Platform Application Technology Using the Next Generation Network

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Abstract

We have been investigating platform technology that takes advantage of the quality control, security, and other functions provided by the next generation network (NGN) to implement various applications that have a high degree of safety and quality. In this article, we report the situation concerning platform technology for high-definition video distribution, interactive communication, and authentication systems.

1. NGN application platform technology

The next generation network (NGN) is expected to implement various functions for creating various kinds of broadband services, such as end-to-end quality control, unicast communication functions, multicast communication functions, and interactive communication functions. However, technology for implementing specific communication applications that make use of such NGN functions must also be developed. In this article, we introduce some examples of that kind of technology: 1) video distribution platform technology that uses unicast and multicast communication functions for high-definition video distribution, 2) high-definition video IP (Internet protocol) videophone technology and high-quality IP telephone technology for implementing high-presence interactive communication equipment with interactive communication functions, and 3) federated authentication platform and time authentication and timestamping technology that allows the construction of secure and safe services by using NGN security functions.

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2. Video distribution platform technology (high-definition video distribution services)

IPTV (Internet protocol television), which is a video distribution service delivered via IP, has already begun around the world, and it is attracting attention as a service that has potential for rapid growth in the future. For that reason, the provision of a variety of video programming content at higher quality is expected [1]. In the NGN, it will be possible to reserve bandwidth sufficient for stable distribution of high-definition-class video, so we have taken up the challenge of establishing new video distribution service technology to take advantage of that function.

The configuration of the video distribution system that we are developing is applicable to a distribution system that is connected to the NGN's server-network interface (SNI: interface between the application server and the network) (**Fig. 1**). The NGN multicast communication function is used in IP broadcasting and the NGN unicast communication function is used in video-on-demand (VOD) services. In addition, interactive services and various other ancillary services that make use of various servers that store program information (metadata) and other such information are assumed to use best-effort communication functions.
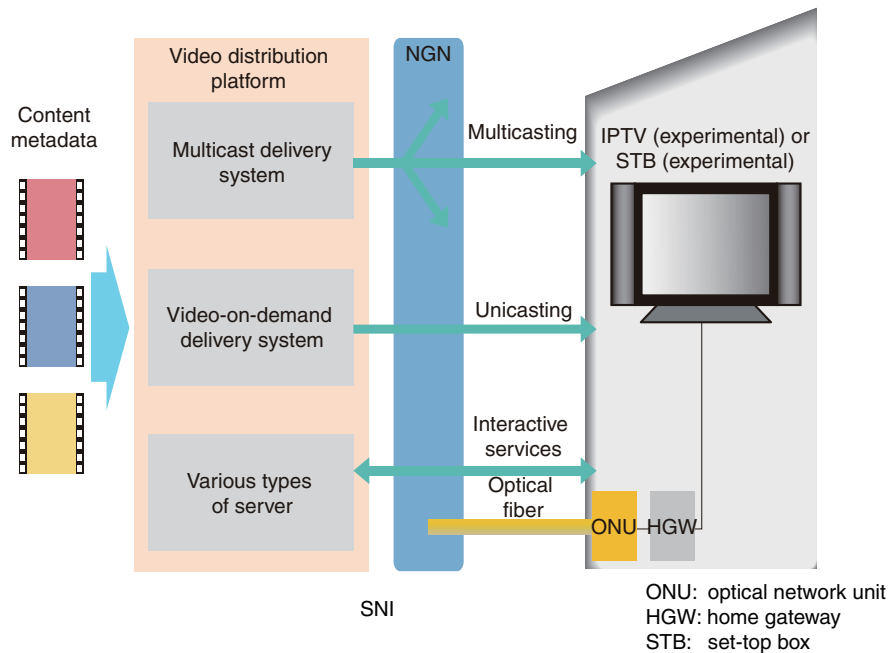
Support Technologies

Fig. 1. High-definition video distribution system.

