

Competing Technology Commercialization in Developing Country

Case Study: Mobile Technology in Indonesia

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Technology commercialization is an interesting topic to discuss given the spurring technology innovation all over the world. Thus with many technologies being commercialized, it is unavoidable for two or more competing technologies to enter a market especially in developing countries. This paper is trying to analyze competing technology commercialization practices especially in developing countries taking Indonesian mobile technology commercialization as the case study. This paper examines the commercialization of a later entrant technology in telecommunication service, the Code Division Multiple Access (CDMA) technology, to the Indonesian market; meanwhile the market already had the Global System for Mobile Communications (GSM) technology as the industry standard. This paper is also trying to give an insight of how commercializing a new technology in a developing country especially when an existing technology has been widely accepted by the market.

Field of Research: technology commercialization, competing technology, mobile technology, developing economies

1. Introduction

Technology commercialization has long been revered as the means to create wealth either for developed countries or developing countries. Technology commercialization increases the people's productivity as well as the people's well-being in general (Cooper, 2000; Dhewanto and Umam, 2009; Levit, 2001; Moriarty and Kosnik, 1989; Solow, 1957).

With the surge in technology commercialization, it is very likely to have two or even more technologies to compete in a market. Competing technology commercialization in recent years are interesting feats to observe and learn from. We have seen the saga battle between Sony's Beta video formats versus JVC's VHS in the 1980s (Arthur, 1989; Park, 2004). We are seeing in late 2000s the competition for high definition DVD format between Sony's BlueRay and Toshiba's HD-DVD. There's also the plasma TV versus the LCD and later the LED TV competition. All high technologies developed in the developed markets also impacted those in the developing market as the world economies more connected and even more globalized than before.

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In developing country, technology commercialization is not yet explored much as the competing technologies feature that follows. As the developing market taking more and more important role in the world's economy, the importance of technology commercialization in those nations are even more important as well – as for the companies who develop the technology and also for the consumers, distributors and governments in the developing countries. This paper is trying to give an insight of how commercializing a new technology in a developing country especially when an existing technology has been widely accepted by the market.

The experience in the US, when the 1G commercialized and standardized by the US Government helped the diffusion of the technology into the market that made the US one of the major market for 1G mobile telephony. This was also true in Europe for GSM (2G) commercialization continent-wide and in South Korea for the case of CDMA (2G). This proves that in order for a technology to be commercialized properly - i.e. has high penetration rate, a standard set by the regulatory body – i.e. the government, must be put in place (Gruber, 2005).

In the contrary, the development of the 2G technology and its commercialization in the US was not rigidly set only to a single standard. The development of the CDMA technology pioneered by Qualcomm, a start-up company from San Diego California founded by University Professors proved that multiple standards or less regulated market really spurs innovation. The 2G CDMA development pioneered by Qualcomm eventually become the standard of 3G later adopted worldwide (Mock, 2005).

Gruber (2005) stated that the South Korean Government made an approach to Qualcomm for the right to produce CDMA based telecommunication equipments. This was intended to put South Korea in the telecommunication market map, parallel with European, US and Japanese counterparts. For Qualcomm the South Korean government policy of adopting a single standard and their eagerness to produce CDMA based equipments was a big win. Not only they had a market ready, but also they had a partner in commercializing their technology especially in the manufacturing side of the technology. Qualcomm later concentrated on becoming a research and development center and a major intellectual property principal of CDMA technology. The strategy also paid off handsomely for the South Korean.

They are now the manufacturing basis of CDMA technology which has become the standard of 3G Telecommunication. Many Indonesian operators purchase their equipment from the South Korean manufacturers. A balanced stroke between government's regulation and supportive environment for innovation has brought South Korea as a major player in the world's telecommunication industry.

Telecommunication sector has been growing in excess of 10% for the last few years in Indonesia (IMF, 2009). The sector uses high degree of technology and also capital which enables the service to be carried forward to the customers. While most of the technology used is imported, the sector proved

to be an important one in technology development. Development of the telecommunication services in Indonesia is continuously year after year given the fast pace of the growth of subscribers. Dissecting such a vibrant sector would provide a valuable insight of how technology commercialization took place in emerging/developing market such as Indonesia.

