

SONY

Sony's QoS Technology

Achieve Low-Delay, High-Quality Streaming Over Mobile Networks

Sony Corporation
Professional Solutions Group

The use of high-speed mobile networks including LTE (Long Term Evolution) is rapidly increasing, along with the popularity of IP transmission via mobile networks. In this network environment, there's a growing need for efficient wireless transmission of camera-captured higher-resolution images.

However, concerns persist about network performance because communication delays can occur with traffic congestion, ambient influences, and fluctuating network conditions depending on distances from the base station. Because of this, it has been challenging (and often not the best option) to use a wireless streaming in mobile network environments for applications that require high-quality live streaming.

Typically, live streaming on a mobile phone network or the internet is affected by any drop in network speed, and packet loss can cause considerable communication damage including image disturbance, freezing, and noise. To improve network quality, QoS (Quality of Service) technology is required. This secures service quality on the communication network and is essential to maintaining video and audio quality levels.

Sony's PWS-100RX1 Network RX Station, CBK-WA100/CBK-WA101 Wireless Adapters, and PXW-X500(*)/PXW-X200/PXW-X180(*) Camcorders with a built-in wireless capability are equipped with Sony's innovative QoS technology designed for mobile phone networks (4G/LTE).

(*): Upgrade scheduled for Q3 2015.

This Sony's QoS technology has been developed from the same technology as used in its well-renowned video conference systems, and features two major improvements in order to cope with mobile networks.

Firstly, a new algorithm has been developed. This Adaptive Rate Control algorithm follows any sharp fluctuation in network bandwidth. Secondly, Forward Error Correction (FEC) is performed with large FEC blocks, enabling correction of a large number of lost packets in an FEC block.

With these improvements, this new QoS system achieves low-delay, high-quality live streaming even over mobile networks which feature sharp fluctuation of network bandwidth and bursts of packet loss.

The Network RX Station with Sony's QoS technology maintains video and audio integrity during communication to support quality live streaming. With this system, you can transmit in real time and live stream your ENG (electronic news-gathering) materials from acquisition points to your broadcast station. You won't need costly dedicated broadcasting equipment and your workflows remain simple.

This wireless solution allows many new possibilities. For example, you can live stream using Sony's camcorders equipped with this wireless solution from places where no live cameras have ever been used before!

The following chapters describe this new QoS technology, system configuration, and QoS performance.

I. QoS Technology

Sony's QoS technology comprises three main elements: Real-time ARQ (Automatic Repeat reQuest), FEC (Forward Error Correction), and ARC (Adaptive Rate Control). These QoS systems are combined intelligently, enabling high-quality live streaming even via volatile mobile communication networks.

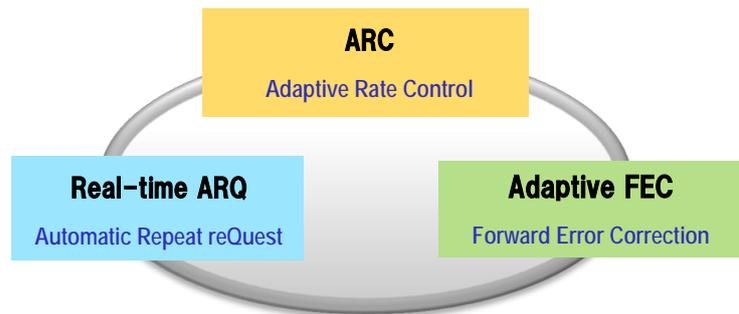


Figure 1: Sony's QoS Technology

II. ARC (Adaptive Rate Control)

ARC is a mechanism to calculate the optimum transmission rate of the video stream corresponding to the network condition. In general, ARC increases the rate additively to seek the available network bandwidth, and slows down the rate if network congestion occurs.

The conventional algorithm for a wired network cannot achieve sufficient network speed and can cause unstable communications. Instead, the new and enhanced algorithm in the Network RX Station and Wireless Adapter can cope with mobile phone networks, and delivers higher speeds and stable streaming.

