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SERIES F: NON-TELEPHONE TELECOMMUNICATION SERVICES

Multimedia services

## Requirements for a real-time interactive multimedia service under poor network conditions

Recommendation ITU-T F.746.12

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# Recommendation ITU-T F.746.12

## Requirements for a real-time interactive multimedia service under poor network conditions


### Summary

Recommendation ITU-T F.746.12 describes the scenarios, general framework and requirements for a real-time interactive multimedia service (RIMS) under poor network conditions. The RIMS system plays an important role in many scenarios and situations, e.g., emergency relief, remote education and emergency communication. The RIMS requires provision of measures for dynamic adjustment of coding parameters, including those for video and audio coding, and it requires setting maximal priority of audio communication under low-speed network conditions and configuring usage attributes to ensure the appropriate priority from high to low of service uses.



### History

| Edition | Recommendation | Approval | Study Group | Unique ID* |
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| 1.0 | ITU-T F.746.12 | 2022-03-16 | 16 | 11.1002/1000/14959 |

### Keywords

Multimedia service, poor network conditions, real-time.


* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

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## Requirements for a real-time interactive multimedia service under poor network conditions

### 1 Scope

This Recommendation specifies requirements for the framework to provide real-time interactive multimedia service (RIMS) under poor network conditions, and corresponding application scenarios.

### 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T X.500] Recommendation ITU-T X.500 (2019), *Information technology – Open Systems Interconnection – The Directory: Overview of concepts, models and services*.

[ITU-T X.511] Recommendation ITU-T X.511 (2019), *Information technology – Open Systems Interconnection – The Directory: Abstract service definition*.

[ITU-T Y.2201] Recommendation ITU-T Y.2201 (2009), *Requirements and capabilities for ITU-T NGN*.

[ITU-T Y.2701] Recommendation ITU-T Y.2701 (2007), *Security requirements for NGN release 1*.

### 3 Definitions

#### 3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

**3.1.1 application service** [b-ITU-T H.360]: A network-based service involving the transmission and/or processing of multimedia information.

**3.1.2 call control** [b-ITU-T G.8081]: Call control is a signalling association between one or more user applications and the network to control the set-up, release, modification and maintenance of sets of connections.

**3.1.3 directory server** [b-ITU-T X.518]: A DSA or an LDAP server.

**3.1.4 decoder** [b-ITU-T H.265]: An embodiment of a decoding process.

**3.1.5 encoder** [b-ITU-T H.265]: An embodiment of an encoding process.

**3.1.6 multimedia service** [b-ITU-T Q.1743]: Services that handle several types of media such as audio and video in a synchronized way from the user's point of view. A multimedia service may involve multiple parties, multiple connections, and the addition or deletion of resources and users within a single communication session.

#### 3.2 Terms defined in this Recommendation

None.

## 4 Abbreviations

This Recommendation uses the following abbreviations and acronyms:

AC Application Client

ASU Application Service Unit

CCSU Call Control Service Unit

DS Directory Server

DSA Directory System Agent

FEC Forward Error Correction

LDAP Lightweight Directory Access Protocol

MPSU Media Processing Service Unit

MSSU Media Storage Service Unit

RIMS Real-time Interactive Multimedia Service

SAN Storage Area Networking

VACU Video and Audio Capture Unit

VARU Video and Audio Render Unit

VSAT Very Small Aperture Terminal

## 5 Convention

In this Recommendation:

– The phrase "is required to" indicates a requirement that must be strictly followed and from which no deviation is permitted if conformity to this Recommendation is to be claimed.

– The phrase "is recommended" indicates a requirement that is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformity.

– The phrase "can optionally" indicates an optional requirement that is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator or service provider. Rather, it means the vendor may optionally provide the feature and still claim conformity with the specification.

## 6 Overview

Real-time multimedia service plays an increasingly important role in many scenarios and situations with poor network conditions, e.g., emergency relief, medical emergency, remote education, emergency communication, maritime communication, remote technical support and vehicle communication [b-Martini] [b-Tsou].

In most of these scenarios, the communications infrastructure is broken (in disaster scenarios) or even non-existent (in remote rural areas). Thus, the underlying network conditions are very poor. Packets often suffer a high bit error rate (burst packet loss), significant delay jitter or long transmission delay. The wireless environment changes rapidly, and the transmission power of nodes is often adjusted, which leads to frequent changes of network topology [b-Ni].

