The Growing Power of the Digital Communication Market

As we enter the 21st century, IT (Information Technology) technology is beginning to change our lifestyle and may eventually change our industrial structure as well. Worldwide aggregate shipment of the mobile telephone, that symbol of the IT era, was estimated to be 400 million units in the year 2000. As a result, a gigantic market unlike any other before it has come forth. Also, digital communications markets such as digital home appliances that combine communication products, home electronic appliances, and computers together, and PDAs will undoubtedly drive this new era.

In addition to the previously mentioned fusing of technologies, another characteristic of this digital communication market is its pursuit of all possibilities and its constant change. What’s more, the rate of change is extremely rapid. There are differences between the products, but it is not exaggerating to say that products are born out of a new concept every several months. One more characteristic of this market is the progress of mobile personalization, which makes “anywhere at anytime” possible. Such market needs and market characteristics create newer, larger scale semiconductor demand while bringing forth great essential changes.

The System LSI Solution Era Has Arrived

General new product development, up to this point, had mainly consisted of hardware-centered development processes such as development of new ASICs (gate arrays) or development of custom LSIs. However, in the case of digital communication products, technologies in several different fields such as communications, home electronic appliances, and computers must be merged together and products must be put on the market with short TAT (turnaround time). Consequently, the previous development process would be hard-pressed to keep up with demand both in terms of technology and TAT.

In communications fields such as IMT-2000 and modems for example, “communications protocols” are frequently upgraded and system development that expects these upgrades must be performed. Even if hardware ASICs and custom LSIs were to be newly developed, the product could not necessarily be released onto the market with the original specifications.

In order to respond to a system with such product characteristics, then a programmable device with a built-in embedded processor that has a high processing capacity (in
other words, a system LSI), is indispensable. This means that the era of largely software-based system LSI solutions has replaced the previous era of hardware-based LSI solutions. Even when looking at the system LSI market forecast (Figure 1), it is obvious that this market is growing at an annual growth rate that is in the double digits. The wave of change of system LSI will surge in the gigantic digital communication market segment.

Main LSI Markets for Oki Electric Industry Co. Ltd.

At Oki Electric Industry Co. Ltd., the proportion of memory was quite high by product field sales in the mid-1990's and since this market was highly dependent on the PC market, this market was affected by the silicon cycle several times. This is when Oki began trying to strengthen its logic LSI business and shift its business policy by specializing in all types of memory from general-purpose memory for PCs to memory for communications and household devices.

In order to increase sales of logic LSI products, Oki concentrated its investments of development costs in logic and system LSI, reorganized its personnel, and has enhanced its marketing abilities in this field. As a result, the memory sales rate within Oki decreased from 70% in fiscal 1995 to less than 50% in fiscal 2000. In contrast, the logic LSI sales rate increased from 30% in fiscal 1995 to approximately 50% in fiscal 2000, so it seems that the logic shift is being implemented quite smoothly.

Among these fields, the field that Oki will concentrate on is the digital communications field, which is based on communications technology that Oki has been cultivating for many years. Specifically, this field consists of three markets: the mobile device market, the Internet market, and the digital home electronic appliance market. In order to realize this, Oki is concentrating on system LSI development for the proper markets simultaneous to developing products for related logic LSIs, developing memory LSI products, and developing technology. “Communications markets” such as those for mobile devices and Internet-related markets and “household device markets” such as digital home electronic appliances occupy over 70% of projected share by application in the system LSI field (Figure 2). A big demand can be expected in this field.

Product Development Policy by Market Field

Next, we would like to discuss the current status and future policy for the three markets that Oki is focusing on.

1. Products for the mobile devices market

Oki is developing a variety of products for mobile telephones, a major application of the mobile device market. Example products, which are centered around Bluetooth LSI, are PHS baseband LSI, sound source LSI for phone ring melodies, audio codecs, and low voltage DRAM. Oki will continue to promote the development of these products. Later in this article, we would like to elaborate on some of these products.

As illustrated below in Figure 3, short-distance radio is used between a variety of devices such as mobile telephones, laptop computers, and mobile devices. Oki is starting to sell baseband controller LSI (M L7051LA), RF transceiver LSI (M L7050LA), protocol stack software (BTS Pack 1/2/3), and system development kits (BT-SDK) as total solution products.

Moreover, the range of applications for radio communication functionality by Bluetooth is extremely large, so many applications such as digital home appliances and game machines can be expected. Not only the previously mentioned Bluetooth communication LSIs, but also system LSI development that embeds Bluetooth functionality and protocol stack development are both

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*1 ARM7DMI is a trademark of ARM Ltd.
*2 µPLAT is a trademark of Oki Electric Industry Company, Limited

Figure 2: Projected share by application by system LSI application segment in 2004

![Diagram showing market share by application segment in 2004](image-url)
making progress, so Oki will work towards providing a total solution for all application product types.

The PHS baseband LSI (ML7008) employs a wealth of peripheral functions such as TDMA, ADPCM codec, and Modem. A couple of years from now, it will be more possible for PHS to be mounted standard onto various mobile devices such as notebook computers as a communication terminal. We plan to develop this LSI as the system LSI IP that will be used at that time.