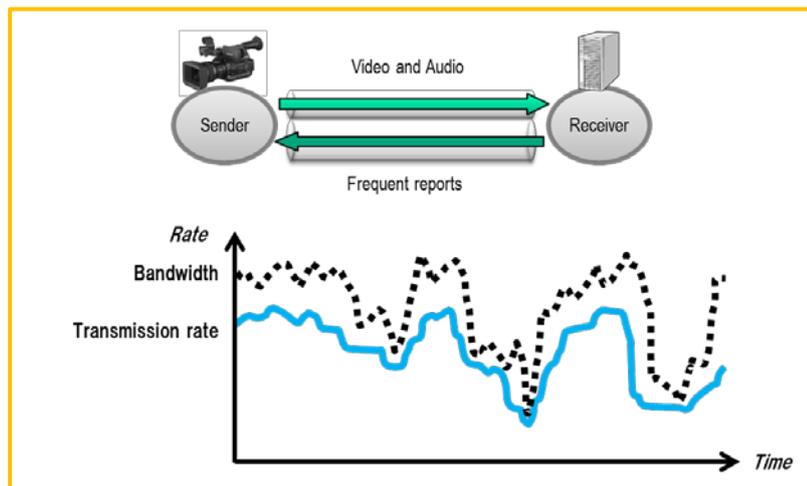


Figure 2: ARC (Adaptive Rate Control)

III. Real-time ARQ (Automatic Repeat reQuest)

ARQ (Automatic Repeat reQuest) is a lost packet recovery technology where a

sender retransmits any lost packets detected and requested by a receiver. Real-time ARQ is enhanced ARQ for real-time communication; it takes into account both the network condition and interactive communication delays.

Figure 1 shows how Real-time ARQ works. All packets are given a sequence number and time stamp by the streaming protocol, which designates audio/video decoding timing. As a basic ARQ mechanism, the receiver detects the loss of data packets by monitoring sequence numbers that do not appear (e.g., packet number 2, in Figure 3) and sends a “retransmission request” with the lost sequence numbers to the sender. The sender has a sending buffer in which to store the packets sent, and from which the packet requested in the retransmission request is retransmitted. The receiver reorders all received packets, including the retransmission packet, in a receiving buffer and moves them to the decoder before the decoding time.

The Real-time ARQ mechanism, in addition to ARQ, can optimize ARQ performance while maintaining real-time constraints for interactive communication. When the RTT (Round-Trip Time) has elapsed after a retransmission request is sent, the receiver can receive the requested packet as shown in Figure 3. But the requested packet needs to arrive at the receiver before its decoding time. To accommodate these two conditions, Real-time ARQ measures the RTT between the terminals, and judges whether the retransmission packet of the Nth retransmission request ($N=1, 2, \dots$) would arrive by its decoding time or not. In this way, Real-time ARQ prevents wasteful retransmission and enhances ARQ’s recovery performance.