There are several methods deployed, such as flexible macroblock ordering [b-ITU-T H.264], slice segment and key frames re-synchronization, to provide resilient multimedia services over the Internet. However, under poor network conditions, the transmission issues previously mentioned cannot be solved by these methods [b-Wang] [b-Zhang].

Forward error correction (FEC) performs well with random error, but cannot deal with burst errors. In the situations previously mentioned, encoding every packet with FEC will overburden the network. An automatic repeat request sends data repeatedly when the network condition goes badly and makes congestion worse. When some links are instable or with high latency (> 200 ms), e.g., satellite links, the general signalling control mechanism, such as that specified in [b-ITU-T H.323], may lead to frequent re-connection.

To overcome these issues, many vendors have proposed proprietary solutions to provide better performance, which leads to the problem of interoperability [b-Nguyen]. This Recommendation focuses on the requirements of RIMS under poor network conditions.

## 7 Key components of a real-time interactive multimedia service system

This clause presents a reference framework for a RIMS system, which is shown in Figure 7-1. It consists of an application service unit (ASU), application client (AC), call control service unit (CCSU), media processing service unit (MPSU), media storage service unit (MSSU), directory server (DS), encoder, decoder, video and audio capture unit (VACU) and a video and audio render unit (VARU).

Unless explicitly stated in the text, the framework depicted in the figures and functions in this Recommendation are logical and thus do not necessarily represent a particular physical implementation.

The ASU, CCSU, MPSU, MSSU and DS are deployed in a RIMS service node. The ASU provides specific application service(s) to RIMS users. Its main functions include access registration, access authentication, identification, authorization, presence, business processing, information management and target media serving function selection. The CCSU is a signalling association unit between service node equipment and user equipment to control the set-up, release, modification and maintenance of sets of connections. The MPSU provides video and audio processing services. Its main functions include media reception, media mixing, media transcoding, media routing, media transmission, media forwarding and media replication. The MSSU is used to retrieve, store media and provide media serving capability. Its main functions include media storage, media serving, media indexing and media downloading. The DS is an entity that stores information about objects as records and provides records to other units. It can return directory information when receiving a request over the directory access protocol or lightweight directory access protocol (LDAP).

RIMS user equipment consists of five units: AC; encoder; decoder; VACU; and VARU. The AC is an agent that initiates requests and receives ASU responses. The encoder is an embodiment of an encoding process. The decoder is an embodiment of a decoding process. The VACU captures video and audio media streams, such as a camera or microphone. The VARU feeds media streams to devices, such as a screen or loudspeaker.

