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New Products

Challenge to FTTH by "S-MAC PC"

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1. Introduction

The advanced telecommunications society is defined as " a new socio-economic society where one can freely create, distribute, and share information and knowledge, which are the products of human beings' intellectual production, and where life and culture, industry and economy, nature and environment can be put into harmony in general. " To make this advanced telecommunications society a reality requires a fast, broadband key communications infrastructure. To that end, quick preparations are under way for the laying of an optical fiber network. (The target is to complete laying the optical fiber network nationwide by 2010.)

In response to these trends, there is a plan for laying an optical fiber network reaching households, instead of telephone lines based on copper wiring that are currently in use in households and other establishments. This plan is called " Fiber To The Home " (FTTH).

This paper studies the FTTH plan. As the company's FTTH challenge, the paper presents a typical implementation of an optical fiber network implemented on the S-MAC PC " SMS-10, " which is the company's industrial personal computer (" industrial PC ").

2. FTTH

2.1 Background

Inspired by the " Information Superhighway " scheme presented in 1991 by U.S. Senator Gore, President Clinton's public commitment to establish an information network connecting all homes, companies, research centers, classrooms and libraries by 2015" led to the concept of FTTH. The U.S. Clinton administration presented the National Information Infrastructure (NII) in 1993, and the Global Information Infrastructure (GII), a globally advanced version of the NII. The " G7 Conference of Ministers Concerning the Information Society " (commonly known as the Telecommunications Summit) was held in Brussels in February, 1995. The conference reached a basic agreement for the buildup of an advanced information society. Fig. 1 shows the GII concepts.

The concepts of the G7 agreement for the GII are:

◎ Open access to the network

◎ Cultural and linguistic diversity

◎ Necessity of international cooperation

◎ Equal opportunity for citizens

◎ Appropriate regulations

◎ Private investment

◎ Promotion of competition

◎ Varied service.

The FTTH is also implemented along the GII concepts. That is, efforts will be made to cut costs by promoting competition by laying an optical fiber network under the leadership of the private sector. The aim is to build up an open environment to connect all parts of the world seamlessly.

2.2 Network demand

Demand for a fast, broadband communications service using the optical fiber network is expected to grow rapidly with the advancement of multimedia use. How high will the need be for telecommunications resulting from the buildup of a network infrastructure and the advancement of the FTTH centering around the optical fiber network in the future? The projections made in a report by the Ministry of Posts and Telecommunications are outlined as follows:

① Around 2000

Households will use transmission capacities of 64kbps to about 1.5Mbps for Internet access and teleconferencing.

Companies will have transmission capacities of dozens of Mbps to about 150Mbps for use in connections between Local Area Networks (LANs), teleconferencing and other purposes.

② Around 2005

Households will use transmission capacities of 1.5Mbps to about 10Mbps in fast Internet access, remote medical care, remote education, video on demand (VOD) and other image transmission.

Companies will use transmission capacities of 150Mbps to about 600Mbps in connection between LANs, satellite offices, and other applications.

③ Around 2010

Households will have transmission capacities of dozens of Mbps in video on demand (a few channels), at-home work, and other applications. These days, the transmission of image information from households is expected to rise.

Companies will commonly use about 600Mbps. Connection between LANs by fast lines will make a seamless communications environment a reality not only inside each company but between companies as well.

Table 1 summarizes the demand prospects of communications.