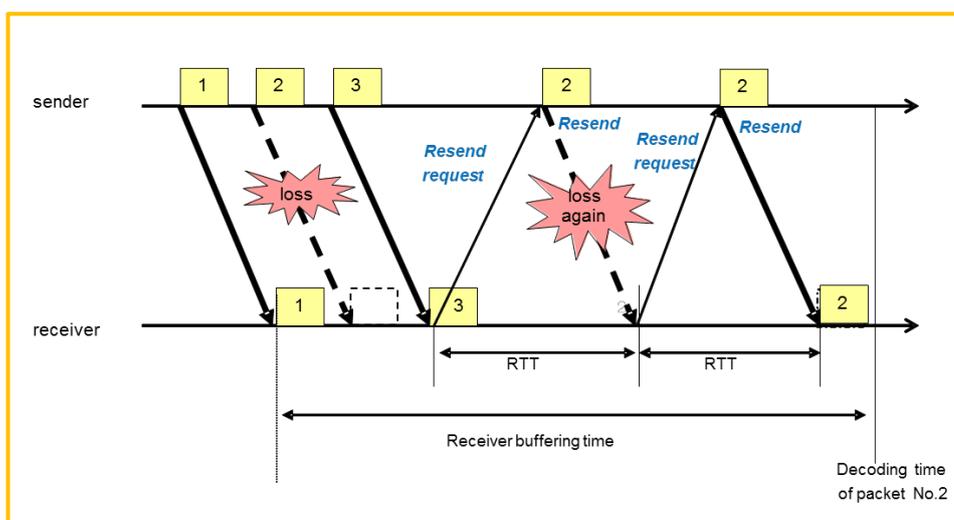


Figure 3: Real-time ARC (Automatic Repeat reQuest)

IV. Adaptive FEC (Forward Error Correction)

FEC (Forward Error Correction) is another loss recovery technology using parity data. The sender generates parity packets from original data packets and the receiver recovers the lost packets with the original packets and parity packets that have already been received. In general, the recovery performance of FEC is not affected by the RTT. Therefore, FEC is more effective and suitable than ARQ in long RTT networks. However, FEC needs a larger amount of packets for recovery than ARQ.

The Adaptive FEC function of the Network RX Station and Wireless Adapter improves recovery performance for sudden packet loss, by enlarging the size of the FEC block and optimizing blocks. Moreover, Adaptive FEC can adjust the ratio of parity packets in the FEC block according to network conditions such as the RTT. It reduces parity packets and yet can satisfy the expected recovery performance, and this improves image quality.

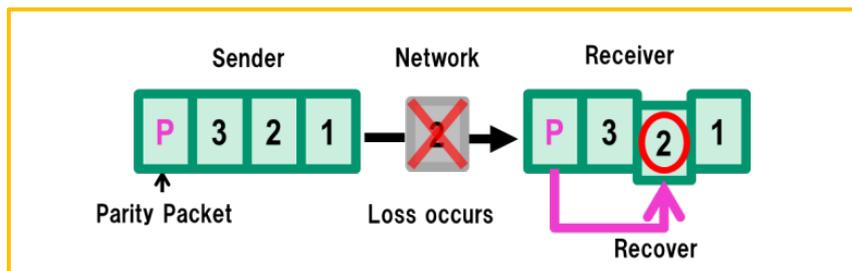


Figure 4: Adaptive FEC (Forward Error Correction)

V. System Configuration

The Wireless Adapter and Sony's camcorder with a built-in wireless capability (the sender) transmits live video and audio data to the Network RX Station (the receiver). The Network RX Station receives and monitors the video and audio data, and periodically feeds back information on network conditions to the sender.

The sender receives feedback information from the receiver and, based on this information, transmits live video and audio data under QoS controls as follows: the ARC changes its transmission rate automatically according to network conditions, and the FEC generates parity packets from original data packets.

The sender will adjust the transmission rate automatically based on feedback information, add the FEC packets, and transmit live video streaming and audio data.

The receiver monitors the sequence numbering of the received packets, detects any packet loss, and sends a retransmission request to the sender. The sender re-sends the requested packets.

The receiver receives all packets including the resent packets, and sorts the all data into the correct order. The receiver sends data to the decoder prior to the decode time.

In this way, Sony's QoS technology delivers optimized live streaming despite any uncomfortable fluctuation of mobile phone network bandwidth and any effects of delay.

