

Voice over Internet Protocol Millions of Packets, Packets for Free

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Executive Summary

This report analyzes the Voice over Internet Protocol (VoIP) market; including VoIP Handsets, Analog Telephone Adaptors (ATAs), and Internet Protocol Private Branch eXchanges (IP PBXs). In addition, the overall VoIP Network will be discussed, though not evaluated as some hardware overlaps with other reports.

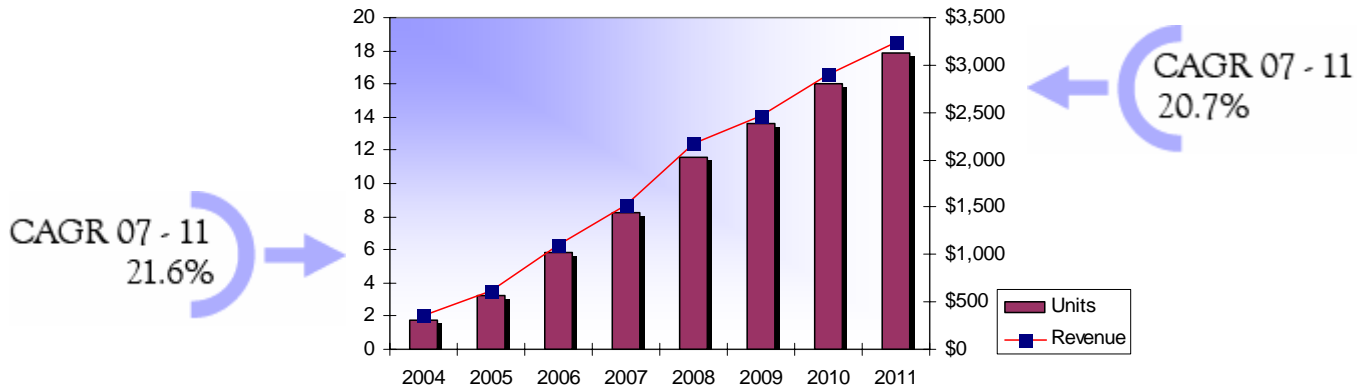
VoIP is an industry revolution, changing the way enterprises and consumers stay in contact. In addition it will dramatically change the business model for telephone service providers. VoIP provides local and long distance telephone calls essentially for free. That service has been provided by telephone companies for very profitable fees that will no longer be required. PSTN phones are being phased out by IP Phones, and most cell phones will work with VoIP software. The cost benefits as well as ease of use are making consumers flock to this market in unprecedented numbers. Yet today, most consumers are not only aware of this technology, but they use it daily, either at work, at home, or on the go.

VoIP is creating an industry where no one needs to worry about being out of the loop or away from the desk. VoIP is enabling the world to always be connected, always be on, and over 100,000 people are switching to VoIP a month to prove it. Not only does this create opportunities for new VoIP devices, but it is also creating new niche services by traditional phone providers, as they seek to keep their customers from moving entirely to VoIP.

Five years ago VoIP was an entirely new market. The first IP PBX was created by 3Com in 1998. IP PBX shipments will grow from 8.2 in 2007 to 17.9 million units in 2011 for a CAGR of 21.6%. IP PBX OEM revenues will grow from \$1,524 in 2007 to \$3,237 million dollars in 2011 for a CAGR of 20.7%. Asia Pac and China will lead in manufacturing growth.

The TAM (Total Available Market) for semiconductor revenue will increase from just over \$1.2 billion in 2007 to nearly \$2.6 billion in 2011. Nearly 60% of the semiconductor cost per box will be in micro logic. Partly for that reason wafer demand at the .065 wafer process node and beyond will increase at a CAGR of 45% from 2007 to 2011.

Figure 1: IP PBX World Market Forecast (Units & Revenue)



Source: Semico MAP Model

The IP PBX market will begin to decline in 2011 onward, as software and other devices take over the market. Regionally the Asia Pac, Japan, and China regions will continue to drive growth for this market.

