Opportunity For All:

Using Wireless to Provide Universal Access to Telecom Services

CDMA Development Group

October 2004

Executive Summary

Providing access to communication services, traditionally for voice but increasingly also for data, is a key priority for governments and regulators around the world, especially in developing countries. Although much progress has been made, over 2 billion people around the world have never made a phone call. However, the goal of universal access remains achievable, and thanks to advancements in wireless technologies, wireline is no longer the only way to provide it. Next-generation wireless (IMT-2000, or 3G) technologies, which significantly enhance efficiencies and enable operators to provide voice as well as access to the Internet at lower cost, offer a tremendous opportunity for increasing global access to telecommunications. This paper reviews the attributes that wireless technologies – particularly CDMA2000® – have that make them viable solutions to achieve universal access goals.

Introduction

"Universal access" is a broad term used to describe the goal of providing reasonable access to basic telecom services, usually voice telephony, and increasingly to the Internet as well. The definition varies by country. For example, in Nepal, a phone that's within a two-day walk is considered reasonable access, whereas many countries, including Brazil, have expanded the scope to include Internet access as a basic need.[1] Besides bringing service to individual users, universal access programs also often focus on underserved facilities, such as schools and hospitals. Regardless of the definition, the common denominator is that across the globe, governments, businesses and international organizations identify universal access as a top priority.

Universal access efforts that have relied on wireline have produced incremental results at best; in many regions, wireless has done a better and faster job of providing access to basic voice services. In fact, wireless became the leading global platform for basic voice services in 2002. The impact of wireless is particularly pronounced in developing regions. For example, in Africa, the number of fixed lines increased from 12.3 million in 1995 to 22.7 million in 2002. During the same period, Africa's cellular subscribers increased from 652,000 to 34.9 million.[2]

Much work remains before the goal of universal access is realized. There is a large disparity between cities and rural areas. And, although significant progress has been made in providing access to basic voice services, much

still has to be done to expand access to the Internet. In Latin America, for instance, only 8 percent of the population has access to the Internet, and in some countries, such as Venezuela and Colombia, it is as low as 5.4 and 4.5 percent respectively. While wireless has played a significant role in expanding access to voice services, thus far it has had almost no impact on the growth of Internet access.

Why Wireless?

There are a number of factors that make wireless technologies better solutions for providing access to telecom services than wireline. In general, wireless offers much more flexibility and allows for rapid deployment of services. In many cases, wireless technologies are more economical, especially in rural and hard-to-reach areas. According to a study by researchers at the University of California:

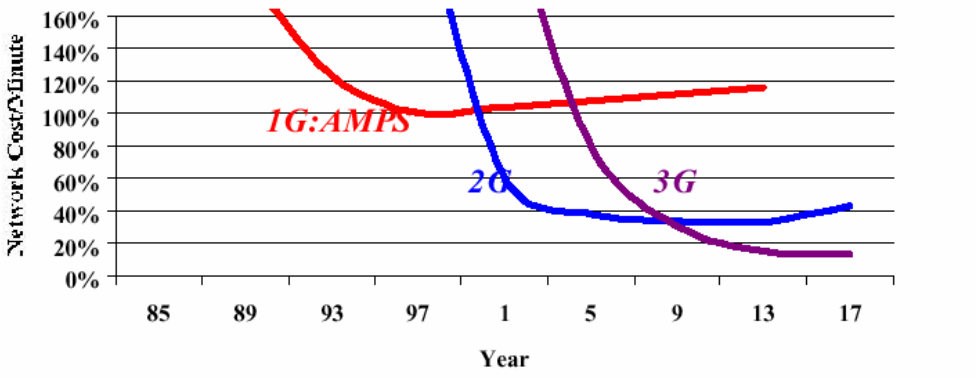
> In most developing countries, pro-competitively regulated and efficiently implemented wireless network access is quickly surpassing fixed wire lines as the primary mode of network access… Mobile networks (more specifically Wireless – mobile and fixed networks) have been used very gainfully in developing nations with weak infrastructure and low spending capacities. Wireless technology is a particular boon for rural service because the cost per user of laying a cable to distant villages with smaller populations is very high (especially in areas with challenging climates). Different forms of wireless technology are likely to be much cheaper.[3]

Morgan Stanley estimated that capital expenditures (capex) to build incremental capacity on a wireless network are 43 percent less than for a fixed line.[4] The cost advantage of wireless is especially pronounced for servicing remote areas; the cost to build and maintain fixed infrastructure grows proportionally with distance, whereas for wireless, it remains relatively the same.

