SPECIAL TOPIC

Architecture of Intelligent Grouping and Resource Sharing Standard

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Abstract:
The Intelligent Grouping and Resource Sharing (IGRS) standard is set to enable intelligent grouping, resource sharing and services collaboration among information devices. An IGRS system adopts open architecture, that is, the devices abide by the IGRS standard are interoperable with devices following other standards such as Universal Plug and Play (UPnP). The IGRS supports multiple application frameworks and special applications. Developers can use an IGRS media application framework with various media format standards, such as AVS and MPEG-2, to develop multimedia applications. Applied among computers, consumer electronics, and communication devices, the IGRS standard can realize resource sharing and services collaboration in a certain range of wired or wireless network domain.

Computer and communication technologies have been developing fast for 20 years. Personal Computer (PC) as a representative of computer technology development has become a part of normal work and life. Meantime, the construction of fiber optic networks, cable TV networks, and mobile communication networks has further developed the computer industry and made the Internet prevailing globally. As the communication seamlessly integrated into computer environment, the arithmetic and the communication capabilities have promoted each other and brought new perspectives to the industry. The seamless (no time delay, sufficient wideband) communication capability makes it possible to fully share the network resources and allow collaboration. New applications after the convergence of computer and communication capabilities will prosper the Internet, develop the information technology, and bring a revolution to normal life and work.

The development of Computer, Communication, and Consumer Electronics (3C) technologies has concluded the tendency of convergence of 3C industry, which is mainly represented in the following aspects.

(1) Interconnection of Terminal Units

As increasing number of terminal devices, such as mobile phones are capable of being interconnected to PC, laptop, and other mobile phones, users have gradually taking interconnection ability as one of the major guidelines of selecting products. Manufacturers have discovered this market, and launch or plan to launch software and products that support terminal interconnection.

(2) Integration of Foreground and Background Functions

The integration of foreground applications and background services for PC and mobile phone has been widely approved by users, which created enormous economic value. There are integrated applications such as instant messaging, online games, game mobile phone messages and rings, and more. The application and background services of TV are emerging, such as IPTV, but its content and business mode still need a breakthrough.

(3) Diversified Contents, Applications and Services for Various Terminals

While services as instant massaging, online games, short messages and rings become such popular, with the general trend of 3C convergence, the cross-terminal services are emerging and becoming rich and colourful. Typical applications include interactive program selecting, Peer-to-peer (P2P), personalized services, identity verification, E-payment, and more.

The Intelligent Grouping and Resource Sharing (IGRS) Standard is a guideline for information terminals. It is also the technology foundation for intelligent dynamic networking, intelligent interconnection, resource sharing, and service collaboration. The IGRS provides some basic applications for IGRS devices to interact. Through utilizing IGRS basic applications, IGRS intelligent application frameworks, and interfaces

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provided by the IGRS basic protocol, IGRS equipment can provide more complicated and powerful functions. Not to the huge high performance grid computing and massive information sources, IGRS pays more attention to the resources waste caused by current information isolated islands. For instance, current multimedia messages can only be shown on the tiny screen of mobile phone, though we have big-screen devices as projectors, Liquid Crystal Display Television (LCD TV) and Plasma Display Panel (PDP) TV and output equipment as color inkjet printer and others. The IGRS suggests that all the information units in the user's surroundings to be dynamically and intelligently connected into a micro application network. By using effective interconnection among IGRS, it can construct the future information network. The IGRS supporting resource opening and collaboration will be an important part in the next generation networks.

The technical essence of IGRS is integration and collaboration. Seen from the technical aspect, IGRS has three key technologies: intelligent grouping, resource sharing, and service collaboration.

Intelligent grouping, which means each IGRS device will automatically discover each other upon entering a network and will dynamically generate new networks based on the IGRS protocol, and further automatically networking or access network after security authentication. By intelligent grouping, numerous different complicated devices, applications, and services within certain range can be intelligently, efficiently and conveniently organized. Intelligent interconnection is the foundation for implementing IGRS applications at the levels as individual, enterprise, and society. All personal information terminals, enterprise information applications and society information services need to be intelligently interconnected before resource sharing and services collaboration.