Market Segments

IP PBX

An Internet Protocol Private Branch Exchange, it replaces older PSTN Private Branch Exchanges. It is a voice, video, and data switching system, and is located on the user's property. Since IP PBXs do not rely on the telephone company, they save corporations significantly on their phone costs, as they do not have to pay for each phone line used by an employee.

Table 1: Illustrative IP PBXs

Meridian 1 Option 11C



Image Source: TAC Centre
OEM: Nortel
Features:

up to 800 lines
Multi site
ELAN
ISDN Q. Sig.
Power: 500 watts

IP-PBX ZT-9005



Image Source: Zinwell

Features:

up to 30 lines
SOHO
5 RJ-45

KXTDA600 Hybrid IP PBX



Image Source: Panasonic

Features

Up to 960 lines
Multi site
Power: 295 watts

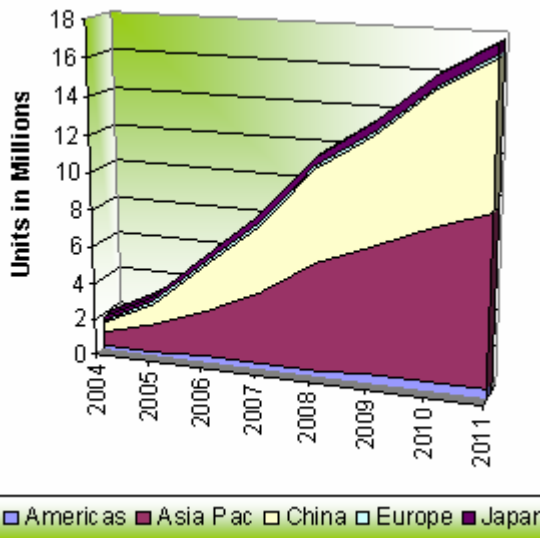
Source: Semico Research Corp.

Table 2: IP PBX OEMs

| Tier 1 | Tier 2 |
|---------|------------|
| 3Com | Aztech |
| Alcatel | TalkSwitch |
| Cisco | Zinwell |
| Nortel | Cortelco |
| | D-Link |

The IP PBX market is growing as enterprises abandon their old PBX systems to include Voice and Video over IP capabilities. This market is shifting to a software-based system, as consumer and enterprise hardware is able to provide the processing power for VoIP. Not only is software slowing the growth of the IP PBX market, but hosting companies can also replace company IP PBXs, making a smaller market.

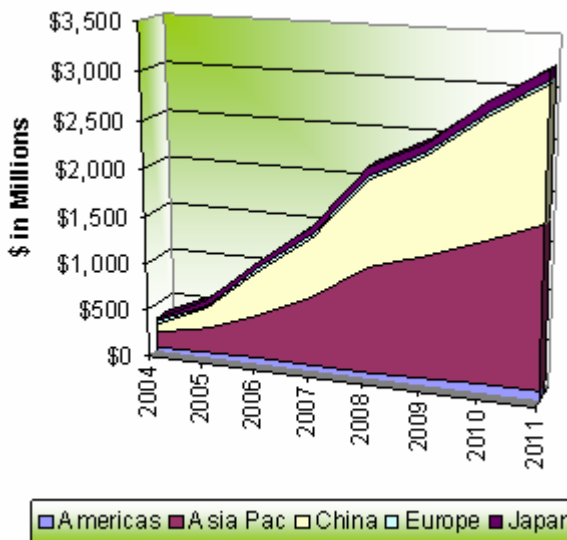
Figure 2: VoIP Regional Manufacturing Shipments



As seen in Figure 2, most IP PBX units are manufactured in Asia Pac and China. Though manufacturing costs are similar across the regions, the IP PBX market is most popular in those same regions, due to low cost and ease of implementation. See Table 11 for actual shipment numbers.

Source: Semico Research Corp.