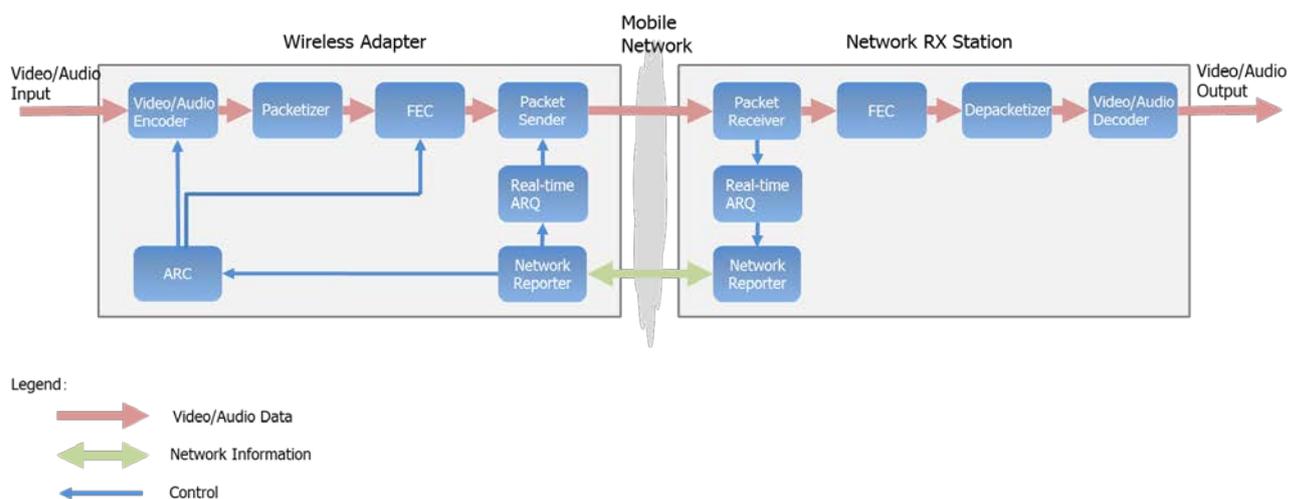


Figure 5: System Configuration

VI. QoS Performance: Packet Loss Tolerance

The Network RX Station is equipped with two QoS modes: Standard mode and Short mode.

With Standard mode (3 sec delay mode), Sony's QoS technology achieves a video loss ratio of less than 10^{-5} under the condition of a 30% packet loss ratio. This is less than one video frame loss per hour with 6 Mbps, 30 fps high-definition live streaming.

With Short mode (1.5 sec delay mode), performance equivalent to Standard mode can be achieved under the condition of a 15% packet loss ratio.

* In the event of low-rate transmission, packet loss tolerance is lower than the above values.

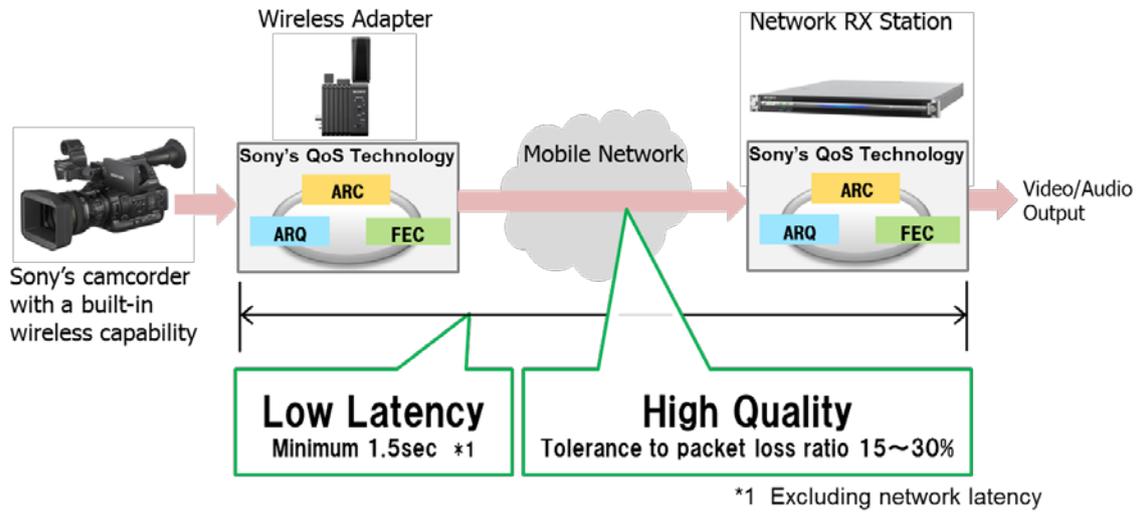


Figure 6: Sony's QoS Performance

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