2.1 System features

1) High-quality video distribution technology

The NGN makes it possible to select an IP packet communication quality class (packet transfer priority) that suits the form of communication required by the application. For high-quality VOD, however, the bandwidth required for video distribution between the distribution server and the terminal can be reserved by using the NGN unicast communication function, which has the highest priority; this assures the distribution of the video and audio packets. That would make it possible to implement applications in which realtime communication such as a video service is not disturbed even if one views it at the same time as using the Internet. The actual mechanism involves specifying an identifier that indicates the high-quality communication class in the headers of the IP packets for video communication (**Fig. 2**). That results in the video signal packets being transferred within the network with higher priority than packets for Internet access or other best-effort class communication. In this way, the end-to-end communication quality of the video data is maintained within the preset range.

2) H.264 video encoding technology

H.264/AVC encoding technology*, which allows the encoding of high-definition video at a high compression rate, is a very effective technology for distributing the increasingly diverse video programming content with efficient use of communication bandwidth. Currently, technology that uses the H.264/AVC high profile for distribution to large-format HDTV (high-definition television) is being evaluated. That method compresses the video signal to 10 Mbit/s or less, which makes it easy to distribute multiple high-definition videos to the user at the same time.

3) Diverse program creation technology

Cooperation between the NGN and video distribution systems allows cooperation between communication and broadcasting [2]. Detailed distribution services such as the provision of information that matches individual preferences and attributes can be provided in addition to high-quality video distribution. Some examples are:

- Selection of previously viewed scenes for replay
- Viewing of missed broadcast programs
- Insertion of commercials according to viewer attributes
- Cooperation between video distribution and interactive services

The foundation technology for implementing these

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* H.264/AVC is a common way to refer to H.264/MPEG-4 AVC (advanced video coding), a standard that was developed jointly in a partnership between VCEG (Video Coding Experts Group) and MPEG (Motion Picture Experts Group).
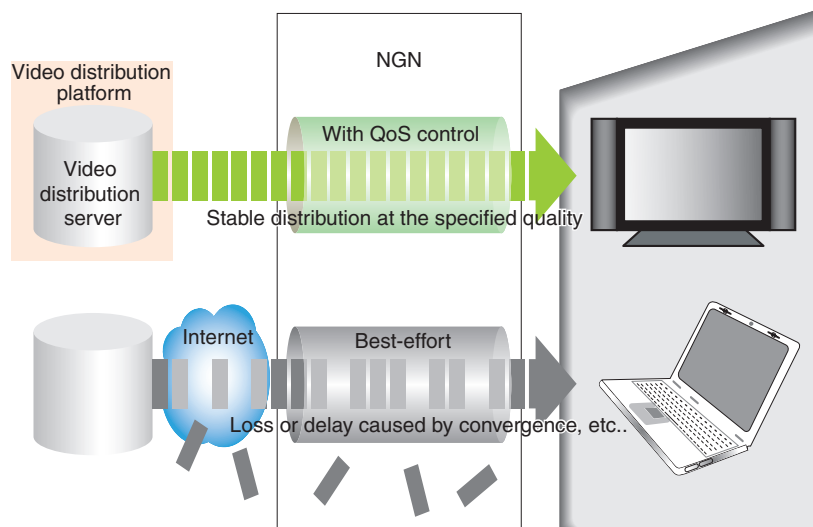
Fig. 2.   Video packet priority control.

services is metadata-controlled viewing technology [3].

4) Standard IPTV terminal configuration technology

We are currently working together with manufacturers of home electronics to investigate an IPTV standard format that can be installed in standard digital TV sets [4]. While we are proceeding with the establishment of technology for an NGN-oriented prototype, we have chosen a configuration that uses the same processing modules as the digital broadcasting system as much as possible [5].