Resource sharing is announcing resource that the intelligently grouped equipment can provide actively through wired and wireless networks. In addition, obtain resource that can be provided by other units, for instance, arithmetic resource, storage capacity, input function, display function, print resource, communication function, and audio resources. Resource could be the functions of equipment or combined applications and services. Sharing equipment could be PCs, laptops, servers, switchers, routers, printers, fax machines, mobile phones, Personal Digital Assistants (PDAs), and more. It could also be TVs, audios, projectors, refrigerators, water heaters, air conditionings, DVDs, and others. Sharing applications could be word processing, graphic display, music, animation, video programs, and more. Or it could be database, mail systems, Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) systems, and more. Sharing services could be automatic positioning, distance mediation, travel planning, tracking service, or E-business and E-government, and more. Summing up, the resource sharing is all equipment, applications, and services that could be intelligently interconnected based on IGRS. Resource sharing is the way to apply IGRS, and is also the key to centralizing all resources to collaboratively serve individuals, enterprises, and the society.

Based on intelligent interconnection and resource sharing, the network will be fully utilized through service collaboration and optimization of applications and resources.

It is to generate new application forms on individual, enterprise, and society levels and provide better services. Service collaboration is the purpose to apply IGRS and the standpoint of intelligent interconnection and resource sharing.

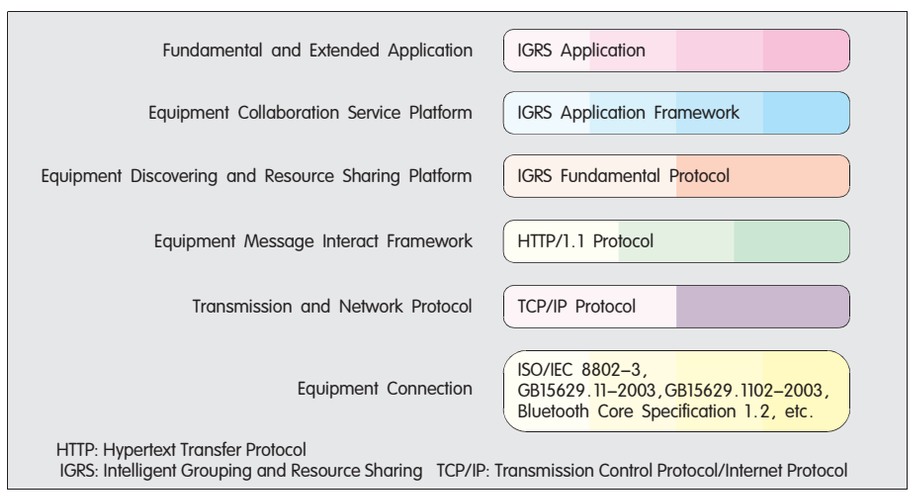
The standard working group set up the IGRS protocol in July 2003. Version 1.0 was formally released as national industry recommended standard in June 2005, the first one in 3C collaboration field in China. Besides, based on the IGRS standard, numerous different developing, testing, and verifying tools have almost been completed and are under fine tuning and updating.

1 The Architecture of the IGRS Standard

The goal of IGRS standard[1-2] is to effectively realize resource opening and service collaboration and enhance functional inter-operability among devices. This goal can be accomplished by following the common resource description and service interface standard when interconnecting the equipment from enterprises, public locations, individuals, and families.

The IGRS standard provides a uniform mechanism for network resource discovering, utilizing, and management, consisting of three parts: IGRS basic protocols, IGRS intelligent application frameworks, and IGRS basic applications.

The architecture of IGRS is shown in Figure 1. IGRS supports all information equipment to realize connection through wired LAN, wireless LAN, Bluetooth, and



▲Figure 1. IGRS levels architecture.

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others.

Transmission and network protocol are based on Transmission Control Protocol/Internet Protocol (TCP/IP). The equipment interact message framework is based on the Hypertext Transfer Protocol(HTTP)/1.1 protocol, and the equipment discovering and resource sharing abide by the IGRS basic protocol, while the equipment collaborative service is based on IGRS application frameworks.

Equipment connection, transmission and network protocols, and equipment interact message frameworks adopt the extensively recognized network technologies, IGRS basic protocols, IGRS application frameworks and IGRS basic and extended applications form. These technologies are the main content of IGRS standards, in which the IGRS basic protocols define the networking among IGRS equipment and the interacting mechanism between clients and services. By the basic protocol, the IGRS application frameworks abstract and define the corresponding standard service and interacting logic for the IGRS applications. Therefore, the standardization and interoperation based on the related IGRS application could be realized.