New technology commercialization has been a mature and established topic in the developed countries where the infrastructure to develop such technology has been established. The problem for the developing countries currently is that when it comes to commercialize a new technology, the structure is not yet as established as the ones in the developed countries, making technology commercialization a challenge of its own. This paper tries to analyse the problem faced by the telecommunication companies in Indonesia, a developing country, when a technology already existed in the market and a new technology is being introduced as a competing technology.

This paper is using an established framework in explaining competing technology commercialization developed by Jolly (1997) as we aim to see the applicability of the framework in the developing countries with Indonesia as the case study. The description of the framework is explained in the literature review section. In the methodology section we explain what activities were done in the research to gather data and information. The discussion of the findings and analysis of the findings according to Jolly's framework is listed in the fourth section: discussion of findings. Finally, conclusion and also the limitation of this paper are stated in the last section.

2. Literature Review

According Jolly (1997), the market constituent analysis of introducing a new technology to the market includes its partners in delivery, competing / incumbent technology and also advocates and arbitrator – illustrated in Figure 1 below. The significance of competing technology and its early adoption is being described by the competition between the dominant early entrant telecommunication provider and the new entrants. The partners in delivery and market readiness has been described another significant factor, namely the regulation, also has high impact.

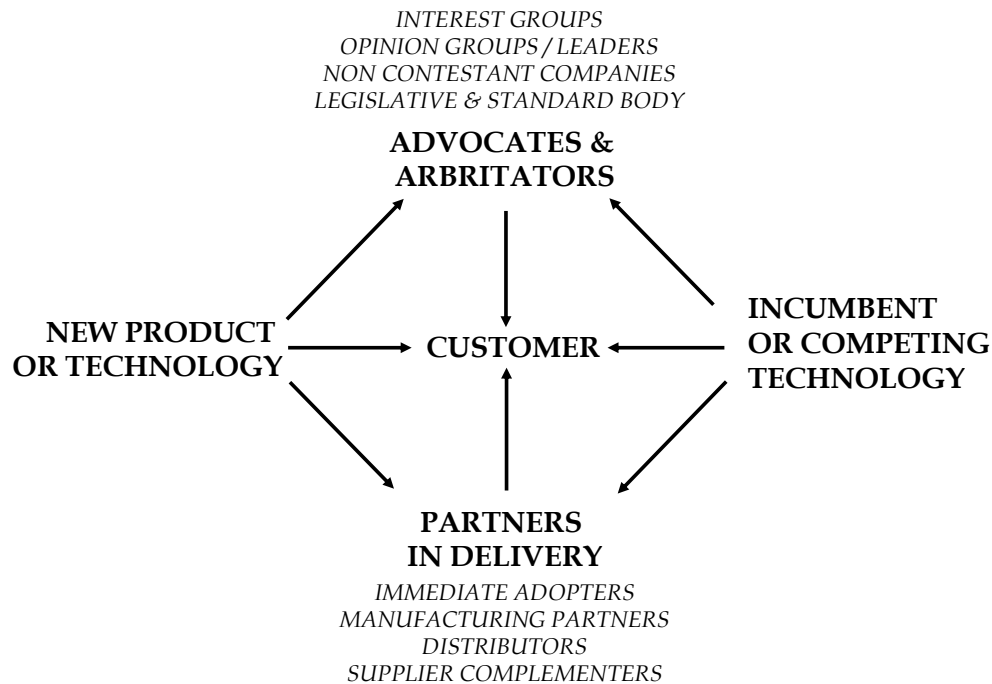


Figure 1 Market Constituent Analysis Framework for Introduction of a New Technology (Adopted from Jolly, 1997)

Shapiro and Varian (1999) argue that the decentralized system competition approach followed in the USA may have hindered diffusion of the current technology but gave the innovative CDMA technology a chance to develop that makes CDMA the basis for 3G mobile telecommunication system. Gruber (2005) argues that the diffusion of mobile telecommunication service is effected by entry regulation and standard setting on the evolution of cellular mobile telecommunication services industry (also controlling for a set of country specific variables). The actual first entry had a significant impact on the diffusion of mobile services. The introduction of second entry license (competition) also had a significant impact on the diffusion of mobile services. The effect was strong during the digital phase. The capacity binding during the analogue phase – expanded drastically in the digital phase – confirming the expectation speeds up diffusion.

