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QUALITY OF INTERNET SERVICES IN SUPPLY CHAINS AND IIoT

The huge amount of data collected and processed through the IIoT in the supply chain (LS) requires: (1) establishing the same amount of information for all users of the chain, (2) monitoring the process and user interaction, (3) adapting data to their purpose and conditions of use based on which would make reliable decisions in predicting subsequent operations in LS processes[1, p. 95].In addition to the general requirements, there are various technical preconditions and limitations in the application of IIoT and new technologies. First of all, that means a state of existing IT and operational technologies (OT) of network users, network status and configuration, lack of standards, connectivity and solutions for users, security of data circulation, compilation and alignment of analytics, reliable connection of services, know-how, operational flexibility, and other major global initiatives promoting IIoT, all in order to achieve interoperability through the Business-to-Business (B2B) model [2, p. 5].To realize the set requirements, it is necessary to provide and control the quality of services (QoS). This implies the application of appropriate recommendations, standards,and other documents.

A quality of e-services (QoS) measurement is focused on the interaction between users and websites. There are several methodologies for measuring mainly technical quality, such asWebQuale,SITEQUAL(based on SERVQUAL-u), eTailQ, E-S-QUAL, E-RecS-QUAL, etc. Under QoS (quality of service), one should mean the quality of the complete service, that is, the ability of the Internet to fulfill the user's requirements in terms of reliability of data delivery, speed and accuracy of messaging, flexibility, simplicity, transmission security and other user requests, which are very strong essential for the design and construction of the IIoT system through which supply chain (SC) monitoring is required. Often, quality assurance is performed by quality parameters of QoE (Quality of Experience), that define the general acceptability of the application or service, the expected benefit, or degree of customer satisfaction or dissatisfaction with the fulfillment of an application in the context of the "and-to-end" service.QoE is different from QoS, it affects QoS and depends on network or non-network indicators that have specific metrics with a certain range and boundaries. QoE depends on the perception of the end user because the characteristics of the services can result in quite different ways of specifying the value of certain user parameters and can vary according to the requirements from one user to another. The three groups of parameters are most often monitored: the user interface, the network infrastructure, and the parameters of the functionality of the service. According to ITU-T Rec. G.1000 [3, p. 14], the general framework is defined with seven basic criteria that are common to all network requirements: service time (refers to all service functions), accuracy (transaction quality, call performance ratio, accountability, etc.), availability (coverage, accessibility of services, etc.), reliability (drop in calls, number of billing complaints, etc.), security (fraud prevention, cyber-attack), simplicity (software updates, easy contract termination, etc.), and flexibility (ease of change of contracts, availability of different billing systems, online or through banks, etc.). These criteria are mapped to form the "Performance Model" defined in ITU-T E.802.

Depending on the needs of IIoT, and types of devices and mobile communications, different mobile web services architectures are created, e.g. such as "Proxy-based", P2P or "Asymmetric". It can be noticed that there are two ways to use web services: (1) when a user is on the server application and can directly use the server, so-called target users - "users vs. business", and (2) where the application runs on mobile devices by connecting to a server using a wireless or local network "network connection" - "disconnected vs.connected". The basic idea is to form such a platform that will actively measure the infrastructure parameters by specific tools based on hardware or software.

The quality of the service can be characterized by a very large number of parameters that include a range of non-functional features such as service prices, availability, reliability, reputation, etc. They can feature individual or group services (i.e. Composite Web Services) presented by different dimensions, which depends on the requirements of the web service users.[4, p. 882].

Differentiation of the service is one of the main problems with any technology that needs to be measured for each process flow because,in some nodes of the central network, the number of simultaneous flows can exceed 10,000 / sec, which will be characteristic for IIoT. Basically, the quality of the network is measured, according to ITU-T (Rec.1.1541), where seven classes are defined, with the upper limit values of performance (excluding transmission capacity) for end-to-end IP services. [5, pp. 2-6].The classes of the above latency (ping) IP values are shown in [3, p. 49].

This group of parameters (delay of IP packet transmission, IP delay variations and loss of IP packets) provides the basis for determining network efficiency with enough levels of network devices for its IP network.

Ping should be as small as possible, up to 60-80 ms is considered as a good ping. If it is higher, for example, 150-200 ms, it comes to the so-called lag, that is, and there appear even a greater delay because process depends on many factors such as the quality of the telecommunication network, connected servers, the number of users, etc.Of the other parameters, it is important to observe the experiential speed (input and output) of the flow. The field of width 2 to 500 Mbps is divided into 7 flow classes (2 to 8), (8 to 18), (18 to 25), (25 to 50), (50 to 100), (100 to 200),and (200 to 500), marked with 1to 7 respective[3, p. 77]. It is considered that the speed of 2 – 4 Mbps is sufficient for basic surfing the Internet; 4-6 Mbps provides enough speed for surfing the Internet, and can easily stream 720p video of high resolution, but it can still be insufficient for other purposes; 6-10 Mbps provides surfing the Internet without major problems, and can stream 1080p high-resolution video; 10 - 20 Mbps is enough for super users who want to download files of any size without any problems, while 20+ Mbps provide seamless internet usage.

When defining appropriate quality service standards, it is important to design such an IIoT, which in the conditions of permanent ICT development, will enable high competitiveness in the digital environment, both individual and group services (IoT / IIoT, M2M, etc.) related to monitoring. Parameter tracking should be organized classically through implementation into own system or by a specific provider with aligned parameters of all users.

Based on the experience of different countries, good practices and trends, it is necessary to plan monitoring to increase efficiency, select key parameters and monitor them (not all). Data on parameters must be available and significant in a way that suits the needs of all SC participants, regularly updated with respect to the measurement tools, and applied tests (for example, for testing higher bit rates, larger files are needed for uploading and downloading)[6, p. 32].

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