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ANALYSIS OF TCP ISSUES IN INTERNET OF THINGS

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Abstract: Transmission Control Protocol (TCP) is the dominant transport layer protocol on the internet assures reliable data delivery. The explosive growth of the "Internet of Things" is changing our world and the rapid drop in price for typical IoT components is allowing users to update new designs and products. The TCP misjudge the frequent discontinuation of data transmission that occurs due to frequent interruption in IoT applications. In this paper we review the main issues and challenges of TCP in Internet of Things.

Keywords: TCP, Internet of Things

1. Introduction to TCP

Transmission Control Protocol (TCP) is most popular transport layer protocol [1] in the worldwide internet environment in assuring end to end quality. In wired environment congestion situation occurs usually because of heavy load on the same channel. TCP handles congestion situation very gently by varying segment size and sending repetitive Acknowledgments (ACK) to the sender.

The channel behavior in the wireless environment changes dynamically and drastically and leads to loss of data without reaching to the receiver, and receiver going on sending acknowledgments to the sender for transmission of data. This dynamic situation creates artificial congestion environment in wireless networks. TCP misjudges this dynamic behavior of wireless channels and interprets the situation as congestion situation.

TCP congestion algorithm does not stand for wireless links as they grieve from high error and packet loss rates, and thus, they are still considered suggestively unreliable. For this reason, any packet loss in wireless transmission is falsely considered by the TCP protocol as due to congestion which activates the congestion algorithm to reduce the window size to one segment and consequently reducing transmission speed and packet throughput. TCP has been successfully used in mobile networks shown in figure1.

Figure1. TCP in Mobile Networks

2. Internet of Things

Today the Internet has become universal, has touched almost every angle of the globe, and is disturbing human life in unimaginable ways. We are now entering an era of even more universal connectivity where a very varied variety of appliances will be connected to the web. According to Vermesan et al. [2] the Internet of Things is defined as the collaboration between the physical and digital worlds. The digital world cooperates with the physical world using a plethora of sensors and actuators. We use these abilities to query the state of the object and to change its state if possible. For this intelligence and interconnection, IoT devices are equipped with embedded sensors, actuators, processors, and transceivers. IoT agglomeration of numerous technologies that work together.

The storage and processing of data can be done on the edge of the network or in a remote server. If any preprocessing of data is possible, then it is typically done at either the sensor or some other proximate device. The processed data is then naturally sent to a remote server. The storage and processing capabilities of an IoT object are also restricted by the resources available, which are often very reserved due to limitations of size, energy, power, and computational capability. As a result the main research challenge is to confirm that we get the right kind of data at the preferred level of accuracy. Along with the challenges of data collection, and handling, there are challenges in communication as well.

The Internet of Things finds various applications [3] shown in figure2 such as Smart Home, wearables, Connected Cars, Industrial Internet, Smart Cities, IoT in agriculture, Smart Retail, Energy Engagement, IoT in Healthcare, IoT in Poultry and Farming. IoT technologies have significantly been able to moderate human effort and improve the quality of life.

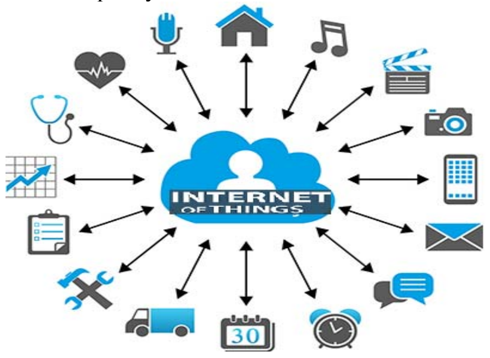

Figure2. IoT Applications

The communication between IoT devices is mostly wireless because they are regularly installed at geographically dispersed locations. The wireless channels frequently have high rates of alteration and are variable. In this scenario reliably communicating data without too many retransmissions is an important problem and thus communication technologies are integral to the training of IoT devices.

3. TCP in Internet of Things

The TCP should continue to operate as long as there was any form of connectivity and irrespective of the path taken by packets. The impacts transport, especially multimedia transport, is the potential for convergence of existing systems towards IoT devices. One of the main goals of TCP is to provide quantitative end-to-end QoS assurances to individual multimedia services/applications over a multitude of network technologies on the end-to-end path.

Connecting *Things* to the Internet allows end-to-end connectivity between IoT devices and other computers on the same network. When working within lossy wireless networks, the in-order delivery and retransmission mechanism of TCP may also cause head-of-line blocking, which introduces needless delay. Moreover, most wireless MAC protocols also implement link-layer automatic repeat request (ARQ), which may further impair the performance of TCP if the L2 retransmission delay is longer than the TCP RTO [4]. While some industrial IoT standards (e.g., ZigBee IP [5]) still mandate the TCP support, more and more IoT protocols (such as BACnet/IP [6] and CoAP [7]) decided to build transport functionalities into the application layer and chose UDP as the transport layer protocol, which essentially turns the transport layer to a multiplexing module. Such trends highlighted the need for the application level framing [8]. With application level framing, network can identify individual application data units (ADUs), thus enabling more flexible transport support, e.g., apply different retransmission plans for different types of ADUs, distributing data more professionally with in-network caching, etc. Unfortunately, current TCP/IP architecture does not permit applications to embed application semantics into network level packets, therefore failing to provide enough support for application level framing.

4. Issues and Challenges of TCP in Internet of Things

IoT applications usually face a variety of communication designs which TCP cannot support efficiently. If we use TCP without any modification in IoT, we experience a serious drop in the throughput of the connection. There are several reasons [9] for such a drastic drop in TCP throughput.

1. Due to the energy constraints, devices may regularly go into sleep mode, hence it is infeasible to keep a long-lived connection in IoT applications.
2. A lot of IoT communication involves only a small amount of data, making the overhead of beginning a connection unacceptable.
3. Some applications (e.g., device actuation) may have low-latency requirement, which may not tolerate the delay affected by TCP handshaking. The in-order delivery and retransmission mechanism of TCP may also cause head-of-line blocking, which introduces needless delay.
4. TCP uses sockets which needs refreshing every now and then to update the resources. It even consumes more RAM on your controller as when the data is received, they pass through layers for processing the received data. This is not suitable for IoT applications.
5. TCP was designed for web not for Low power, resource crunch devices . Using it is an overweight and will tax the IoT network , instead try CoAP or MQTT.

So, the conventional TCP misjudge the frequent discontinuation of data transmission that occurs due to frequent disconnection in IoT applications. Thus the performance of wireless based systems significantly degraded and demand modified version of TCP to suite such requirements.

5. Conclusion

TCP has traditionally been neglected in IoT network designs, current trends suggest that TCP will gain extensive deployment in IoT scenarios. Particular drawbacks of TCP increase header overhead, lack of flexibility for loss-tolerant applications, and unsuitability for multicast. TCP failed for non-critical monitoring with relatively frequent sensor reading updates. However, with appropriate configuration, TCP can behave similarly to unicast end-to-end reliability mechanisms well accepted for the IoT.

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