Setting technology standards rather than allowing multiple competing systems was a relevant determinant of the evolution of the industry (LaBrecque et al., 2009). Results in Europe suggest that a single analogue standard helped to develop the market faster than competing ones – consistent with network effect and scale economies. Gruber (2005) argues that although GSM single standard may have stimulated the diffusion of digital mobile telecommunication, the advantages of competition from CDMA may have to be assessed in the future as the technology to be used for 3G mobile telecommunication system – whether its adoption could outweigh the network and scale advantages from a single standard (i.e. GSM).

3. Methodology

This paper uses mainly secondary data derived from public sources and also annual reports from the companies deploying CDMA technology. The data of Indonesian telecommunication companies in this paper is obtained from annual reports of Indonesian telecommunication companies from 2004 to 2008 (Bakrie Telecom, 2008; Mobile-8 Telecom, 2008; Telekomunikasi Indonesia, 2008). During this period, the telecommunication companies in Indonesia had just gone through rapid growth after the introduction of the deregulation in late 1990s and early 2000s.

A background research on papers and books written regarding technology commercialization and also the emergence of CDMA technology was conducted. Discussion sessions with R&D employees and managers regarding technology development in a major telecommunication company were conducted prior to the writing of this paper. From the discussion we get the perspective on the context of the technology commercialization from firsthand major telecommunication R&D point of view. The case study for this paper - the Indonesian mobile technology is analyzed using the Constituent Analysis for Introduction of a Technology developed by Jolly (1997).

4. Discussion of Findings

The Framework

To analyze the competing technology commercialization in developing market, this paper will discuss the matters using Jolly's Framework. According to Jolly (1997), the introduction of a new product of technology to the market is influenced by three other factors than the technology namely: the incumbent or competing technology, the advocates and arbitrators and also partners in delivery. Adopters, partners, distributors and other complement suppliers play important roles for a technology to succeed in the market.

The Technologies

The main resource in telecommunication is actually radio spectrum which is a scarce resource. The utilization must ensure the efficient use of it. In order to exploit the radio spectrum efficiently, a proper technology must be employed. The emergence of early telecommunication technologies was based on the analogues technology which varies the frequency and amplitude – like a commercial radio station usage. The rise of the digital era enhances the uses of the radio spectrum. Instead of using the frequency and amplitude to convey the information, the digital revolution sends information through a stream of discontinuous pulses that corresponds to the digital bits used in the computer. This process leads to a significantly more efficient use of the spectrum, thereby improving the spectrum capacity by a factor of three to six (Rappaport, 1996).

The access mechanism of cellular systems can be commonly divided into three types (Gruber, 2005; Rappaport, 1996):

1. Frequency Division Multiple Access (FDMA)

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2. Time Division Multiple Access (TDMA)
3. Code Division Multiple Access (CDMA)

The CDMA technology gives a more efficient mobile telephony by using lower frequency giving broader coverage (see Table 1). The coding system CDMA technology uses enables more bits to be conveyed through the airwaves hence higher efficiency of transmitting data through the radio spectrum (Gruber, 2005; Rappaport, 1996).

Table 1 Key Features in Different Generation of Mobile Telecommunication

(Adopted from Gruber, 2005, pp. 24)

	1G	2G	3G
Transmission Mode	Analogue	Digital	Digital
Application	Voice Only	Voice & Low-speed data	Voice & High-speed data
Access technology	FDMA	TDMA, CDMA	CDMA
Number of incompatible system adopted	7	4	2
First Adoption year	1979	1991	2003

The Industry – Partners in Delivery

The Indonesian telecommunication industry is clearly undergo a major shift after the liberalization of the market in late 1990s after the enactment of Law No. 36 / 1999 ending the state owned companies monopolies after previously a decade earlier Law No. 3 / 1989 giving the private sector a room to participate in the telecommunication sector (Toarik, 2008; Widhiyanto, 2008). For the detailed overview of the Indonesian telecommunication sector from 1961 to 2008 see Table 2.

