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QoS Management in a Next Generation Home Network

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Abstract: We propose to classification the sensing data in the next generation home network according to the level of importance. Priority control for the classified data is described, together with some simulation results. The proposed QoS management scheme is shown to control the data correctly.

1. Introduction

The number of broadband access users, which includes FTTH (Fiber-To-The-Home), is rapidly increasing. In the next generation home network (NgHN), home terminals/appliances that are not now connected to each other will be networked by using IP technology. Therefore, the amount of traffic data in the HN will increase a lot. Video terminals are the major bandwidth consumers and their traffic is bursty [1].

When all kinds of sensors will be accommodated in the NgHN, and information regarding the daily life of the user passed across the NgHN, new such systems in the NgHN as a home automation, remote sensing and life support service should be developed [2]. Several technical issues associated with signal transmission quality such as packet loss, delay and jitter still remain to be finalized before we can realize the NgHN. Those issues are important in assuring the transfer of daily life information, security data, and disaster data.

It is not efficient to assign a different Quality of Service (QoS) to each sensing data stream. This paper classes the sensing data in the NgHN according to level of importance. The priority control based on the classes is described, together with some simulation results.

2. Classification of the sensing data

Table 1 summarizes the proposed sensing data classes.

Both category I, which includes medical care, nursing care and health care information, and category II, which includes security and disaster information have the highest level of importance as they impact the Quality of Life (QoL) of humans.

3. Priority control with PQ/CBWFQ

Category I and II use the Priority Queuing (PQ) method, while the other categories use Class-Based Weighted Fair Queuing (CBWFQ) in order to assure minimum bandwidth as shown in Table 1.

The PQ method is used to guarantee the transmission of packets with the highest priority.

CBWFQ is able to guarantee the minimum bandwidth if the bandwidth value is pre-assigned. As categories III to VI may allow packet loss, use of CBWFQ is sufficient for the NgHN.

Table 1 sensor, service, priority Queuing for each categories

Category		Sensor	Service to become an object	level of importance	Queuing method
Ⅰ	medical care, nursing care, healthcare	Beat sensor, heat sensor, acceleration sensor	blood pressure, beat, blood glucose level	High	**PQ** :Higher priority
Ⅱ	Security, disaster	Infrared sensor, smoke sensor, heat sensor	Object sensing, smoke, heat,	↑	**PQ** :Lower priority
Ⅲ	environment control , saveenergy control	Light sensor, humidity sensor, gas sensor,	heat, humidity, brightness, utility	↑	**CBWFQ** :Large Bandwidth
Ⅳ	location management	IC (integrated circuit) tag	Article of value, important documents	↑	**CBWFQ** :Middle Bandwidth
Ⅴ	livelihood support	ultrasound sensor, pressure sensor, infrared sensor	Someone's location, activity	↑	**CBWFQ** :Middle Bandwidth
Ⅵ	domestic cares support	IC (integrated circuit) tag	location management in frigidaire, freshness date management	Low	**CBWFQ** :Small Bandwidth

4. Simulation

4.1. Simulation summary

To verify the effectiveness of PQ/CBWFQ, a simulation was conducted using NS-2 (Network Simulator 2) [3]. The traffic flows allocated to each node and network topology in the simulation are shown in Fig.1. Maximum capacity between any two nodes was 100 Mbps. Source0 sends both category I and II data with PQ; Source1 the VoIP (Voice over IP) data also with PQ; Source2 category III, IV, V and VI data with CBWFQ. Source3 sends IPTV, HD (High Definition video) and Telnet data also with CBWFQ. Source4 sends FTP (File Transfer Protocol) data using the BE (Best Effort) method. All traffic is passed through intermediate nodes that offer PQ/CBWFQ control.

4.2 Simulation results and discussion

Figure 2 shows the bandwidths of each source, or services vs. starting time of each traffic. It is clear that service bandwidth varies in response to the emergence of new traffic. Figure 3 shows a magnified plot of Fig.2, together with traffic of Source0 without PQ/CBWFQ for comparison.