The top level of the IGRS protocol stack is the application developed by users. Through services provided by the protocol stack and user's descriptive specification wrapping, applications could be launched on IGRS equipment and become IGRS services and clients. The application framework is a set of services and clients supporting specified applications. Specified application frameworks provide to the specified applications more appropriate and sufficient support for development. The service and application of IGRS equipment interact with the service and application of other IGRS equipment through bottom IGRS standard protocol, including searching for each other and utilizing each other. The bottom equipment router protocol provides the destination for sending interactive message of the higher level, while the transmission of message is based on the current transmission protocol.

The IGRS equipment is an abstract from all information terminal equipments in reality and is the container and manager of all resources shared by the equipment. Application programs realize usage and management over the shared resource on the network, consisting of the IGRS equipment, through the IGRS protocol stack Application Protocol Interface (API) and sharing resource management interactivity.

Shared resource for the IGRS equipment could be divided into two categories: one is the equipment intrinsic resource which could be shared, such as the arithmetic resource and the storage resource; the other one is a certain service provided by application developers to other application programs, for instance, the media player service and the document print service.

Application programs, which need to use the shared resource on the IGRS equipment, accept management from the shared resource manager through the form of client proxy. Meantime, application programs realize usage and management on shared resource of the IGRS equipment through the API provided by the resource manager.

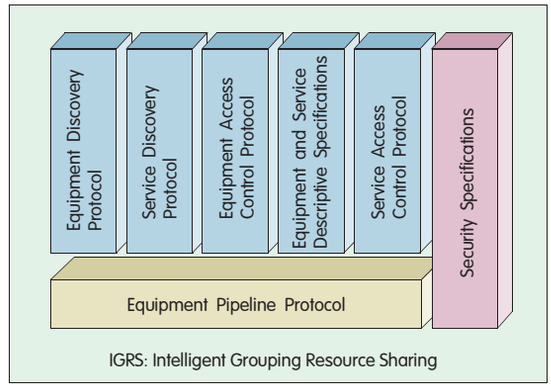
Different shared resource managers on the IGRS equipment realize functions such as equipment visiting and control, service visiting and control, service data distribution and event subscription and notice, and more through universal IGRS equipment interactivity protocol.

Through the IGRS standard protocol reflection specification, the universal IGRS equipment interactivity protocol could be reflected to different transmission protocols. For example, the IGRS equipment interactivity protocol based on the Transmission Control Protocol/User Datagram Protocol (TCP/UDP), the HTTP, the Internet Inter-Object Request Broker Protocol (IIOP), and Remote Method Invocation (RMI), and more.

2 The IGRS Basic Protocol

Among the IGRS equipment the IGRS basic protocol defines the followings:

- the uniform resource discovery and announcement mechanism
- the equipment configuration management mechanism
- the service access control mechanism
- the data collection and distribution mechanism
- the security specifications



▲Figure 2. The IGRS basic protocols.

The IGRS basic protocol consists the following parts. (See Figure 2)

- equipment pipeline protocol
- equipment discovery protocol
- equipment access control protocol
- service discovery protocol
- service access control protocol
- security specifications
- equipment and service descriptive specifications

Equipment and service descriptive specifications define the standardized descriptive format for the IGRS equipment and services.

The equipment pipeline protocol defines the uniform message framework and message forwarding mechanism among IGRS equipment. Abiding by this protocol, different IGRS equipment could realize intercommunication through message forwarding in the protocol.

The equipment discovery protocol defines the IGRS equipment information announcement and discovery mechanism. When an IGRS device entering a network, it could announce to the network its intrinsic resource information through such protocol and could discover related information of other IGRS devices in the network.

The equipment access control protocol defines the interactivity and management mechanism among IGRS equipment. The IGRS units can group with each other to realize centralized equipment management through such

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protocol; meanwhile, IGRS devices also could realize configuration management through such protocol.

The service discovery protocol defines the service information announcement and discovery mechanism on the IGRS equipment. Services on the IGRS equipment can announce related information about itself through such protocol. Clients on the IGRS equipment can discover the service information announced by the equipment in the network through such protocol.

The service access control protocol defines the access control mechanism between clients and services of the IGRS equipment, including the negotiation about the access method, he security mechanism, and the related service status changes.

Security specifications define the security mechanism of interactivity between the IGRS equipment, and between clients and services on the IGRS equipment, including the identity verification, the authorization management, and the data transmission encryption among equipment.