2.2 Terrestrial digital broadcasting IP retransmission services

We are also working on technology for IP retransmission of terrestrial digital broadcasting. As a step towards the complete transition to terrestrial digital broadcasting in 2011, the Ministry of Public Management, Home Affairs, Posts and Telecommunication is moving forward with the technical validation of terrestrial digital broadcasting retransmission by IP multicasting (**Fig. 3**) to expand the options for use and viewing methods in regions where conditions are unfavorable. One important item for technical validation is to maintain the synchronization of services when using a terrestrial radio signal and when retransmitting IP data.
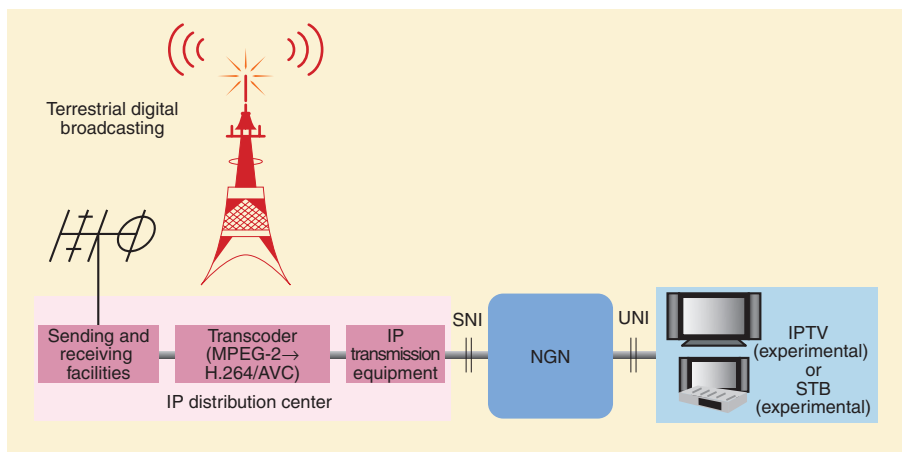

Fig. 3.   Configuration of an IP retransmission system for terrestrial digital broadcasting.

Basically, consistency in the following items must be maintained.

- Quality (video, audio, and data broadcasting)
- Information content (video, audio, data broadcasting, closed captioning, EPG (electronic program guide), etc.)
- Operability (functions, channel changing speed, etc.)

To both satisfy those requirements and achieve highly efficient use of transport routes in IP multicasting, we are investigating system configuration techniques such as those shown in **Fig. 4**. This system makes it possible to compress the data to be distributed from 17 Mbit/s to about 12 Mbit/s without loss of information that is required for the service. This allows efficient retransmission over the IP network. The two fundamental technologies used in this system are explained below.

1) H.264 video/data synchronous remultiplexing technology

The video data in the terrestrial digital broadcasting signal is compressed by the MPEG-2 encoding method. For IP retransmission, however, a transcoder for converting to H.264, which is an encoding method that can provide even further compression, is being considered. However, the broadcasting signal contains data signals such as PSI/SI (program specific information and service information, which includes program distribution information) and data

broadcasting data in addition to the video, audio, and subtitle media signals that should be transcoded. In this system, to maintain the consistency of program content, the received broadcasting signal is separated into a media signal and a data signal, and only the media signal is passed through the transcoder. The two signals are then remultiplexed while controlling the output timing with the data signal, thus maintaining timing that is consistent with the broadcasting signal.

2) SI multicast retransmission technology

In terrestrial radio signal digital broadcasting, the service information (SI) signal of each channel is transmitted in its own individual MPEG-2 transport stream (TS). However, if the receiver receives all of the SI individually multiplexed in each stream, this places a large load on it. Therefore, in this system, the SI multiplexed to the MPEG-2 TS of the various channels is collected and a new MPEG-2 TS is created to transmit the SI as a dedicated IP multicast stream. As a result, the load on the receiver is reduced.