Table 1. Demand prospects of communications

Households	Capacity	Around 2000	Around 2005	2010
	Form of use	64kbps to about 1.5Mbps	1.5Mbps to about 10Mbps	Dozens of Mbps or so
		Internet access, TV phone, etc.	Fast Internet access, remote medical care, remote education, video on demand, etc.	Video on demand (a few channels), at-home work, etc.
Companies	Capacity	10Mbps to about 150Mbps	150Mbps to about 600Mbps	About 600Mbps
	Form of use	Connection between LANs, teleconferencing, etc.	Connection between LANs, satellite office, etc.	Fast connection between LANs

2.3 Positioning of the FTTH

A subscriber system optical fiber network is being built under the leadership of the private sector; that is, by common carriers, power utilities, and CATV operators. The

target completion date for the buildup of optical fibers up to each household, which is the final target of the FTTH is 2010. Companies are moving ahead of that trend by promoting IT and otherwise building up optical fiber networks with ″ Fiber To The Office ″ (FTTO), which is designed to connect office buildings by optical fibers. In addition, ″ Fiber To The Zone ″ (FTTZ), and ″ Fiber To The Building ″ (FTTB) are used to lay optical fibers to the baseline points (the rise points in underground cables) of apartment houses and residential houses. The ″ Fiber To The Curb ″ (FTTC) is used to lay optical fibers to roads and curbs and then connected by metal cable to each household. Thus, optical fibers are being laid to points very close to users ahead of the schedule for 2010. Fig. 2 illustrates the positioning of the FTTH.

2.4 Services

Traditional telecommunications services arrived in many varieties, including telephony, telex, data communications, and dedicated facsimiles. In the course of their development, they were normally provided via a leased network reserved for the User Corporation. If, therefore, one wished to use more than one service, one had to make a contract for each service and set each subscriber line. Since one cannot share the network equipment in each separate service, this is uneconomical, inefficient in operation and maintenance, and disadvantageous in many aspects to both users and common carriers.

To counter these inconveniences, the Integrated Services Digital Network (ISDN), a network that uniformly handles the services of telephony and data communications has been provided since 1989. In addition, the Broadband-ISDN (B-ISDN) is being standardized as an extension of the ISDN, as a more complete integral network that includes the functions of the ISDN as well as those of a leased line network and an image communications network. With the increasing speed, broadband, and digitization of the B-ISDN, progress will be made in the fusion of communications and broadcast and the sharing of transmission channels that accompany them. This will realize various forms of services, including broadcast services based on a communications network (video-on-demand, or VOD) and communications services based on a broadcast network (Internet connectivity service based on a CATV network). The FTTH will be a common infrastructure for making this B-ISDN a reality, thus allowing users to use both communications and broadcast services with one optical cable to each household. Fig. 3 summarizes the forms of services.

The B-ISDN has the following characteristics:

* Forms of services
  High-quality interactive service (teleconferencing and TV phone)
  Message service (video mail)
  Information retrieval service (video database, etc.)
  Image communications service
  Selective or simultaneous provision of these services
* Variable-speed communications
  The Asynchronous Transfer Mode (ATM) technology can be used to meet any communications speed, high or low, on an optical fiber, with a fixed or variable speed (compatible with all services ranging from traditional telephony to fast, broadband services of hundreds of Mbps).
* Multimedia communications
  Integrally provides various media: sound, image and data.
* Service quality
  Allows users to select service quality levels by raising requirements to the network from their terminals. As media varies, they raise different requirements for service quality (including qualities of connection, transmission, stability, processing, safety, and operation).

3. Industrial PC, ″ SMS-10 ″

The development concept of the ″ SMS-10 ″ is an inexpensive but environment-resistant industrial PC based on an open architecture. Fig. 4 shows the positioning of industrial PCs.

The industrial PC, ″ SMS-10, ″ is characterized by the following:

* The HDD, fan motor and other mechanically operating parts are eliminated to increase reliability.
* Parts (such as CPUs and connectors) and materials (such as solders) are optimized to increase service life and environmental resistance. The functions are reduced to reduce the size.
* One can use the rich software environment and the network communications environment used on office automation PCs.
* System expandability and compatibility are ensured by an open standard interface configuration.

(The advantages and disadvantages of industrial PCs are summarized in Fig. 5, and the interface of the ″ SMS-10 ″ and its specifications are shown in Fig. 6.)