Figure 3: VoIP Regional Manufacturing Revenue

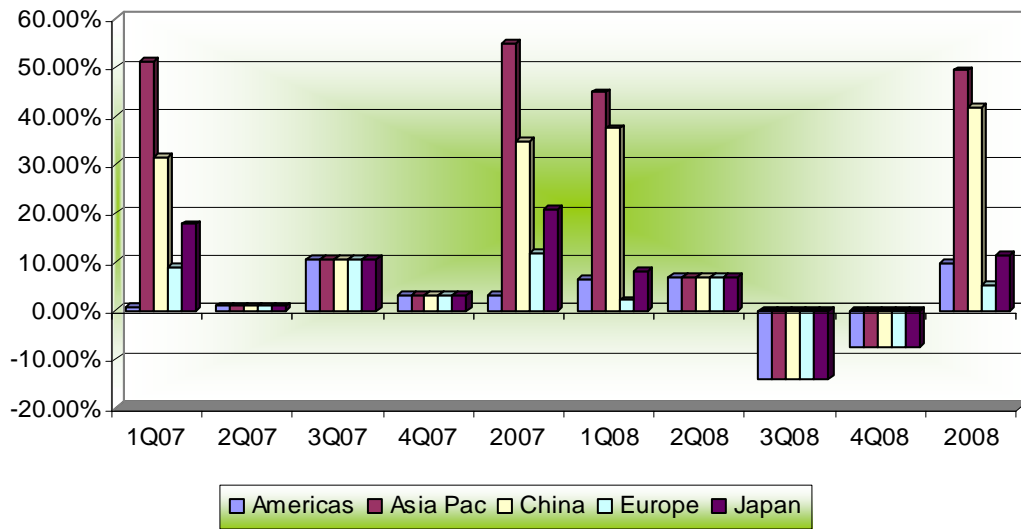


As discussed above, OEM ASPs are similar across all regions, resulting in revenues that resemble unit shipments. See Table 11 for actual revenue numbers.

Source: Semico Research Corp.

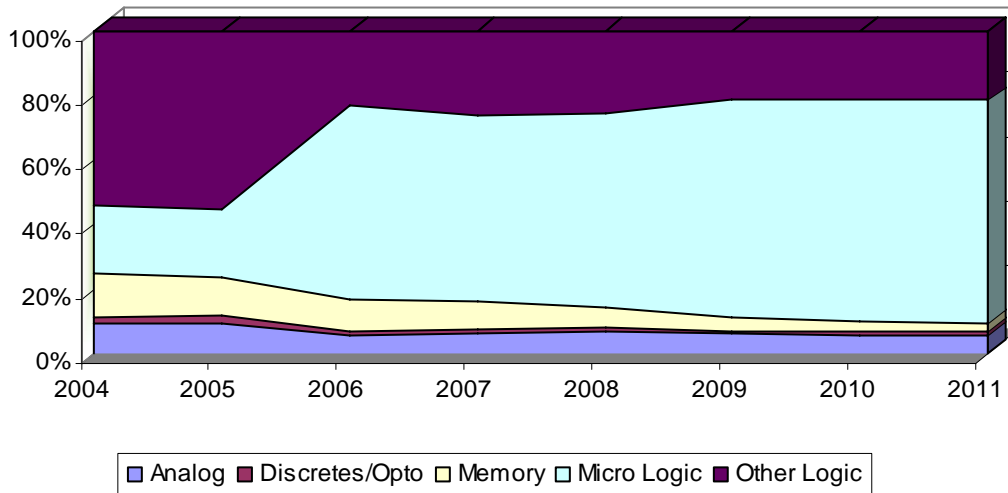
The IP PBX market would see larger growth opportunities except for the availability of other IP gateways, hosted IP PBXs, and software IP PBXs. Growth slows in the years 2010 and 2011 and will begin to diminish afterwards, though opportunities will continue, both in enterprise and consumer implementations.

Figure 4: IP PBX Regional Quarterly Manufacturing Percent Change



Source: Semico Research Corp.