3. Interactive communication with high presence

QoS (quality of service) control on the NGN makes it possible to provide stable high-presence interactive communication services with high-definition video
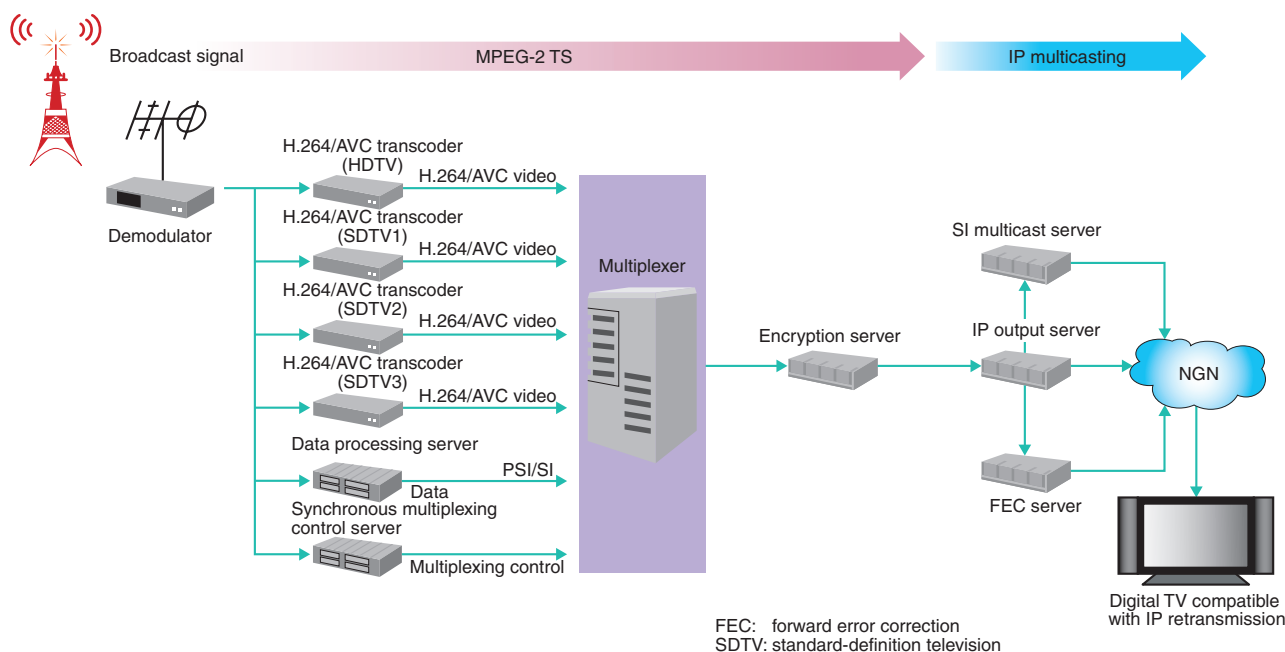

Fig. 4.   H.264 video/data synchronous remultiplexing system.

FEC: forward error correction
SDTV: standard-definition television

and wide-frequency-range audio.

3.1 IP high-definition videophone

Large thin flat-panel TVs that can display high-definition video are becoming popular for home use, and the market for consumer high-definition video cameras is also growing. The IP high-definition videophone (**Fig. 5**) has been developed as equipment that uses these high-definition video consumer products to offer lifelike high-presence interactive communication. This equipment has been implemented with (1) low-delay video/audio codec technology and (2) audio technology using compact microphones for realistic sound acquisition and playback.

For the codec, we have used MPEG-2 HDTV encoder/decoder boards developed in our laboratories. We achieved smooth conversation over high-quality video (about 20 Mbit/s) by transmitting video (1080i/60 fps: 1080 lines interlaced at 60 fields per second) and audio signals with a codec delay of less than 200 ms. In addition, we have developed a stereo

microphone array that collects sound at distances of from two to three meters and can be mounted on the display without protruding. This microphone array gathers uniform stereo sound in a realistic manner and enables users to identify the speaker's position. We believe that these technologies can provide audio-visual telecommunication that uses high-definition video to provide a more comfortable experience with a sense of presence. Furthermore, we are using a hand-held device with an integrated user interface that not only starts and terminates communications but also remotely controls the appliances with infrared signals.