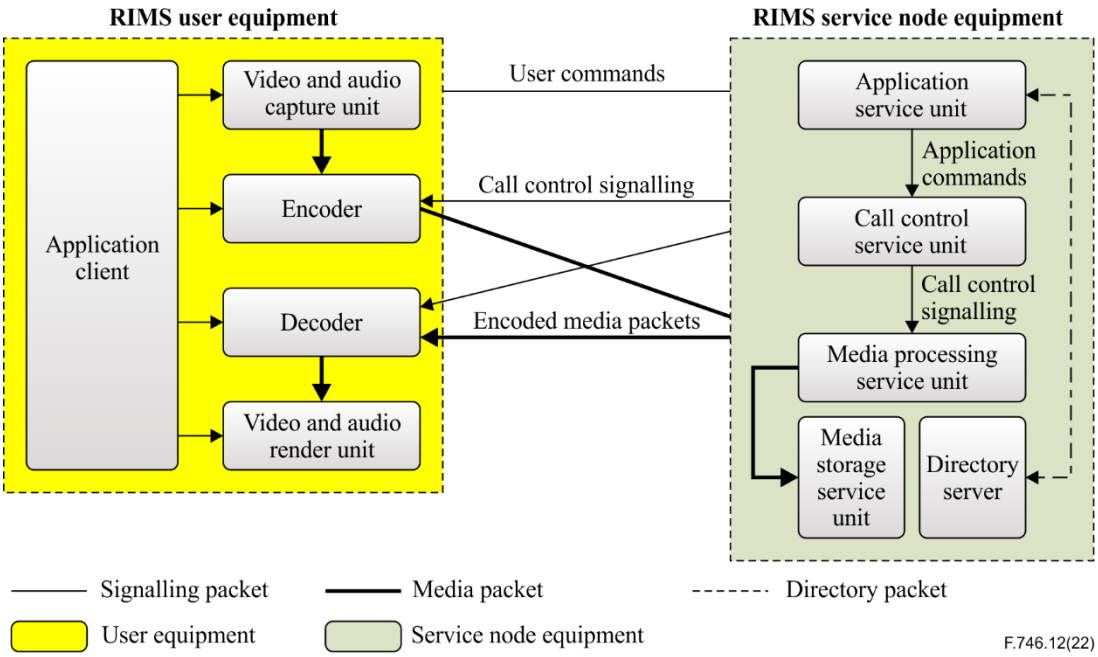


**Figure 7-1 – Reference framework for real-time interactive multimedia service system**

## 8 Requirements for real-time interactive multimedia service system

This clause presents the requirements for a RIMS system.

### 8.1 General requirements

GEN-01: The system is required to configure routing policies between different service nodes directly, based on emergency communication requirements, to realize fast-forwarding of signalling and media packets.

GEN-02: The system is required to provide mechanisms for adjusting video coding parameters. including video resolution, frame rate, bit rate and network abstract layer (NAL) size.

GEN-03: The system is required to provide mechanisms for adjusting audio coding parameters including audio sampling frequency, sample accuracy, bit rate and sound channel numbers.

GEN-04: The system can optionally provide protecting mechanisms for important information including video sequence head, image frame head, strip head, motion vector information and I-frame.

GEN-05: The system is required to set maximal priority of audio communication under low-speed network conditions.

GEN-06: The system can optionally deliver media packets using the network multicast protocol.

GEN-07: The system is required to ensure that high-priority uses have priority of service over low-priority uses.

### 8.2 Requirements for application service unit

ASU-01: ASU is required to support the authentication of users and devices.

ASU-02: ASU is required to support the authorization of allowed uses.

ASU-03: ASU is required to respond to AC operation requests and convert them into commands for other functional units.

ASU-04: ASU is required to provide business processing functions including video calling, video conferencing and video surveillance.

ASU-05: ASU is required to collect information about system status including user device online status and session status.

### 8.3 Requirements for application client

AC-01: AC is required to provide services configuration function.

AC-02: AC is required to provide system status display function.

AC-03: AC is required to provide system configuration function.

AC-04: AC is recommended to provide shortcuts for control services.

### 8.4 Requirements for call control service unit

CCSU-01: CCSU is required to negotiate the media parameters for the two parties during a session establishment stage.

CCSU-02: CCSU is recommended to ensure effective connection of signalling in a network environment with long time delay and frequent interruptions.

CCSU-03: CCSU is required to control the creation or closure of media transfer channels.

CCSU-04: CCSU is recommended to update I-frame using a signalling protocol to speed up the synchronization of I-frames.

CCSU-05: CCSU can optionally configure the interval of I-frames using a signalling protocol.

### 8.5 Requirements for media processing service unit

MPSU-01: MPSU is required to provide media delivery.

MPSU-02: MPSU is required to provide video compositing.

MPSU-03: MPSU is required to provide audio mixing.

MPSU-04: MPSU is required to provide media transcoding.

MPSU-05: MPSU is recommended to support constant bit rate flow control to avoid bursts-induced traffic congestion.

MPSU-06: MPSU can optionally smooth traffic through setting cache size, I-frame interval, I-frame size and key message retransmission frequency.

MPSU-07: MPSU is required to unify the transport packaging format and related parameters including package length and timestamp.

### 8.6 Requirements for media storage service unit

MSSU-01: MSSU is required to support media storage and streaming.

MSSU-02: MSSU can optionally receive media packets through network storage facilities including storage area networking and network attached storage.

### 8.7 Requirements for directory server

DS-01: DS is required to support storage and synchronization of static information.

DS-02: DS is required to synchronize static information with an ASU.

DS-03: Each request may be accompanied by information in support of security mechanisms for protecting directory information. These definitions are contained in [ITU-T X.500].

DS-04: The DS is required to support interrogation, retrieval and modification of directory information. This service is specified in [ITU-T X.511].

### 8.8 Requirements for encoder

En-01: Encoder is required to implement media coding according to the strategy that carries out coding adjustment with respect to the network state feedback information.