When the intermediate nodes do not support PQ/CBWFP, all traffic streams suffered packet loss of about 50 % because the total amount of traffic sent was about twice the capacity between two Edge nodes.

The application of PQ/CBWFQ ensured the successful transmission of the high priority class. Source0 had throughput of up to 5.0Mbps without any packet loss. Traffic from Source1 was also sent without packet loss. All traffic of Source2 sent was transmitted without any packet loss because the minimum bandwidth was set to 10Mbps, twice the service rate. Source3 traffic suffered packet loss of about 64 % as its service rate was set to 35Mbps. This loss value is reasonable as the service rate was 100 Mbps. Source4 traffic experienced packet loss about 38 % because it was sent on the BE basis.

5. Conclusions

For efficient management of QoS in the NgHN, we proposed to class the traffic according to importance. The effectiveness of the proposed priority control method (PQ/CBWFQ) was verified by simulation. The results showed that data with higher priority was transmitted correctly.

References

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[2] Takumi Emori, et al., "Construction of Gateway Services between DLNA/UPnP Home Network and ZigBee Sensor Network", 2006 IEICE General Conf., DP-2-5, March 2006 (in Japanese)

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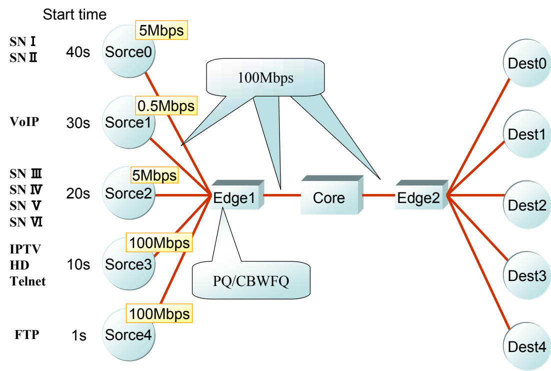

Fig. 1: Simulation Topology

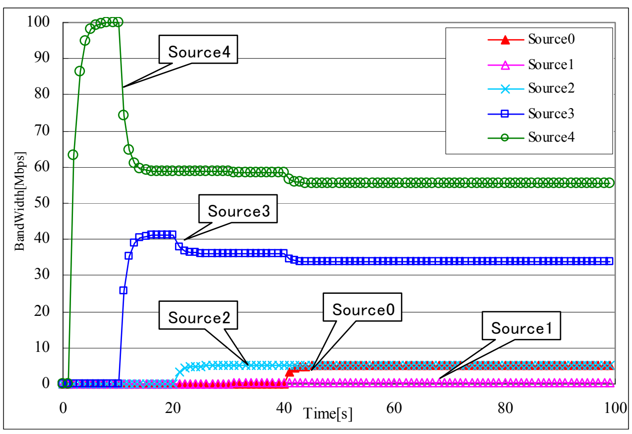

Fig. 2: Service Rate

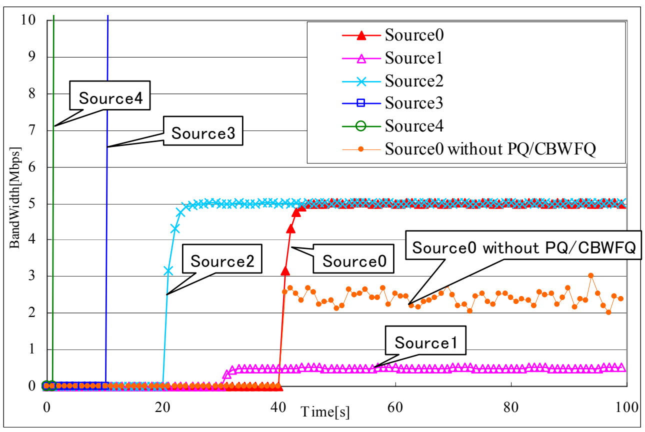

Fig. 3: Service Rate
(Zoom Y axis of Fig.2 to 10 Mbps)