3 The IGRS Application Framework

The IGRS intelligent application framework is based on basic protocols. It defines corresponding clients, services, data objects and their interactive rules aiming at different application modes. Different application developers can develop corresponding client services or data objects according to specified intelligent application frameworks. Based on the rules in intelligent application frameworks, those related client services and data objects could be dynamically combined into completed applications. For instance, a client terminal PDA and a service terminal laptop, both of which have realized file exchange application framework discover each other and then they can exchange files.

The intelligent application framework, through the package of the IGRS basic protocol, provides interfaces for more specific purposes for the specified application development and makes that development easier. For instance, the control–type intelligent application framework defines respective functions of clients and service ends evolved in control–type applications, interactivity rules, and corresponding application program development interfaces. Developers can develop client– end application programs unrelated to the specified being–controlled service end programs through service application development interfaces of control–type application frameworks, therefore, realize the uniform control function.

Presently, the IGRS standard has defined four intelligent application frameworks.

(1) The Audio/Video (A/V) application framework defines the transmission, play, and control mechanism of streaming in audio and video applications.

(2) The file sharing application framework defines announcement, searching, collection, and related security mechanisms among the IGRS equipment.

(3) The control–type application framework defines the interactive logic, the security mechanism and the corresponding application program development interfaces between being–controlled–end and controlling–end of IGRS equipment.

(4) The periphery Plug and Play (PnP) application framework defines the discovery of the IGRS units, the acquisition of driver programs, and the corresponding security mechanisms.

The IGRS standard will launch new intelligent application frameworks in the future.

4 The IGRS Applications

Based on the IGRS standard, application program developers can develop numerous different applications supporting IGRS.

The IGRS basic applications provide some fundamental applications based on the IGRS standard for interactivity among IGRS equipment. It is to realize more complicated and powerful functions and applications by utilizing IGRS intelligent application frameworks and interfaces that provided by the IGRS basic protocols.

The internal basic applications of the IGRS equipment are necessary to support extendable collaborative work mode among multiple units. The applications extend with the development of work mode.

For instance, a laptop and a TV in accordance with IGRS specifications are equipped with internal A/V streaming transmission basic applications. Consequently, when the laptop and the TV discover each other, laptop can distribute its multimedia data to TV in the form of streaming, while laptop can receive TV program streaming from TV and store it live.

Besides, the IGRS basic applications can support developing other IGRS applications. For instance, developers can develop a network proxy application on IGRS equipment with internal network access basic applications. Other IGRS equipment can share network resource through the network proxy application.

One IGRS application consists one or more IGRS services and one or more users. A typical completed IGRS application interactivity process is shown in Figure 3.

5 The Relationship between IGRS and Other Standards

5.1 Foundation of Interoperation

The IGRS is established on number of other standards. It adopts HTTP/1.1, Simple Object Access Protocol (SOAP) 1.1 protocols as the message framework among IGRS equipment. Due to the extensive use of HTTP/1.1 and SOAP 1.1 protocols, the IGRS system architecture supports interoperation among various standards.

5.2 Interoperation with UPnP

The IGRS doesn't put limit on the addressing method and addressing among equipment is realized by mechanisms beyond IGRS. Furthermore, the IGRS support equipment using addressing methods such as static IP, Dynamic Host Configuration Protocol (DHCP), and automatic IP.

There are two equipment/service discovery mechanisms. One based on the global peer group and the other one based on the master/slave group. The IGRS adopts and extends the Simple Service Discovery Protocol (SSDP) as the foundation for equipment to discover