After 1989, numerous telecommunication companies entered the area after the market liberalization. At that time, the regulation of the market was still inherent with the state owned company PT Telkom and *Dirjen Postel* (Directorate General of Post and Telecommunication) within the Ministry of Transportation. There was no technology standardization. The technologies available then: AMPS, NM-950 and GSM all used by the operators. During that period, mobile telecommunication industry in Indonesia was still dismal therefore interconnection was not yet an issue. The formal regulator body, BRTI, was formed later in 2003, after the enactment of Law No. 36 / 1999 (Komang, 2008).

During the early years, the major players: Satelindo, Telkomsel and Excelcomindo all using GSM as their technology base. At that time CDMA was just an infant technology, being developed by Qualcomm in the United States (Mock, 2005).

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Table 2 Chronology of Indonesian Telecommunication Regulatory & Policy

(Komang, 2008; Toarik, 2008; Widhiyanto, 2008)

Milestones	
1961	Post & Telecommunication Service was formed as a government entity company (<i>Perusahaan Pemerintah</i>) mandated to guard the post and telecommunication service originally from Sumatra
1965	The Telecommunication service was separated from the post and giro service, named as state company (PN Telekomunikasi)
1974	PN Telekomunikasi was divided into two companies: Public Company (Perum) Telekomunikasi (Perumtel) and PT Inti. Perumtel was mandated to develop telecommunication services (domestic and international) while PT Inti was to produce telecommunication equipments
1980	Perumtel's international business spun-off to PT Indosat
1989	Telecommunication Deregulation with the enactment of Law No. 3 / 1989. The private sector was given licenses to perform telecommunication services – spawning companies such as Excelcomindo (private), Satelindo (subsidiary of Indosat), Telkomsel (subsidiary of Perumtel) – all using GSM. AMPS licenses were given to Komselindo, Metrosel, Telesera. NMT-450 license was given to Mobisel.
1991	Perumtel's public company status changed to State Company (<i>Persero</i>) and given the mandate to provide telecommunication service for the general public
1993	The Government allowed Operational Cooperation (KSO) with PP No. 8 / 1993 for Telecommunication implementation. Foreign companies involved in establishing Divre or Regional Division
July 1995	Eight Divre established within Telkom (with partners)
1999	Law No. 36 / 1999 on Telecommunication abolishing Telkom's monopoly on Long-distance calls and Indosat's monopoly on International direct call
July 2003	The formation of BRTI – the Indonesian Regulatory body for Telecommunication with Transportation Minister Decree No. KM 31/ 2003. The members of the body including Post and Telecommunication Directorate General and Telecommunication regulation committee.
Nov 2003	Telkom's and Indosat's exclusive rights effectively withdrawn – ending their monopolies.
2004	The Government established the Interconnection regulation with Transportation Minister Decree No. KM 32 / 2004 on Interconnection Cost on Telecommunication Services
June 2004	Telkom entered the International Direct Connection previously held by Indosat and its subsidiary Satelindo
April 2008	Enactment of the Duopoly on Long-Distance calls. The Government forced Telkom to open access code to Indosat. Previously the exclusive right was in-force until 2010.

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Due to lack of foreign capital investing in the telecommunication sector, the companies operating in the telecommunication sector during the early period mostly exist in a condition of equity crossholding between Telkom and Indosat and to some extent with other investors. After the enactment of Law No. 36 / 1999, the operators underwent a serious ownership changes, consolidating into formidable players: Telkom with Telkomsel, Indosat with Satelindo and Excelcomindo. The big-3 telecommunication operators remain until 2009 even after the introduction of CDMA technology primarily by PT. Telkom (Telkomsel's parent company), Bakrie Telecom and Mobile-8 Telecom, both new entrants, in early 2000s and followed later by SMART and Sampoerna Telecom.

The market shares of the CDMA operators are still below its GSM counterparts. By 2009, CDMA subscribers are only around 30 million compared with more than 150 million GSM subscribers (Internet World Stats, 2010).