En-02: Encoder is recommended to provide type identifiers for its underlying channels (e.g., fixed network, satellite network and mobile network) in the registration message.

En-03: Encoder is recommended to contain the description of coding capability in the registration message to improve negotiating efficiency.

En-04: Encoder is recommended to support constant bit rate flow control to bursts-induced traffic congestion.

En-05: Encoder can optionally assist in managing sending traffic load through setting cache size, I-frame interval, I-frame size, key message retransmission frequency, etc.

En-06: Encoder is required to unify the transport packaging format and related parameters including package length and timestamp.

### 8.9 Requirements for decoder

De-01: Decoder is required to implement media decoding according to the strategy.

De-02: Decoder is required to support adaptive decoding function, within the capacity range of media negotiation, to automatically adapt to media flow.

De-03: Decoder can optionally provide adjusting mechanisms of buffer threshold to adapt and eliminate out-of-order packets, duplication and jitter in network transmission, and to ensure the synchronization of video and audio media.

## 9 Security considerations

It is recommended that the security requirements of [ITU-T Y.2201], [ITU-T Y.2701], and applicable ITU-T X, ITU-T Y and ITU-T M series security Recommendations be taken into consideration, including access control, authentication, data confidentiality, communications security, data integrity, availability and privacy.

# Appendix I

## Example use cases of real-time interactive multimedia service

(This appendix does not form an integral part of this Recommendation.)

### I.1 Real-time interactive multimedia service in highly rural areas

Figure I.1 shows that, given their poor communication infrastructures, satellites can provide worldwide Internet access for some highly rural areas. However, the long latency associated with satellite channels (> 200 ms) often triggers session timeout. RIMSs, such as education and medical diagnosis delivered remotely, are expected to be tolerant of long latency. This is one RIMS scenario.

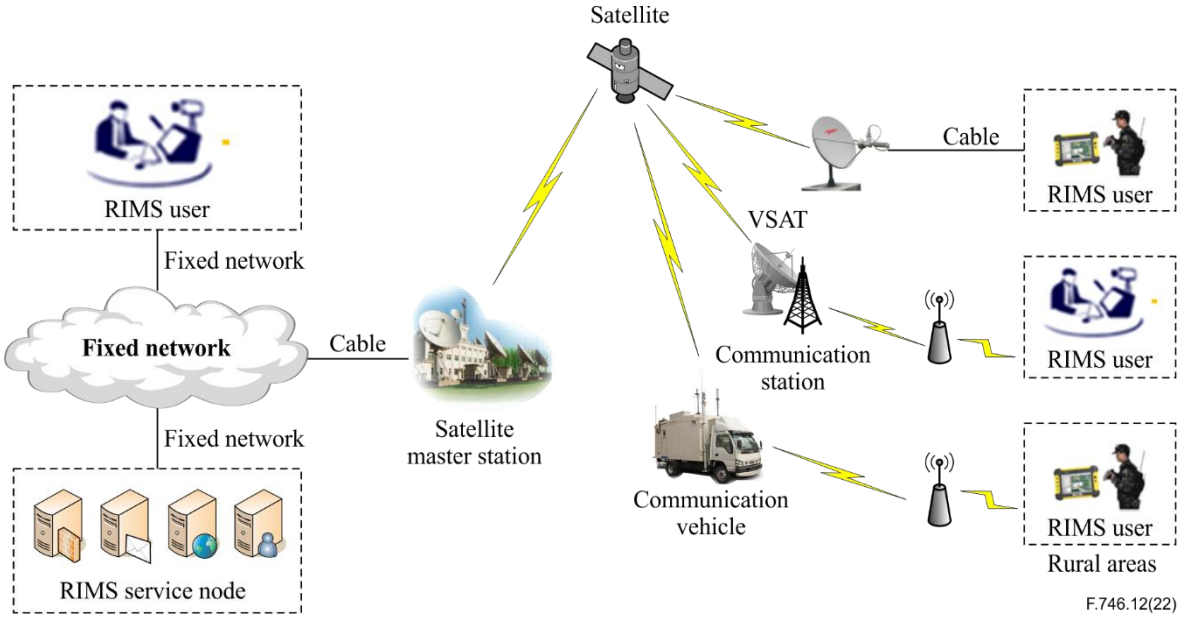


**Figure I.1 – Real-time interactive multimedia service in highly rural areas**

### I.2 Real-time interactive multimedia service in maritime communication

Figure I.2 shows that, during an ocean voyage, uses on ships mainly rely on satellite and other wireless means to communicate with remote users in real-time multimedia. In this scenario, the channel state, such as end-to-end delay and the available bandwidth, changes dynamically. RIMS system can adapt to the coding strategy of the sender (e.g., resolution, frame rate, code rate and NAL size) and the flow shaping strategy (e.g., I-frame interval and cache setting) according to the changing status of the channel.