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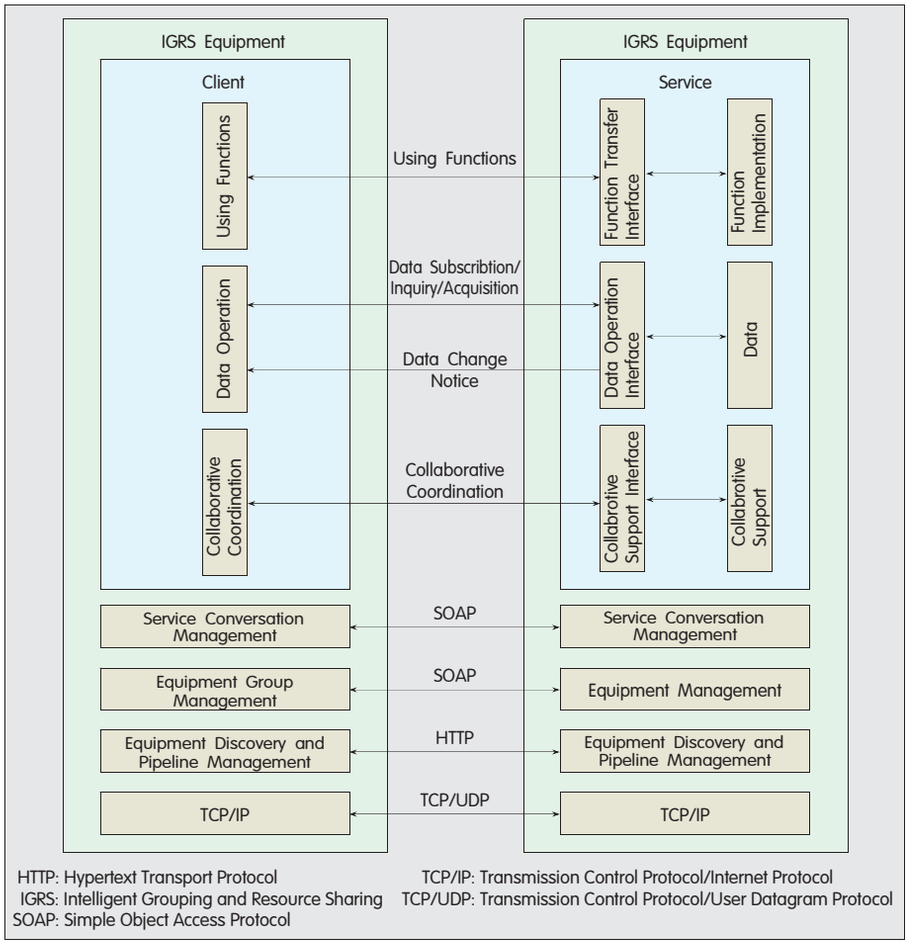

▲Figure 3. The IGRS application interactivity process.

each other, while the SSDP is the foundation for equipment to discover each other in Universal Plug and Play (UPnP). Therefore, through expansion, the IGRS equipment can support interoperation with UPnP1.0 equipment, discover and use each other.

As UPnP, the IGRS also defines equipment descriptive format for describing all information of IGRS equipment. Both formats are Extensible Markup Language (XML) formats. Though the format definition is different, through the expansion mechanism of IGRS equipment format, string recognizable by UPnP can be added in the IGRS equipment description.

The IGRS adopts Web Service Description Language (WSDL) as the descriptive format for IGRS services, while UPnP defines a set of service descriptive formats. These two formats differentiate greatly. The IGRS services can add the corresponding UPnP descriptive extension in the IGRS equipment descriptive file; therefore, the UPnP equipment can recognize the IGRS services. The IGRS equipment can add the UPnP service descriptive file to the explain engine and further recognize UPnP services.

The IGRS defines the service dispatching mechanism based on conversations, and supports interactivity between users and services based on the non-security pipeline. The IGRS services can add the corresponding UPnP user access interface description to the service description of IGRS equipment descriptive file, therefore, to realize interactivity with UPnP users. The IGRS users can realize the UPnP service control of UPnP equipment based on the non-security pipeline. Meantime, through the non-security pipeline mechanism, the IGRS service can open event access interfaces to UPnP users, to accomplish the event interactivity with UPnP users. The IGRS users can also realize the event subscription of UPnP services on UPnP equipment and receive the corresponding event notice based on non-security pipeline.

The interoperation between the IGRS and UPnP includes the following two aspects.

(1) The IGRS users on IGRS equipment discover and recognize UPnP equipment and services, further realize the access control over UPnP services.

(2) The UPnP users on UPnP equipment discover and recognize IGRS equipment and services, further realize the access control over IGRS services.

6 Conclusions

The IGRS alliance has sixty-three members, and the industry chain includes completed 3C collaborative industry links. Among these links are such as standards formulating, chip manufacturing, operation system manufacturing, middleware manufacturing, application software developers, network operators, system integrators, terminal equipment developers, and content service providers. The IGRS can bring development to all the links on the industry chain, solve the problem of short industry chain and too densely clustered downstream industry, and is favorable for the improvement of China's information industry. Meanwhile, the IGRS have extended to some famous companies in Taiwan, Japan, Korea, USA and Israel. The inclusion of those companies will enhance the influence of IGRS in Asia and the world.