The penetration usually is the goal of a government handing out licenses to telecommunication companies while the companies have profitability as their motive thus return on investment of capital employed as their goal demanded by their shareholders (Gruber, 2005). Maintaining a balanced approach is desirable so that the regulation could enhance penetration giving consumers low price, and a normal and reasonable return and profitability for the operators. Excessive license fee is bad for the penetration, while very low license fee is also bad for the company due to high competition the operator will face. It is in this spirit the government rolling out a license called FWA (Fixed Wireless Access) – using wireless technology to enhance the penetration of the telephone to the mass.

The rolling out of the FWA license being used well by Telkom to divert their fixed line business technology from wired telecommunication to wireless. Telkom is the first operator to introduce FWA using the CDMA technology back in 2002. Soon after that, other players following Telkom's footsteps entering the FWA service using CDMA technology as well (Telekomunikasi Indonesia, 2004).

Advocates and Arbitrators

The Indonesian Government through the Ministry of Communication and Information (Depkominfo) regulate the telecommunication industry in Indonesia through policy and another independent body acting as the day to day regulatory body – BRTI (The Indonesian Telecommunication Regulatory Agency) – comparable to Federal Communication Committee in the US. BRTI is the authority in Indonesian telecommunication market. One of its preceding which affects the outcome of the competing technology commercialization of GSM vs. CDMA was the decision to issue a Fixed Wireless Access (FWA) license – which was the only one in the world.

The FWA License permits telecommunication operator to use a wireless technology to serve a local area with limited access – which means the service is no longer available for the mobile telephone outside the service

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zone which in turn categorize the FWA as a local connection rather than mobile telephony which differs a lot in the cost and pricing structure. The operators in turn use the newly issued license to deploy services using CDMA as their technology due to its superiority in coverage and capacity.

Analysis

Park (2004) finds in the competing technologies, what made VHS the winner in competition with Betamax was due to the network advantage of VHS as an increase in the network advantage of VHS was an engine of tipping toward the VHS format. Park also notes that in the early 1980s, the network advantage of VHS was mainly due to its expected growth advantage. This phenomenon could be related with the GSM vs. CDMA competition in the Indonesian telecommunication industry. The competing technology commercialization in the case of Indonesia mobile technology is resulting in a co-existence of both technologies in different level of acceptance. GSM supported by strong early joiner players (Telkomsel, Indosat and Excelcomindo) stays leading with more than 150 million subscribers; CDMA the challenger only has 30 million subscribers – all in a country of 240 million people. That with Telkom – the state owned telecommunication operator having nearly 100 million subscribers both from its Telkomsel subsidiary – uses GSM and FWA license through Flexi brand which utilize CDMA technology.

With Telkomsel who uses GSM, the return perceived by the customers is likely to increase as Arthur (1989) theory states. It is also consistent with the finding that customer who was offered a lower price by the FWA – CDMA operators still chose GSM over the CDMA technology in the medium-term, i.e. over 3-4 years after CDMA inception to the market.

The role of the Advocates and Arbitrators are also important in the emergence of CDMA as an accepted technology with widespread usage through the FWA license. With the adoption of CDMA technology as FWA based technology with lower cost structure due to its local usage, the operators such as Esia and Flexi are able to mull subscribers and even GSM subscribers who don't switch their phone but rather have two hand phones at once, one mobile phone and one local wireless phone. As LaBrecque (2009) suggested that the development and acceptance of a technology is influenced by industry standard bodies. This phenomenon also holds true for the FWA standard in Indonesian telecommunication industry whose standards defined not only by the ITU but also by the BRTI.

See Figure 2 as the representation of the discussion of the framework – with actors represented with their logo on the figures. The Advocates & Arbitrators are, to name some, the Indonesian Telecommunication Regulatory Body (BRTI), The Department of Communication & Information (Depkominfo), Indonesian ICT Society (Mastel) and the International Body for international telecommunication standards – the International Telecommunication Union (ITU). Meanwhile the partners in delivery including the mobile handset manufacturers (Samsung, Motorola, Nokia, Siemens, etc) and also the operators or the technology user of the competing technologies, namely Flexi,

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Esia, Fren the adopters of CDMA - the new technology and Telkomsel, Indosat, Excel of GSM – as the incumbent technology ones.