The small-size, environmentally resistant ″ SMS-10 ″ can be installed in a location where traditional PCs could never be installed, because of the smallness of the location or severe conditions (temperature, humidity, and noise). This model is also greatly advantageous in cutting costs of maintenance and servicing in uses where high reliability is aimed at, such as in unattended continuous runs at remote locations. As a result of the consideration of these severe conditions for installation, an inverted concept was born: the introduction of an industrial PC into the home.

4. Typical implementations of the ″ SMS-10 ″

The FTTH makes various forms of services a reality. To make sufficient use of these services, the items of equipment in households must be networked together and connected to the FTTH. How the network to be adopted in such equipment will be determined in the future remains unclear at the moment, but this section will describe network configurations that can be implemented now. The devices suited for networks to equipment (such as lighting equipment and alarm units) that mainly handle ON/OFF signals and other contact information are USB, LonWorks and other sensor device buses. For such operations as the exchange of data with PCs and that of information on the Internet, Ethernet networks (such as 10/100BASE-T) used on a standard basis on the TCP/IP are used for FANs and LANs. Considering these, together with the leading-in of CATV and other image networks, it will presumably be necessary to use the gateways and routers of four networks at the stage where the optical fiber enters the household. Fig. 7 shows the four networks.

For connecting these several networks, the ″ SMS-10 ″ offers optimal configuration. Fig. 8 shows the interface configuration of the ″ SMS-10. ″ The high-level communications of the ″ SMS-10 ″ is provided on a standard basis with an Ethernet that connects directly with a Field Area Network (FAN) or a LAN, while a same-level communications field network can be equipped optionally with the communications interface of DeviceNet or LonWorks. As low-level communications, a motion bus ″ SERCOS ″ enables multi-axis synchronous control among motors, sensors, and I/O devices. A PC/104 interface is then added as a means of enabling a flexible system configuration. Functions to be necessitated by this can be provided by adding the PC/104 module.

Fig. 9 shows a typical implementation of the ″ SMS-10 ″ as an FTTH gateway.

For FTTC, FTTZ, and other uses where high-level communications is ensured by a FAN or LAN, the traditional configuration of the ″ SMS-10 ″ can be used as is. Household LANs can be handled simply by installing LonWorks or other PC/104 interface.

When wattmeter readings or something similar is assumed as a service with the FTTH, an alternative method is to replace the existing wattmeter with a new one. This requires both environmental resistance and high reliability. For these requirements, the ″ SMS-10 ″ (an industrial PC) clears the environmental resistance and high reliability requirements sufficiently.

5. Conclusion

The concrete services for the FTTH are still in the trial stage. There are many challenges to be resolved, including finding an effective way to lead the optical fiber to the household. To lead the optical fiber directly into the ″ SMS-10 ″ in tackling the FTTH challenge will require optical-electrical conversion. This issue will be regarded as an extension of the optical-electric conversion of the SERCOS and will be tackled as a future challenge. The author wishes to tackle the issues of cost-cutting and size-reduction while in view of efforts to address the issues with LSI chips. The author hopes that the high reliability and open-standard interface configuration of the industrial PC, ″ SMS-10, ″ will be the bridge to the FTTH.

Reference

Report by the Ministry of Posts and Telecommunications, ″ Prospects and Challenges with Networks for Making the FTTH a Reality ″