3.2 High-quality IP phone

The proliferation of broadband services has made possible audio communication using software telephones on personal computers at bandwidths greater than the telephone bandwidth (3.4 kHz). However, widespread use will require (1) maintaining the interconnectability between a broadband speech
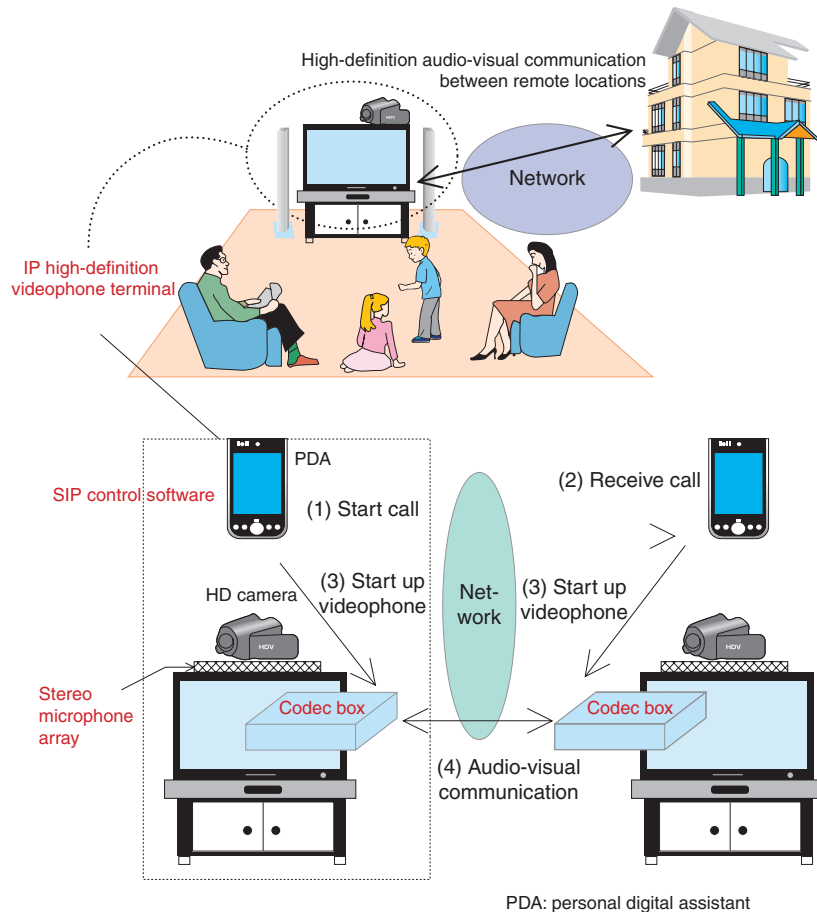

Fig. 5.   IP high-definition videophone.

Fig. 6.   High-quality IP telephone.

codec and a conventional telephone speech codec and (2) implementing a handset suitable for broadband communication, because existing handsets are designed for the conventional telephone bandwidth. Telephones for 7-kHz communications, which can cover nearly all of the frequency components in human speech, were first researched over twenty years ago for the ISDN (integrated services digital network) era, but they never became popular. Now, a high-quality IP telephone (**Fig. 6**) is being developed with the objective of allowing wideband (7-kHz) speech communication. For the speech codec, we used our developed wideband scalable speech codec "UEMCLIP (μ-law embedded coder for low-delay IP communication)" [6], which is in the process of standardization. This codec can maintain interconnectability with G.711. Furthermore, with

emphasis on keeping a balance between the low-frequency and high-frequency responses in the handset, we achieved a handset suited for 7-kHz bandwidth audio by using a circular sound opening structure (Fig. 6). These techniques make it possible to implement a telephone that is capable of both 7-kHz band speech and conventional telephone speech communications.

3.3   Home gateway (HGW)

Various services developed using the NGN, which can simultaneously provide videophone or IP telephone functions (as described above), video distribution, and Internet access, and home appliances connected to a network are expected to increase. Thus, a home gateway (HGW) will become important to provide mediating functions for managing the terminals connected to the home network and to permit terminals to use the many network functions.