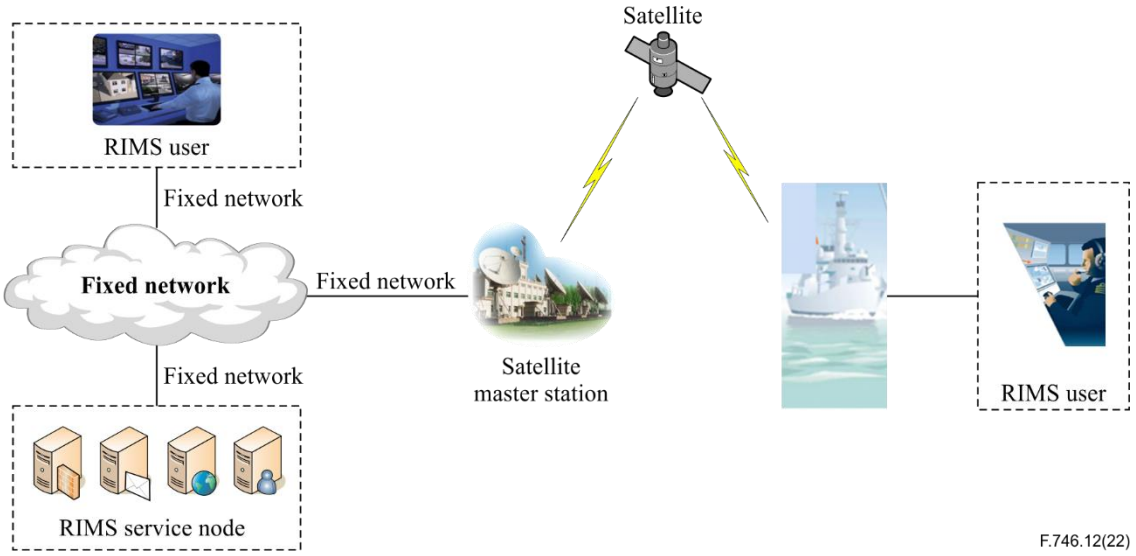


**Figure I.2 – Real-time interactive multimedia service in maritime communication**

## I.3 Real-time interactive multimedia service in disaster relief

RIMS during disaster relief operations is crucial. In this scenario, the communication infrastructure is broken. As shown in Figure I.3, temporary *ad hoc* networks are set up to provide local network connections, and satellite networks can provide remote connections. The RIMS system, which is on top of these networks, can provide interactive multimedia services for disaster medicine and disaster management. However, the quality of wireless links is poor and varies rapidly. The network topology is also unstable. The service is expected to perform at its best in these hostile conditions with limited resources.