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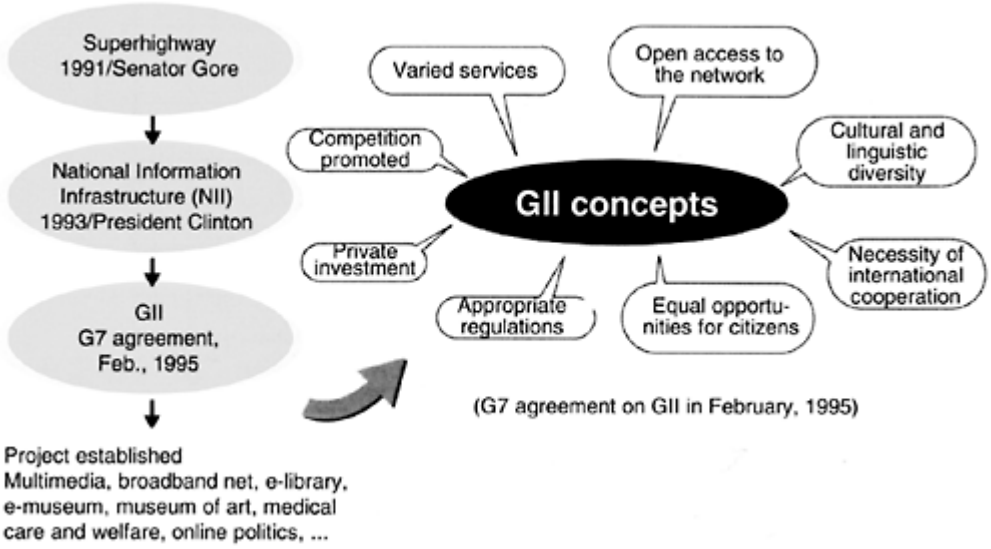