This rapid growth of wireless and its increasing role in providing basic telecom services has been driven by the introduction of digital (2G) wireless technologies. However, because of their limited data capabilities, 2G technologies are not well-suited to provide Internet access. Next-generation (IMT-2000, or 3G) wireless technologies that are now being deployed around the world offer greater opportunity for increasing global access to telecommunication services. Through improved spectrum efficiencies and advanced data capabilities, these technologies allow service providers to offer both voice and data services much more cost-effectively.

As the chart below indicates, 3G technologies can reduce the cost of voice delivery, measuring per minute network cost for a voice call, by 80 percent compared to analog and 20 percent compared to second-generation digital networks.[5]

Figure 6: Economics of Technology Evolution



The high-speed data capabilities of 3G networks enable reliable access to the Internet as well. The 2.4-3.1 Mbps peak data speeds supported by leading 3G technologies – CDMA2000 and WCDMA – are much higher than what is available through dial-up fixed connections (50 kbps).

3G technologies have been commercial for almost 4 years and already over 8 percent of mobile subscribers use 3G services. The number of users will continue to grow exponentially and will exceed 1 billion by 2010.[6] Huge economies of scale will further drive network cost down.

Why CDMA2000?

CDMA2000 offers a viable solution for universal access with a range of services, coverage advantages, equipment availability and cost efficiencies.

Service Variety

CDMA2000 supports both voice and broadband wireless access. It represents a family of IMT-2000 standards which includes CDMA2000 1X, CDMA2000 1xEV-DO and CDMA2000 1xEV-DV. CDMA2000 1X supports

voice and data at speeds of up to 307 kbps; CDMA2000 1xEV-DO provides high-speed data at rates of up to 3.1 Mbps on a dedicated channel; and CDMA2000 1xEV-DV will provide voice and high-speed data at rates of up to 3.1 Mbps simultaneously. In addition to broadband Internet access for individuals, businesses, schools and hospitals, CDMA2000 supports a number of applications for public safety and communication markets, including Push-to-Talk, dispatch services and group communications.

Efficiency

A common concern about using mobile spectrum to provide universal service is that other radio space will be affected. This, however, is not an issue in sparsely populated rural areas, and with the right technology, it shouldn't be a concern in urban areas. CDMA2000 is a highly efficient technology that transmits large amounts of voice and broadband traffic in a small amount of spectrum (Figure 2, 3). And, it is the only wireless technology that can operate in as little as 5 MHz of spectrum.

Figure 1

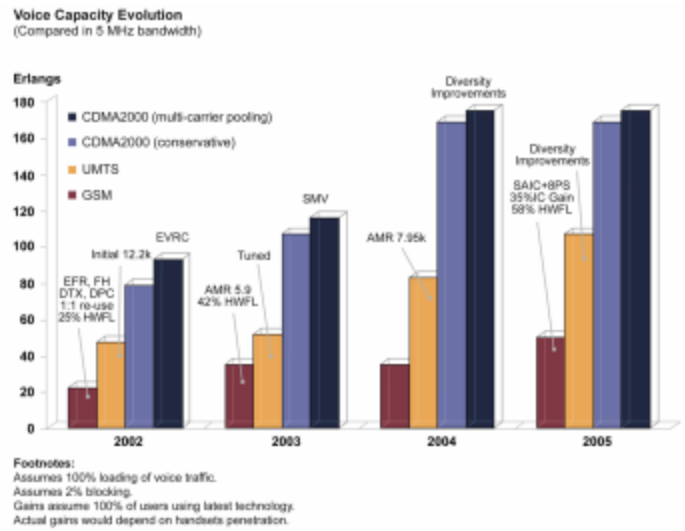
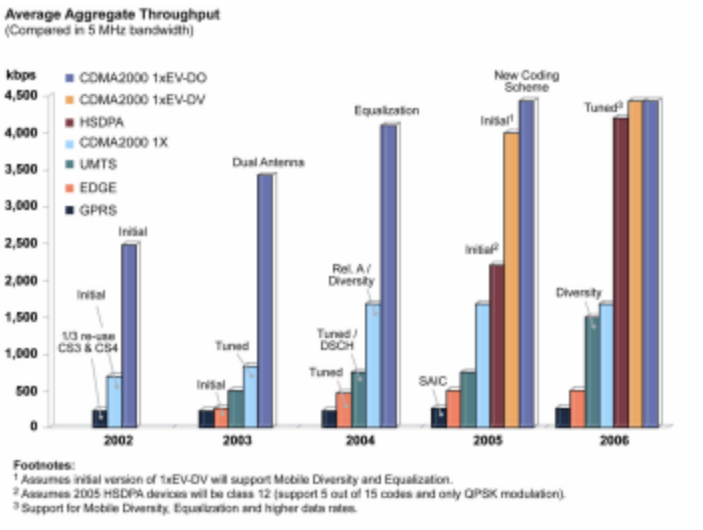


