has been deployed.[7]

Figure 2: The journey to intent-based data centre organization [5]

Each stage along the way is characterized by increasingly automated and simpler ways of deploying and managing network operations.

Manual – Operations staff imperatively manage data centre network devices using CLI, SNMP, and basic and discrete tools.

Semi automated – Scripts and rules-based management combine with traditional tools for basic automation, visibility into network data, and alerts that enable reaction to network events.

Software-defined data centre – A software abstraction of the network infrastructure enables faster, secure deployment of services and applications.

Automation-centric data centre – Builds upon the software-defined data centre by automating provisioning, configuration, deployment, and orchestration.

Intent-based data centre – Continually collects and converts all pertinent data needed to take the automated actions that keep the network aligned with dynamic business intent, data centre conditions, and policies.[4]

Intent-based networking (IBN) has become a hot buzzword in the networking industry, with marketing departments at all sorts of vendors waving the "intent flag." Some have legitimate products, some have cobbled together bits and pieces out of their product portfolios and called it an IBN solution, and some supposed IBN products perform only a part of what a real IBN system (IBNS) does. [7]

Intent-based networking is not only about intent fulfilment; it's also about intent assurance. With intent-based analytics, networks remain in compliance with the original business intent throughout the service lifecycle. Intent-based analytics provide insights into network services, enabling teams to think about their network as a complete service.[9]

Using analytics, intent-based networking enables faster root-cause identification when things go awry. It informs operators of conditions and insights that need attention as with traditional unified management approaches but filters out the irrelevant "noise" so it's easier to see what's most important quickly, as shown in fig. 3.

Correct implementation of IBN to help manage a network that is made in 6G technology requires understanding what IBN is not. IBN is, unquestionably, a popular industry buzzword. Your challenge is to see beyond the fluff and evaluate IBN solutions based not only on what they are, but also by what it is not. Interestingly,

all the functions discussed in this section can be and probably are a part of an IBN solution. What you have to be wary of is a solution that performs one or a few of these functions and claims that that, alone, is IBN.

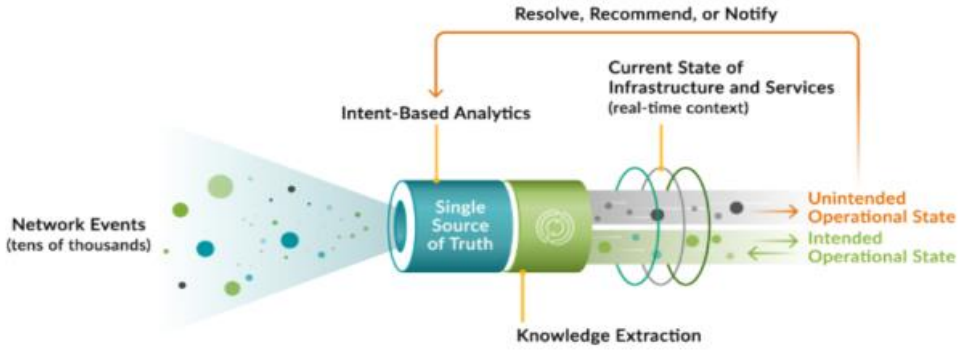

Figure 3: Analytics keep network operations aligned with original business intent throughout the service lifecycle. [5]

IBN is not automation.

Automation, from home-grown scripts to platforms like Ansible and Puppet, are essential to the fast, reliable operation of a network. It's also an essential element of IBN. But automation software says nothing about expressed intent and doesn't by itself maintain a data store of network information to act on. You can automate bad decisions just as well as good ones.

IBN is not configuration management.

A Level 0 IBNS may look like just a fancy configuration management platform that translates intent into practical configurations. Such a system falls far short of significantly improving your operational effectiveness.

IBN is not SDN.

You may be thinking that IBN is just a form of software-defined networking (SDN). But SDN, in its usually understood role, performs only a part of what an IBNS does. SDN maintains an abstracted model of the physical network. It takes generic configuration commands as input and pushes device-specific configuration as its output. But that's all. SDN contains no translational element to convert intent into generic configuration and it has no capability for continued compliance verification and adjustment. Like automation and configuration management, SDN is an element of IBN, but is not itself IBN.

IBN is not orchestration.

Orchestration helps all of your IT systems — compute, storage, and network — act in sync to accomplish your higher IT objectives. IBN, as again the name implies, is concerned just with your network. That said, a good IBNS should integrate with your orchestration system so that orchestration can become a source of declared intent.

IBN is not a policy engine.

Policy engines can both "push" policies to network nodes and "pull" information from the nodes to continually verify correct policy enforcement. But the translation of intent into an actionable "how" is missing. Policies just govern aspects of the network, such as forwarding, security, and prioritization. A policy engine can use control loops to enforce these policies, but it has no concept of desired outcomes. You have to work those out yourself and specify in detail the rules to implement and enforce the policies.[5].

4. Conclusions

In order to maximize the income from investments in telecommunications infrastructure, it is necessary to take a holistic view of the process by which this income is generated. We invest in digital data transmission because the modern world does not need autonomous systems. He focused on remote control and remote transmission of digital information. In the field of military systems, each 6th generation fighter will have a certain number of drones to cooperate with. In civil systems, there will be autonomous cars, distance work, distance learning, the Internet of Things and augmented reality. In order to ensure a collision-free exchange of data, in such an organized society, a physical layer of the network is needed that is adapted to the geography of the area it is to cover. This role is best fulfilled by a

network made in 6G technology. Higher layers are to be agile, reconfigurable to meet the needs of end users. The user will change his whereabouts and the demand for various services. The agility of such a network is ensured by the IBN technology, because the wishes of end users can be transformed into signals controlling the network without human participation in this process. In conclusion, the optimization of the investment process in telecommunications infrastructure will be achieved through the joint implementation of 6G and IBN technologies for the design, construction and operation of next-generation networks. The above recommendations can be used not only by investors or telecommunications providers, but also for setting directions for scientific research and regulating the telecommunications market.[8].

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