Fig. 1 GII concepts

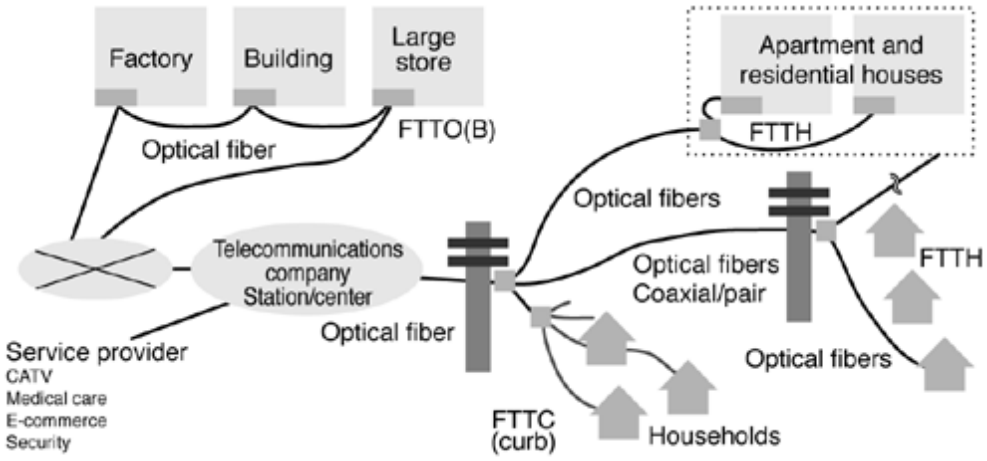


Fig. 2 Positioning of FTTH

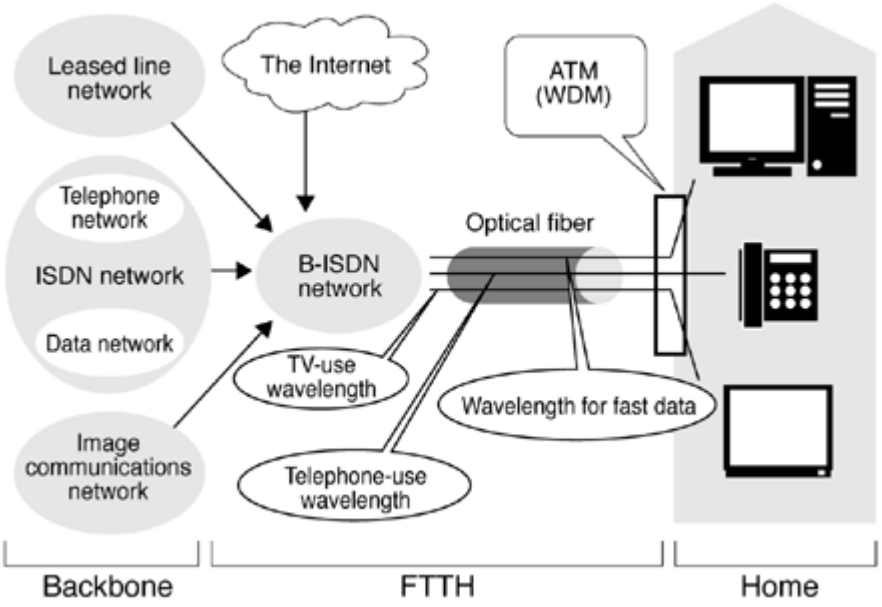


Fig. 3 Forms of services