Figure 2



Coverage

To provide service in sparsely populated areas cost-effectively, a technology should be able to cover the most geography with the least amount of infrastructure. Wireless signals travel farther at lower frequencies, thus a cell site at

450 MHz or 850 MHz covers more geography than one at 1900 MHz or 2100 MHz. For example, using CDMA2000 technology, a single cell site has a radius of 48.9 km at 450 MHz, 29.4 km at 850 MHz and 13.3 km at 1900 MHz (Figure 4). In Belarus, with only 60 CDMA2000 cell sites at 450 MHz, Belcel serves 80% of the population, while its GSM900/1800 MHz competitor has a network of over 500 base stations to cover the same area. (Note: CDMA2000 at 450 MHz is also referred as CDMA450.)

Figure 4: Coverage Comparison of an IMT-2000 System at Various Frequency Ranges

Frequency (MHz)	Cell radius (km)	Cell area (km2)	Relative Cell Count
450	48.9	7521	1
850	29.4	2712	2.8
950	26.9	2269	3.3
1800	14.0	618	12.2
1900	13.3	553	13.6
2500	10.0	312	24.1

Source: "Coverage Comparison of IMT-2000 Systems at Various Frequency Ranges, Including 450", ITU, Radio Telecommunication Study Group, June 11, 2002

In a trial in Brazil, a 450 MHz cell site using CDMA2000 1X provided voice service within a 60 km radius and data rates of up to 120 kbps within 50 km. Using 1xEV-DO, each cell site provided throughput of up to 800 kbps when users were 35 km away. The fewer cell sites that an operator must deploy to cover an area, the lower the cost of deployment and maintenance. Lehman Brothers estimates that the total cost of building and operating a CDMA2000 network to serve 1 million users at 450 MHz or 800 MHz is 31-38 percent of the cost for the same network at 1900 MHz.[7]

Competitive Cost Structure

With 108 commercial networks and 37 more scheduled for launch by the end of 2004, CDMA2000 offers significant economies of scale (Appendix 1). CDMA2000 is the most widely-used wireless technology in the 800 MHz band, with 53 networks in North and Latin America, Asia (including China and India), Australia and Africa. It is also the only wireless technology commercially available in the 450 MHz band. There are already twelve CDMA450 commercial networks and another sixteen are being deployed or in trials throughout Asia, Africa and Europe and vendor and operator support is growing rapidly.

Affordable Devices

In September 2004, more than 124 million people worldwide were using CDMA2000[8] and 59 vendors supplied over 680 models of phones and other devices models, including 300 models for the 800 MHz and 24 for the 450 MHz bands. The Yankee Group estimates that more than 733 million CDMA2000 devices will be sold between 2002 and 2008.[9] Volume and competition are driving down the cost of CDMA2000 phones and PC cards to be on par with 2G devices. Shosteck Group, estimates that the CDMA2000 1X phone prices will continue to decline from $77 in 2004 to $44 in 2007.[10] Although CDMA450 devices carry a premium over CDMA2000 products at other bands, the difference is narrowing as more handset vendors develop CDMA450 products.