The configuration of the HGW that is currently under development is shown in **Fig. 7**. Four LAN (local area network) ports and a wireless LAN PCMCIA (Personal Computer Memory Card International Association) interface are provided for the connection of multiple home appliances. In addition to the broadband router functions that are required for various types of services—IP telephone terminal adapter functions, SIP (session initiation protocol) functions, and IP multicast functions—packet priority control functions that conform to the

PPPoE: point-to-point protocol over Ethernet
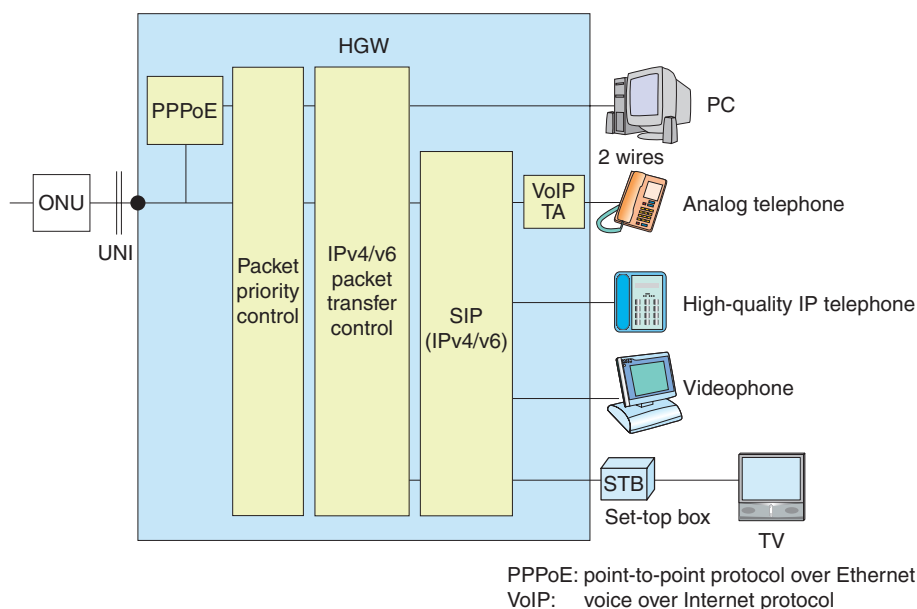VoIP: voice over Internet protocol

Fig. 7.   HGW configuration

UNI (user-network interface) specifications [7] are also provided for compatibility with NGN quality control. With this kind of HGW, we expect various high-quality broadband services that take advantage of the special features of the NGN to become popular.

4. Authentication system platform technology

4.1 Approach to an authentication-based business support platform

The NGN will provide quality control and other such network functions that are not provided by the conventional IP network, so the development of communication applications that take advantage of those functions is expected. However, to support the creation of an even greater variety of applications for use over the network, it is also important to provide the functions that are commonly required by various services over the NGN network as platform functions. Specifically, the functions that should be provided as platform functions will probably depend on service and business trends, but the functions that are provided will probably be restricted to those with high commonality and generality. Furthermore, basic to providing those functions is an interface that conforms to international standards. Below, as specific examples of platform functions, we describe a federated authentication platform and time authentication and timestamping functions that we have been developing.

4.2 Federated authentication platform

The federated authentication platform is based on the NGN basic security function of checking for and blocking forged caller IDs (caller identification) or other such data at the point of entry to the network. It is technology that we are developing with the objective of making use of the results of network authentication even when the user accesses a server on the NGN SNI or a server on the Internet via the NGN.

When the federated authentication platform receives an authentication request from a service provider, it reports results that verify the user access line. Here, the ID that is sent by the federated authentication platform is not actual ID information such as a telephone number, but a pseudonymous ID that is only meaningful to the service provider (**Fig. 8**). This kind of interface with the service provider assumes conformance with the SAML 2.0 international standard specifications [8].

Existing ID/password authentication methods can be performed from any line. However, if they are used in combination with the network authentication results from the federated authentication functions, the service provider can implement user authentication that is even more difficult to defeat through forgery.