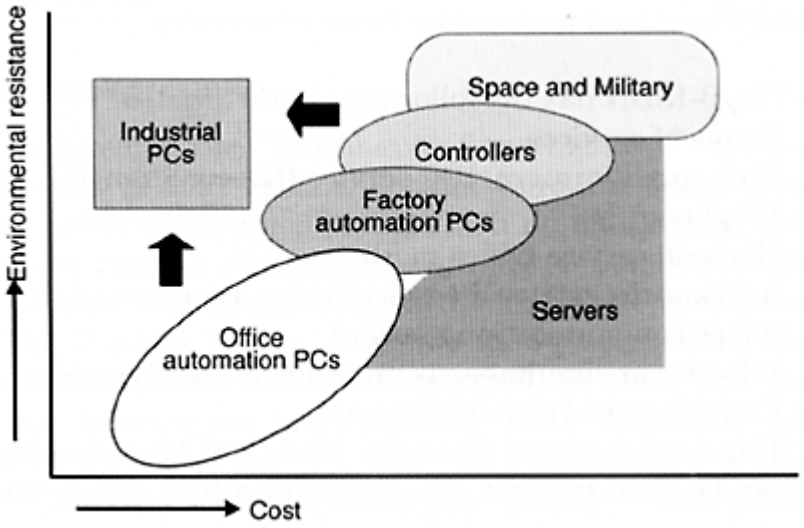


Fig. 4 Positioning of industrial PCs

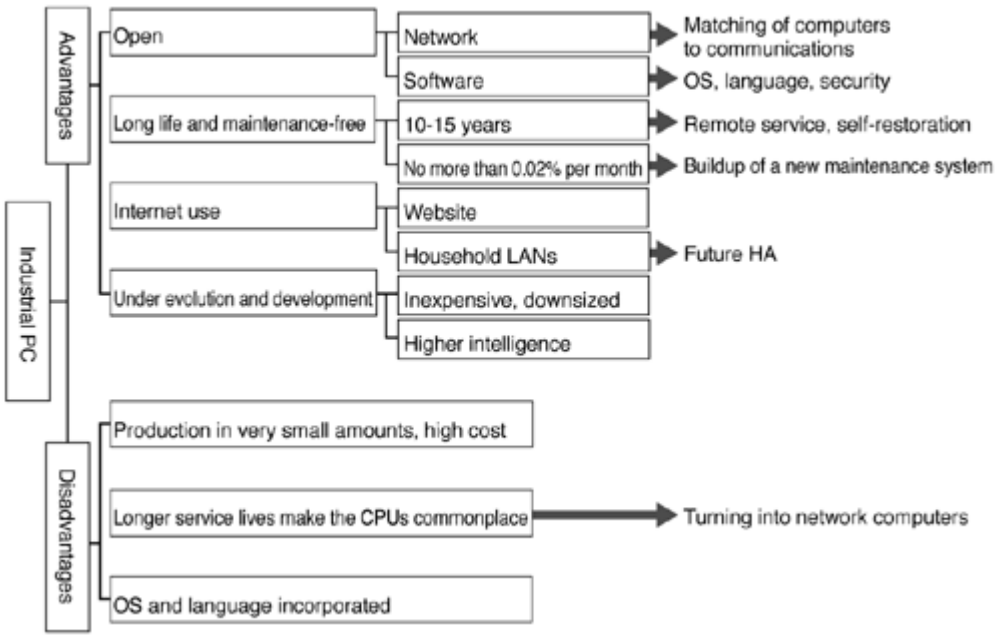
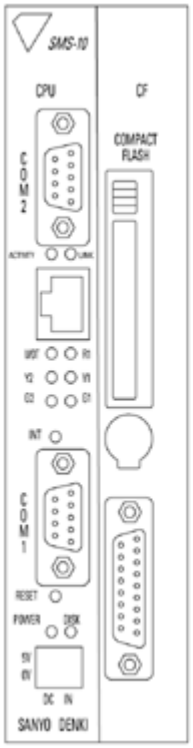