Using CDMA2000 for Universal Access

Many regulators and service providers already utilize or are evaluating CDMA2000 technologies to expand the reach of telecommunication services. A number of operators use their existing 800 MHz networks:

- With the introduction of Unified Licenses in India, CDMA operators have rapidly built networks and offer low-price plans in previously underserved areas. Reliance Infocom, for example, offers wireless services in 1100 towns across India and has 42,000 subscribers in Rural Short Distance Charing Areas (SDCAs) as well as nearly 1 million in the Semi-urban (SCDA) areas. In the Gujarat circles, Reliance installed close to 4100 Village Public Telephones (VPT) in villages which previously did not have access to telephones. In 2005, the operator will expand the service areas to 3800 towns and by then will cover more than 50% of the rural areas.
- Telstra is expanding its CDMA2000 1X network and deploying CDMA2000 1xEV-DO technology to provide Internet access to customers across Australia, including those in remote areas
- BellSouth is installing public telephony centers in many countries throughout Latin America

Many view CDMA2000 at 450 MHz as the key enabler of universal service. In a recent report, Lehman Brothers concludes: "CDMA450 offers cheap voice and data possibilities for the developing world," and "The superior service range, and other advantages, of a CDMA450 base station will provide service providers with what we expect to be the lowest per-line deployment costs in the world."[7]

Interest in CDMA450 is growing rapidly and a number of countries have already deployed or are evaluating the use of CDMA450 to advance their universal access goals:

- In August 2003, Starcomms began building a CDMA450 network in the Federal Republic of Nigeria.
- In September 2003, Tibet Telecom Company, a division of China Telecom Group, launched CDMA450 wireless service. By April 2004, there were over 80,000 users and the percentage of administrative villages with universal access grew from 32% to 85%. When fully deployed, the network will cover 1.22 million km^2 with a population density of 0.01-500/km^2.
- In January 2004, Mandara Selular Indonesia (MSI) announced that it would deploy 210 CDMA450 base stations to target 100,000 customers under the Universal Service Obligation. In April, the company launched the NEO_N pilot program which includes pay phones, phone kiosks and Internet kiosks.
- In February 2004, PCTL in Pakistan announced plans to launch CDMA450 service to provide 200,000 telephone connections to remote areas.
- ETC in Vietnam is deploying a nationwide CDMA450 network to serve 300,000 users and plans to introduce CDMA2000 1xEV-DO services in Saigon.
- Brazil's telecom regulator, Anatel, conducted a trial of CDMA450 wireless technology as part of its "Digital Inclusion and Universal Internet Access" project. During the trial in Brasilia and surrounding cities, more than 3,000 rural residents were able to make voice calls or access the Internet for the first time.
- In September 2004, Cambodia Shinawatra, the largest telecoms operator in the country, deployed CDMA450 to provide Internet access throughout Cambodia. The country has one of the lowest teledensities in Southeast Asia and CDMA450 offered a cost-effective solution to reach remote and hard-to-access areas. The operator achieves 80 kbps data speeds.
- Telecom Argentina and Telefonica del Peru have requested permission to trial CDMA450.

The technology also is receiving recognition in China. The Chinese government established aggressive goals to extend telecommunication services (5% of the administrative villages by 2005 and 100% by 2010), and the Ministry of Information Industry (MII) placed the responsibility of deploying universal services on the six major telecommunication providers. Although multiple technologies are being considered, the majority have voiced preference for CDMA450. For example, Li Ruliang, Director of Telecom Regulatory Affairs of China Telecom Group indicated that, "CDMA450 remains the most effective solution for universal services, and that whether in terms of cost,

the utilization of technology, or the maturity of terminals, CDMA450 provides the best return on an operator's investment."[11]

Another example is Africa, where operators increasingly view CDMA450 as a more cost-effective way to deliver voice and data services. Ethiopia's fixed-line operator is building a CDMA2000 network, which is estimated to cost about a third less than wired technology. The network will include CDMA2000 1X and 1xEV-DO systems at 800 MHz and 450 MHz. There are also trials in South Africa, Nigeria and 10 other African countries.

Realizing The Dream

Providing affordable access to telephony and the Internet to everyone, regardless of their location or socio-economic condition, is a top priority for many governments and a new opportunity for wireless operators. The key for them is to select a technology that can deliver voice and data cost-effectively. In every region of the world, CDMA2000 has shown that it delivers voice and broadband Internet access economically and reliably, which makes it an optimal solution for universal services.