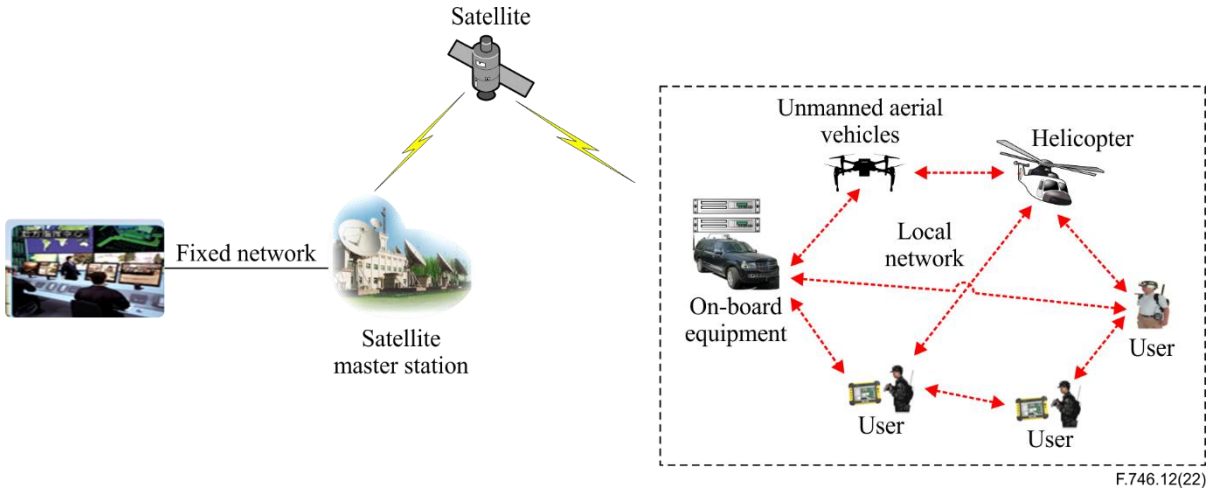


**Figure I.3 – Real-time interactive multimedia service in disaster relief**

## I.4 Real-time interactive multimedia service for managing critical events safety

A large number of terminals need to access the network in some major events, such as celebrations, conferences and exhibitions. Traffic demands can easily overwhelm the capacities of mobile networks. Figure I.4 shows that the RIMS system can be deployed to provide real-time monitoring and management of critical parts of these activities.


**Figure I.4 – Real-time interactive multimedia service for managing critical events safety**

## I.5 Real-time interactive multimedia service in emergency rescue

Visual command and remote diagnostics are often needed for emergency rescue in underground situations such as mass transit railways, garages and tunnels. Figure I.5 shows the application of a RIMS system to an underground railway scenario.

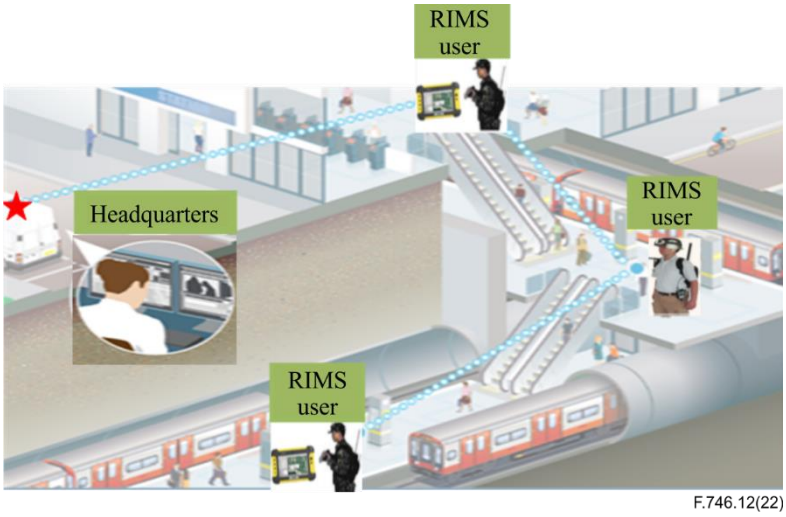


**Figure I.5 – Real-time interactive multimedia service in emergency rescue**

## I.6 Real-time interactive multimedia service in remote technical support

To conduct tasks in highly dangerous situations, such as offshore platform operation, high-voltage cable inspection and fire-fighting operation, high-definition image backhaul and communication provided by RIMS system in real time are critical for technical support. Figure I.6 shows this scenario.

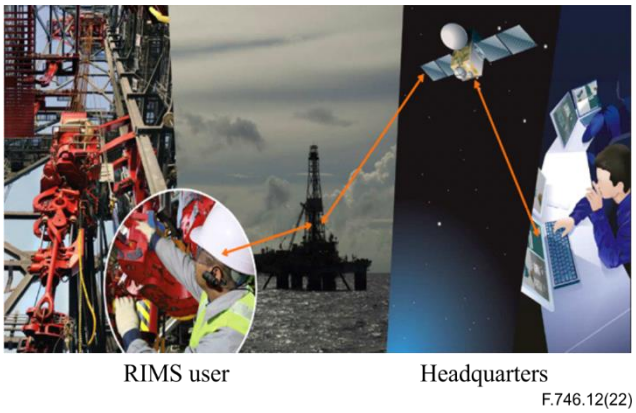


**Figure I.6 – Real-time interactive multimedia service in remote technical support**

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