Fig. 5 Advantages and disadvantages of industrial PCs



General specifications of SMS-10		
Temperature	0 to 50℃	(Operating)
	-10 to 60℃	(Non-operating)
Humidity (non-condensing)	20 to 90%	(Operating)
	90% or less	(Non-operating)
Vibration	4.9m/s²	(Operating)
	9.8m/s²	(Non-operating)
Impact	98m/s²	(Non-operating)
Outside dimensions (mm)	40.7(W) X 123.7(D) X 180(H)	

Fig. 6 Interface of the ″ SMS-10 ″ and its specifications

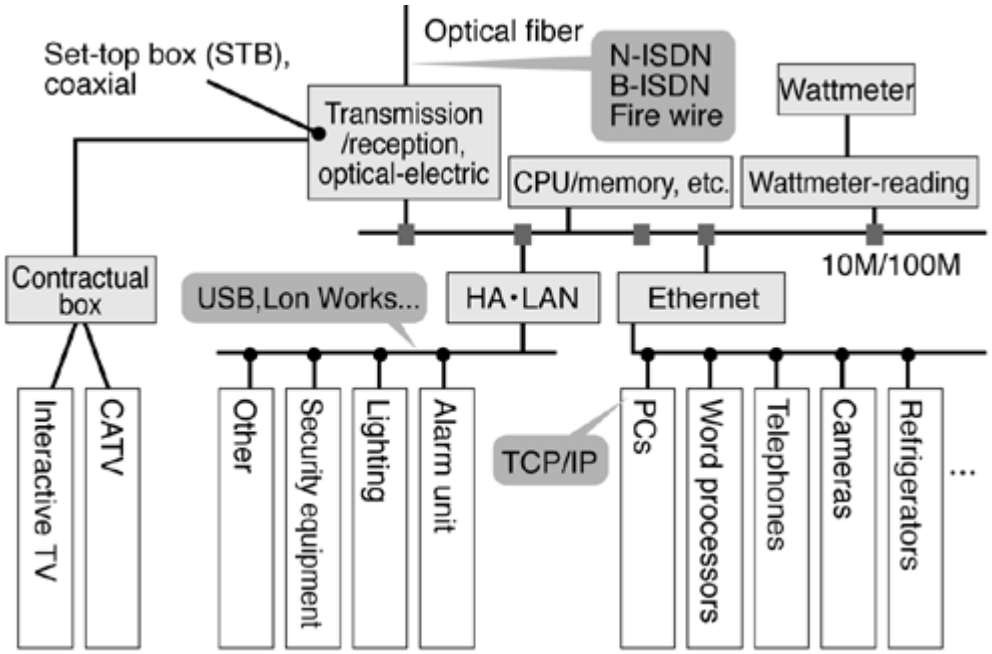


Fig. 7 Four networks

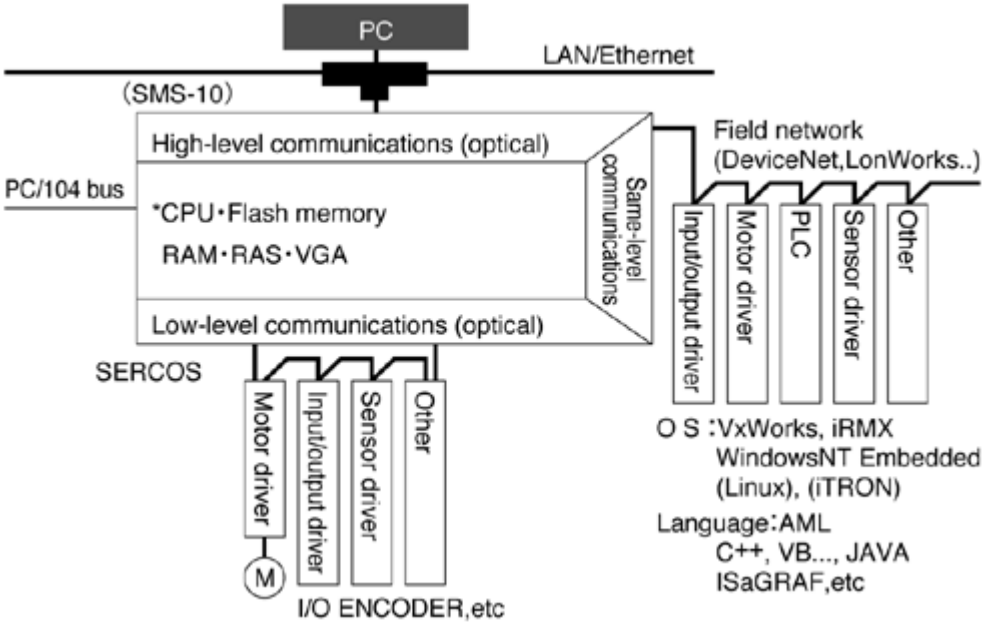


Fig. 8 Interface configuration of " SMS-10 "

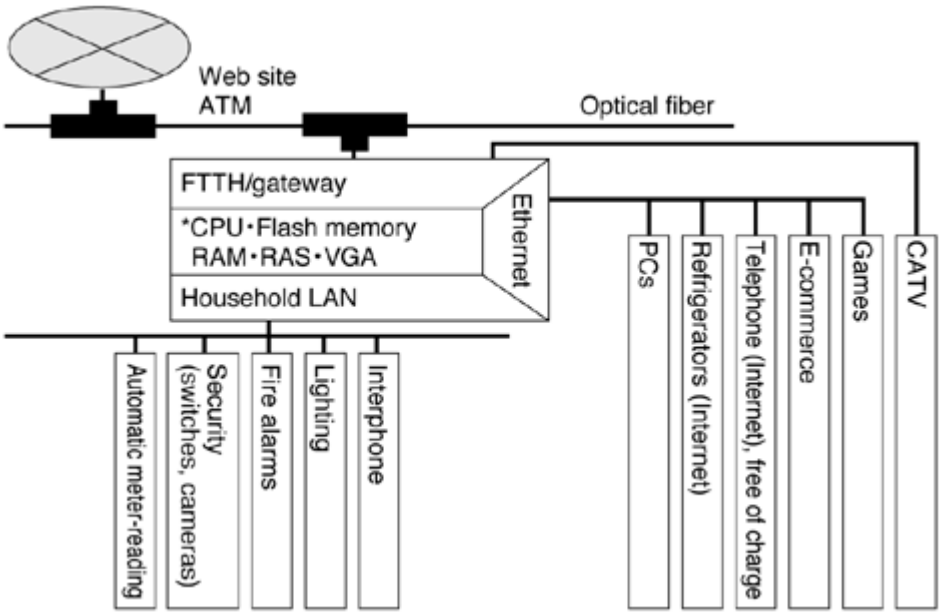


Fig. 9 A typical implementation of the ″ SMS-10 ″ as an FTTH gateway