LSIs for phone ring melodies are gradually becoming standard equipment in mobile telephones. We jointly developed these LSIs with Casio Computer Co., Ltd. and have begun to ship a sound source LSI (ML2857) for phone ring melodies that can simultaneously voice five notes into one of twelve chords. This sound source LSI is the first in the world to employ a PCM format sound source for phonering melodies and has stored the sounds of 100 instruments that were converted into PCM data in advance. As a result, it is possible to generate a natural sound that was not possible with previous synthesized electronic sounds and realize clean CD-quality sound with a rich presence. Also, its high sound quality brings forth a variety of potential contents services. This makes it possible to realize mobile telephones that can play music in addition to conventional phone ring melodies. In the future, the number of simultaneous voices will be increased, further improving the sound quality.

DRAM is expanding out from the PC market and is starting to specialize in communication and household devices in the digital communication market, and is helping promote unique product development centered on 4 MB and 16 MB products. We have realized the lowest operating voltage in the industry (2.0 V) and have released a low current consumption type DRAM. In the future, DRAM is likely to be used in applications such as image processing for mobile telephones, so we will continue to pursue lower operating voltages and lower current consumption.

We have also developed wafer level CSP (Chip Size Package) technology for realizing the smaller packages required in mobile devices. We will also work on an MCP (Multi-Chip Package) that can realize a further reduction in area and weight. Since MCP especially makes it possible to combine LSIs that used different processes, we expect it to become an extremely important technology as a method of realizing system LSIs such as RF transceivers and baseband controllers, and large capacity Flash memory and microcontrollers.

We are planning to have about 30% of our logic LSI sales to be in these mobile device LSIs in fiscal 2003.

2. Products for the Internet market

For the Internet related market, we are developing PC card control LSIs for mobile data communication adapters and PHS cards that will realize a mobile Internet.

The Internet market is growing rapidly along with the expansion of e-mail/Internet capable mobile telephones represented by iMode*3, and information terminal devices such as PCs and PDAs that can access the Internet. These devices are all becoming more mobile. The mobile data communication adapter LSI (ML7070) we developed recently has mounted hardware IPs such as a mobile telephone interface and a DTE (Data Terminal Equipment) interface with data terminal devices on the system LSI platform “μPLAT” which has as its core the “ARM 7TDMI.” Furthermore, we have mounted a network transport layer for the TCP/IP Internet protocol, PDC circuit switching as the data communication protocol for all mobile telephones, and a packet switching format. This makes it possible for us to easily realize data communication control and Internet control systems.

Next we will also work on developing mobile commerce products that conduct transactions on the mobile Internet as a continuing mobile Internet product.

The Internet market is expected to grow as well as the mobile device market. We are planning to sell nearly 20% of the logic LSI geared toward this market in fiscal 2003.

3. Products for the digital home appliances market

For the digital home appliances market, which consists of a variety of products such as digital TVs, M/ D/ DVD/CD players, digital cameras, and car navigation systems, we are developing and selling a variety of LSIs such as DRAM mixed system LSI, P2ROM*4 (Production Programmed ROM), microcomputers built into USB controllers, and speech LSIs. Our noise reduction LSI for TVs and VCRs (M S87V22108) is said to be the most unique. This product is an application of the DRAM technology that we have built up over the years. This system LSI combines 4 M b FIFO (First-In First-Out) memory and TV image signal processing technology such as frame rounding type noise reduction and a function for creating

*3 iMode is a registered trademark of NTT DoCoMo.
*4 P2ROM is a trademark of Oki Electric Industry Company, Limited
double speed conversion interpolating data. What’s more, this system LSI realizes what used to be a two-chip configuration on a single chip. Asynchronous FIFO memory made by Oki for image processing is being mounted in audio-visual devices such as TVs and VCRs not just in Japan, but all over the world. This product boasts the top market share in the industry. We plan to continue to develop LSIs for this image signal processing field as well as for the digital home appliances market.

Figure 4 summarizes the target markets for Oki Electric Industry Co. Ltd. and the product families.

Conclusion

Preparing to Leap into the 21st Century

The IT revolution continues on into the 21st century. The times are changing without our help and generations of electronic product families are being replaced at an increasing rate. In the communications world for example, next-generation multimedia communication technologies such as IMT 2000, high-speed radio LAN, mobile video phones, and digital TV are being established and are replacing existing communications technologies.

In order to provide LSI products for the rapidly changing digital communication market, we at Oki Electric Industry Co. Ltd. will continue to promote a platform for each application product that is compliant with VSIA (Virtual Socket Interface Alliance) VCs (Virtual Components).

We will at the same time like to further increase our investment ratio in software and further enhance our software IP development for TCP/IP, Bluetooth, and modems that support the above platforms. We will also improve the reusability of our hardware and software design resources and realize more advanced system LSI development.

In addition to providing LSIs, we will work towards future actively providing total solutions that meet the customer’s needs including software, system development environments, and design consulting.

References