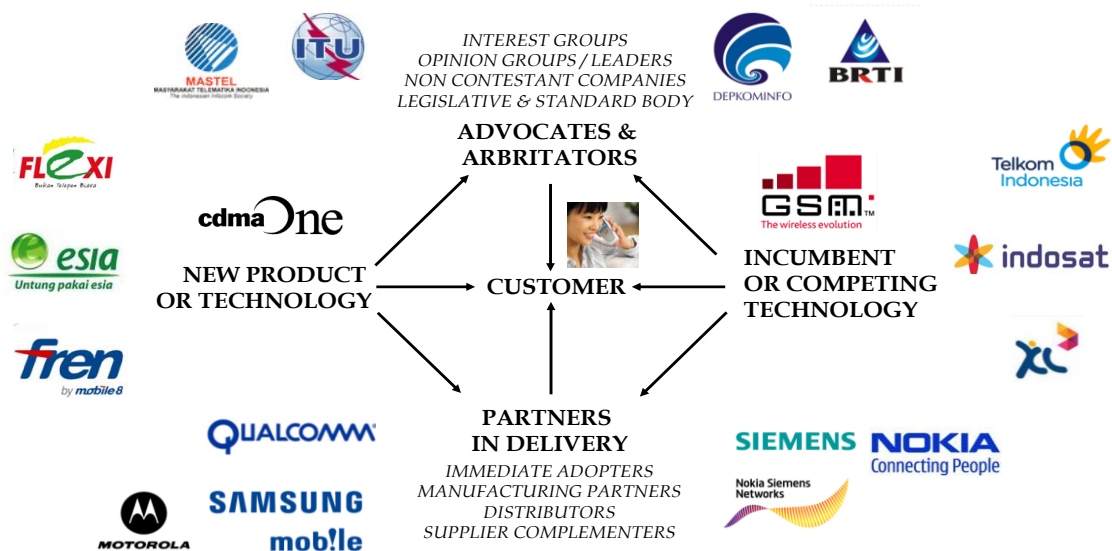


Figure 2 Indonesian Telecommunication Analysis for Introduction of CDMA Technology

(Adopted From Jolly, 1997 - Adjusted)

Contribution

This paper gives theoretical contribution in the application of Jolly's Technology Commercialization framework especially in the developing country using Indonesia as a case study and also shows the use of technology life cycle concept of mobile technology (GSM, CDMA) in the developing country. This paper also gives an insight to technology commercialization in a practical way: dissecting how a technology is commercialized in a developing country with existing technologies already existed.

5. Conclusion and Limitation

Like most developing country, Indonesia has no strong foundation for technology development especially high technology industries such as telecommunication. This fact brings Indonesia to be more reliant on foreign technology whose standards have been defined beforehand by companies and government of developed nations along with multilateral bodies. This issue brings another difficulty which is high capital requirements to start a business or even a public service using such technology. The development and commercialization of CDMA technology in Indonesia shows just that phenomenon.

High capital requirements and limited sources of technology base translated into oligopolistic market in which big players including the government through its state owned companies take part. This phenomenon is also true for Indonesian telecommunication market prior and during the

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commercialization of CDMA technology. While the incumbents have selected their technology (GSM) and in strong affiliation with its technology provider, new players seeking out new ways to take advantage of alternative technologies provided in the market.

In a developing country, in this case Indonesia, although it's a paradox between enhancing penetration rate of mobile telephone in the general population through single standardization and spawning innovation through the use of competing technologies - by adoption of several standardization that has been true for the US market (Gruber, 2005; Shapiro and Varian, 1999) - Indonesia's approach in commercializing CDMA technology has been a valuable insight in competing technology commercialization. We could see how the power of the market and early start of service provider to the market with a technology hinder a novel yet better technology to be fully commercialized and utilized in the market. Those who succeed in commercializing them are supported in the adoption of the technology by the market and in the same time stifled by regulatory system – not permitting them to fully utilize the true extend of the technology.

The limitations of this paper includes the use of Indonesia as a case study which has specific characteristic as a developing country in Asia among other things that made generalization or direct comparison with other countries in other regions may not be appropriate. Another limitation is the technology discussed in the paper – mobile technology which might not be in direct comparison with other technology such as electronic products (LCD TV, DVD Players, etc.) or automobiles.

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