The IGRS standard uses pilot terminal products for its industrialization that is in accordance with the developing progress of the new technology in this industry. Compared to the whole IGRS industrialized system, the terminal product is only the top of iceberg. According to the value chain analysis, almost all electronic manufacturers or IT manufacturers can position themselves in the huge market of 3C industry.

Firstly, the IGRS standard adds value to terminal equipment manufacturers. Because the IGRS standard enable terminal units for networking at short distance and group, not only making

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terminal units utilize resources of each other, but also utilizing back-end network contents corresponding to other units. Such changes of the application are modal and will completely change the usage method of personal information terminals. In the future, terminals that are in accordance with the IGRS standard and convenient for correlation will be more competitive, and such equipment manufacturers will better succeed in the competition. The IGRS standard may lead to new product forms, information terminal manufacturers with the long-term insight will find new increasing points in the market. In case special devices receiving video, audio or network content are developed in the future, TV might be divided into multiple pure display terminals and program comprehensive access devices.

Secondly, telecommunication operators sell their wideband service products by binding with products from computer terminal manufacturers. In such way, telecommunication operators can not only enhance their brand image, but also effectively increase the business volume of wideband access services. Besides, such binding-sale strategy can promote more correlation-based applications for IGRS and help solving the bottleneck problems in the content of wideband services for the operators.

Thirdly, the IGRS standard can increase the value of network operators and content providers. The presence of the IGRS standard will greatly promote the collaboration and application of three back-end networks, and make network operators and content providers face a new integration. Telecommunication operators will highly collaborate and integrate the access method of Internet, broadcast networks, and communication networks, and provide package services to the users. Therefore, multiple operators will be competing with each other. Users will not care about the network access method any more, but choose an operator who can provide over-all network services based on the price and services. While content provider need to provide more specialized content services, because the integration at the front-end will soon change the Chinese Internet surfers from mere youth to the whole population. The content providers need to provide rich content fitting all levels in the society, such as games, news, music, video, and more. At the same time, content providers will fully consider the situation of terminal correlated applications, and design new contents and services appropriate for equipment under correlation status.

Finally, the IGRS will drive the development of the software industry. Because the IGRS standard might be realized on terminals through special chips, operation systems, application models, key technologies, and the application software package integration, it may bring historical opportunities for low-level technical developers.

Promoted by the IGRS work group and the IGRS information engineering Lab, the industrialization of the IGRS standard have made a preliminary progress. Since 2004, 3C collaborative products such as the IGRS computer, the IGRS projector, the IGRS TV, and the IGRS mobile phone have been emerging in the market and become familiar to the people. The industrialization of IGRS brings brand new experiences in applications that will greatly stimulate the demand for digital products from consumers. In addition, it will promote the rapid development of the digital industry in China and finally form a large-scale industry chain.

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Biography

Yu Xingye was graduated from University of Science and Technology Beijing with a Doctor's degree. He is working in the IGRS Engineering Laboratory. He is mainly engaged in the R&D of IGRS technologies, products, and schemes.

Roundup

ZTE Exhibited Full Series of HSDPA Terminals

ZTE, a leading global provider of telecommunications equipment and network solutions exhibited at ITU Telecom World 2006 a complete line of High Speed Downlink Packet Access (HSDPA) terminal products, including the newly-launched HSDPA mobile F890 and the F908, the world's first DVB-H TV mobile that supports HSDPA.

ZTE also launched its HSDPA Modem MF620 at the ITU Telecom World. ZTE has a full series of HSDPA terminals, which includes the MF330, the world's first HSDPA data card Modem with a downlink rate of up to 3.6 Mbps.

ZTE's F890 is a GPS/WVDMA/HSDPA triple-mode, multi-frequency mobile that supports a 3.6 Mbps downlink data rate, which can significantly improve data services on users' mobile terminals. Only Japan and Korea-based enterprises like Samsung and LG have previously launched HSDPA mobiles.

ZTE is leading in the field of HSDPA data cards. At the Beijing Telecom Exhibition held in October last year, ZTE's newly-launched MF330 1.8 Mbps HSDPA data card was applied to its HSDPA demonstration vehicle located outside the exhibit hall. In July, ZTE received an order from Europe for its 3.6 Mbps HSDPA data cards, which were the world's first 3.6 Mbps HSDPA terminals put into commercial application.

ZTE offers full series of HSDPA terminals including mobiles, data cards, and USB Modems, leading the world of 3.5G.

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