[1]http://bear.cba.ufl.edu/centers/purc/conferences/competition/documents/filho.pdf
[2]ITU News: June 2004
[3]http://www.sims.berkeley.edu/~joyojeet/digitalpartners.pdf
[4]Morgan Stanley
[5]Cost of 1G
[6]Deutsche Bank, April 2003
[7]Lehman Brothers, Asian Telco Technology Primer: CDMA450: Perpetuating Asia's "Growth + Profitability" Story?, June 10, 2004
[8] Estimate CDMA Development Group
[9]Yankee Group, April 2004
[10]Shosteck Group Forecast, October 2004
[11]Telecom World, June 22, 2004

Appendix 1: CDMA2000 Deployments

Country	Operator	Date	Frequency
South Korea	SK Telecom	Oct. 1, 2000	800 MHz
South Korea	LG Telecom	Oct. 1, 2000	1700 MHz
South Korea	KT Freetel	May 1, 2001	1700 MHz
USA	Western Wireless	July 1, 2001	800 MHz
Romania	Telemobil	Dec. 7, 2001	450 MHz
Brazil	Vivo	Dec. 12, 2001	800 MHz
USA	Leap Wireless	Dec. 10, 2001	1900 MHz
USA	Verizon Wireless	Jan. 28, 2002	800 and 1900 MHz
Canada	Bell Mobility	Feb. 12, 2002	800 and 1900 MHz
USA	MetroPCS	Feb. 21, 2002	1900 MHz
Japan	KDDI	Apr. 1, 2002	Japan 800 MHz
Puerto Rico	Centennial de Puerto Rico	Apr. 4, 2002	1900 MHz
Canada	Telus Mobility	Jun. 3, 2002	800 and 1900 MHz
New Zealand	Telecom Mobile Limited	Jul. 22, 2002	800 MHz
Chile	Smartcom PCS	Jul. 26, 2002	1900 MHz
USA	Sprint	Aug. 11, 2002	1900 MHz
Puerto Rico	Sprint Puerto Rico	Aug. 11, 2002	1900 MHz
U.S. Virgin Island	Sprint U.S. Virgin Islands	Aug. 11, 2002	1900 MHz
USA	Cellular South	Sept. 9, 2002	800 MHz
Israel	Pele-Phone	Sept. 30, 2002	800 MHz
Moldova	JSC Interdnestrcom	Sept. 30, 2002	800 MHz
USA	NTELOS	3Q 2002	1900 MHz
Colombia	EPM-Bogota	Oct. 2, 2002	1900 MHz
USA	U.S. Cellular	Oct. 6, 2002	800 and 1900 MHz
India	Tata Teleservices	Nov. 7, 2002	800 MHz
Venezuela	Telecel BellSouth	Nov. 13, 2002	800 MHz
USA	Kiwi PCS	Nov. 14, 2002	1900 MHz

Country	Operator	Date	Frequency
Venezuela	Movilnet	Nov. 20, 2002	850 MHz
Canada	Aliant Mobility	Nov. 25, 2002	800 MHz
Canada	MTS Mobility	Nov. 27, 2002	1900 MHz
Poland	OSP Polpager Ltd.	Nov. 2002	800 MHz
Australia	Telstra	Dec. 2, 2002	800 MHz
Ecuador	BellSouth Ecuador	Dec. 3, 2002	800 MHz
Panama	BellSouth Panama	Dec. 3, 2002	800 MHz
Indonesia	PT Telekomunikasi	Dec. 5, 2002	800 MHz
Russia	Delta Telecom	Dec. 16, 2002	800 MHz
Mexico	IUSACELL	Jan. 23, 2003	1900 MHz
USA	Illinios Valley Cellular	Jan. 2003	800 MHz
Puerto Rico	Verizon Wireless Puerto Rico	Feb. 4, 2003	1900 MHz
Belarus	Belcel	Feb. 10, 2003	450 MHz
Thailand	Hutchison CAT	Feb. 24, 2003	800 MHz
Brazil	TMais	Mar. 21, 2003	1900 MHz
Nicaragua	BellSouth Nicaragua	Mar. 26, 2003	800 MHz
Nigeria	Multi-Links	Mar. 26, 2003	1900 MHz
Dominican Republic	Centennial Dominicana	Mar. 27, 2003	1900 MHz
China	China Unicom	Mar. 28, 2003	800 MHz
USA	ALLTEL	Mar. 2003	800 and 1900 MHz
Pakistan	TeleCard Limited	Mar. 2003	1900 MHz
Yemen	Yemen Telecom	Mar. 2003	800 MHz
Canada	SaskTel Mobility	Apr. 10, 2003	800 MHz
Brazil	Vesper	Apr. 28, 2003	1900 MHz
India	Reliance Infocomm	May 1, 2003	800 MHz
Colombia	BellSouth Colombia	May 5, 2003	800 MHz
Russia	SOTEL-Video	May 10, 2003	450 MHz