In recent years, multifactor authentication that adds biometric authentication and/or possession-based authentication using authentication tokens or smart cards has been getting more and more essential for financial organizations and other entities to provide services that require more advanced security. Access
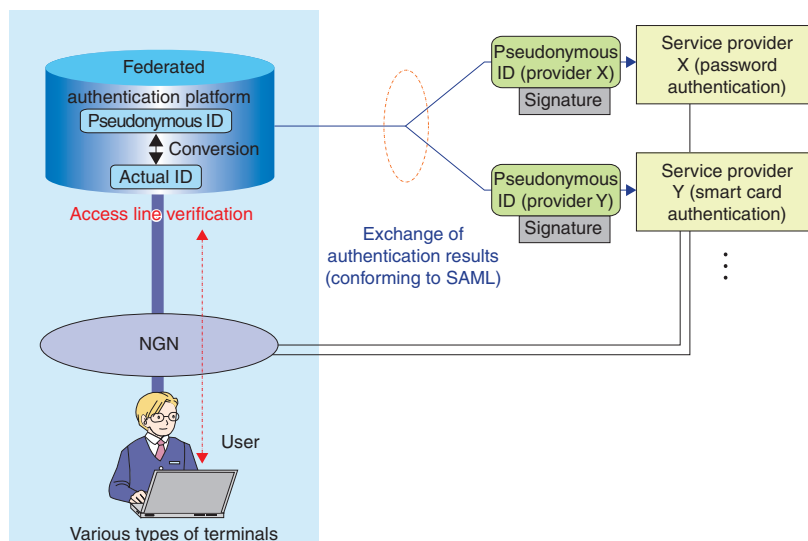

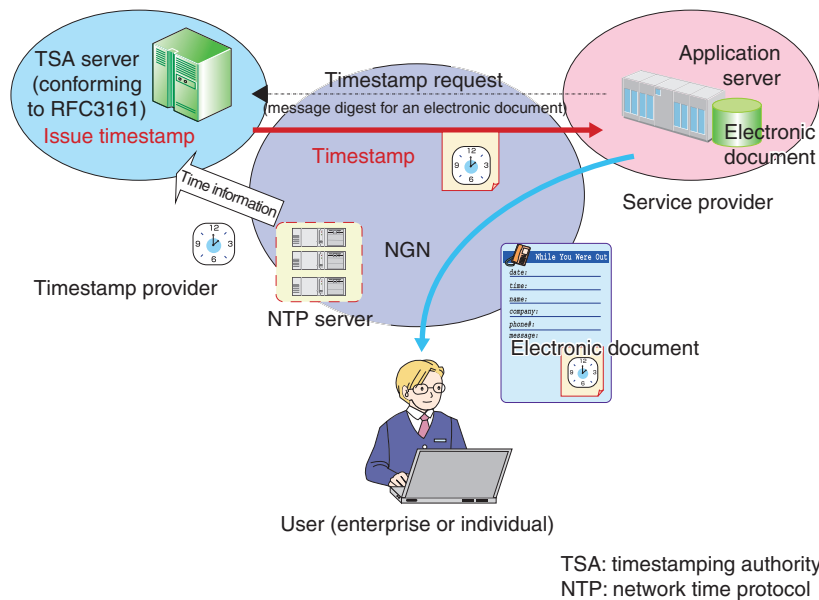Fig. 8. Features of the federated authentication platform.

Fig. 9.   Use of timestamps.

line verification also holds promise for use as one such element.

4.3   Time authentication and timestamping

A timestamping service supports assertions of proof that an electronic document existed at the date and time of the timestamp. It also serves as proof that an electronic document has not been tampered with since then. Timestamps prevent unauthorized modification of various kinds of electronic data, so they improve the safety and reliability of data exchange on the NGN. We expect the applicable area to steadily expand in the future to include transaction receipt for online shopping and banking, document management of patent information and other rights-related records, and electronic medical records.

We are considering that the RFC3161 standard should be used as a protocol for requesting and generating timestamps [9]. Furthermore, the NGN could provide a highly accurate and reliable time source to the timestamping servers (**Fig. 9**).

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