Country	Operator	Date	Frequency
India	Mahangar Telephone Nigam Ltd. (MTNL)	May 19, 2003	800 MHz
Guatemala	BellSouth Guatemala	May 20, 2003	1900 MHz
USA	Midwest Wireless	Jun. 2, 2003	800 MHz
Azerbaijan	Caspian American Telecom	Jun. 15, 2003	800 MHz
Jamaica	Oceanic Digital Jamaica	Jun. 17, 2003	800 MHz
China	China Telecom	1H 2003	450 MHz
Uzbekistan	JSC Uzbektelecom	1H 2003	450 MHz
Vietnam	S Telecom	Jul. 1, 2003	800 MHz
Guatemala	SERCOM	Jul. 15, 2003	1900 MHz
Taiwan	Asia-Pacific Broadband Wireless Communications	Jul. 29, 2003	800 MHz
Indonesia	PT Wireless Indonesia	Jul. 29, 2003	1900 MHz
Nigeria	Starcomms Limited	Jul. 2003	1900 MHz
Chile	BellSouth Chile	Aug. 11, 2003	1900 MHz
Bermuda	Bermuda Digital Communications	Aug. 17, 2003	800 MHz
India	Shyam Telelink	Sept. 5, 2003	800 MHz
Indonesia	PT Radio Telepon Indonesia	Sept. 12, 2003	800 MHz
Nepal	United Telecom Ltd.	Sept. 20, 2003	1900 MHz
Russia	Moscow Cellular Communications	Nov. 1, 2003	450 MHz
Kyrgyzstan	AkTel LLC	Nov. 18, 2003	800 MHz
Argentina	Movicom BellSouth Argentina	December 1, 2003	1900 MHz
Ecuador	TELESCA	December 1, 2003	1900 MHz
Dominican Republic	Verizon Dominicana	December 3, 2003	1900 MHz
Peru	BellSouth Peru	Dec. 5, 2003	800 MHz
Indonesia	PT Mobile-8 Indonesia	Dec. 8, 2003	800 MHz

Country	Operator	Date	Frequency
Kazakhstan	JSC ALTEL	Dec. 10, 2003	800 MHz
USA	Rural Cellular Corporation	Dec. 31, 2003	800 and 1900 MHz
Georgia	Iberiatel	4Q 2003	450 MHz
Kuwait	Ministry of Communications	2003	800 MHz
Angola	Movicel Telecomunicacoes	Jan. 21, 2004	800 MHz
Russia	Kuzbass Cellular Communications	Feb. 17, 2004	450 MHz
USA	Sagebrush Cellular	Mar. 2004	800 MHz
Indonesia	Mandara Selular Indonesia	Apr. 19, 2004	450 MHz
USA	Carolina West Wireless	Apr. 29, 2004	800 MHz
USA	ACS Wireless	May 24, 2003	800 and 1900 MHz
Indonesia	PT Indosat	May 29, 2003	800 and 1900 MHz
Czech Republic	Eurotel Praha	Aug. 2, 2004	450 MHz
Australia	Hutchison Telecomms Australia	August 2004	800 MHz
Cambodia	Cambodia Shinawatra Co. Ltd.	3Q 2004	450 MHz

Appendix 2: Infrastructure and Handset Vendors

Infrastructure Vendors: Airvana, Ericsson, Huawei, Lucent, Nortel Networks and ZTE

Handset Vendors: Axesstel, Compal, Curitel, Giga Telecom, GTRAN Wireless, Huawei, Synertek and Topex

AnyData
AMC-450

Curitel
H-100

Curitel
HX-510B

Curitel
HX-525B

Giga Telecom
Z-510

Giga Telecom
Z-710i

GTRAN Wireless
GCP-5000

GTRAN Wireless
GPC-6420

Huawei
ETS-1000

Huawei
ETS-2000

Huawei
ETS-668

Huawei
ETS-678

Huawei
ETS-688

Synertek
S-200