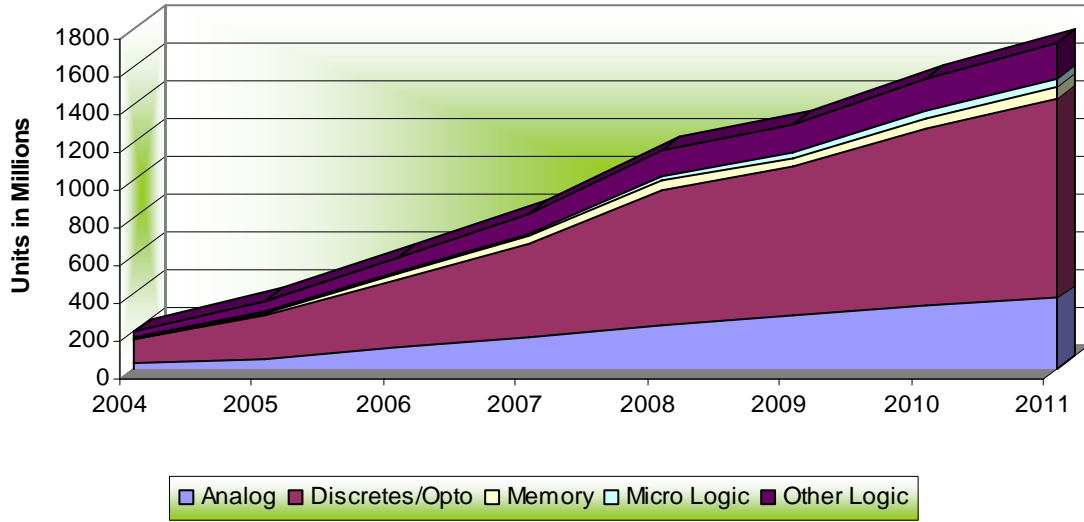
Figure 5: IP PBX US\$ Semiconductor Percentages



Source: Semico Research Corp.

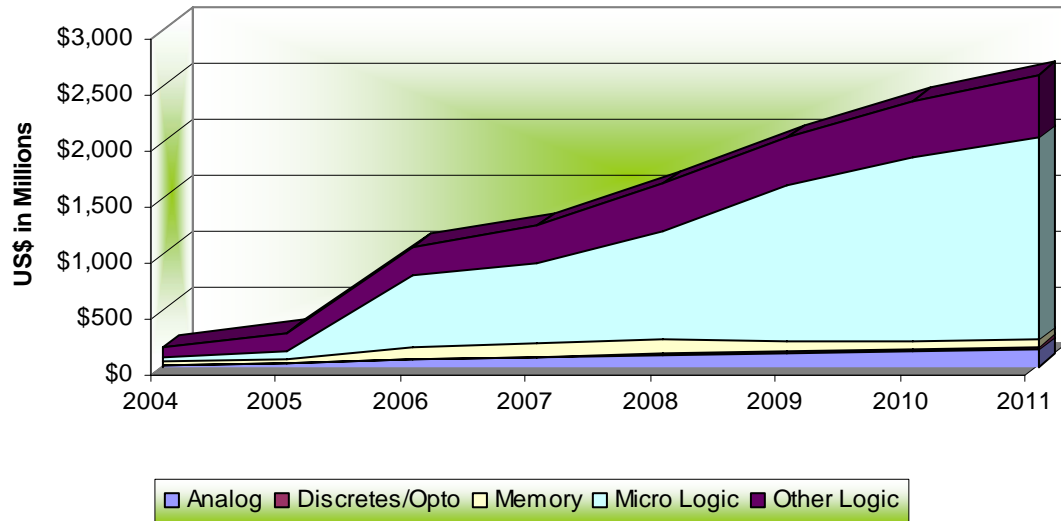
Micro Logic and MOS Logic make up the bulk of the semiconductor cost of the average IP PBX. Essentially a computer, there are multiple processors in an IP PBX to monitor the number of calls, their quality, and routing. The MOS Logic includes a VoIP SoC. Semico accounts for the fact that there are a variety of boxes in the marketplace: some are hosted offsite, others include hosting for 5 to 300 users, and some are comprised completely of software. The semiconductor content in dollars is presented in Table 4.

Figure 6: IP PBX Total Available Market Units



Source: Semico Research Corp.

Figure 7: IP PBX Total Available Market Revenue



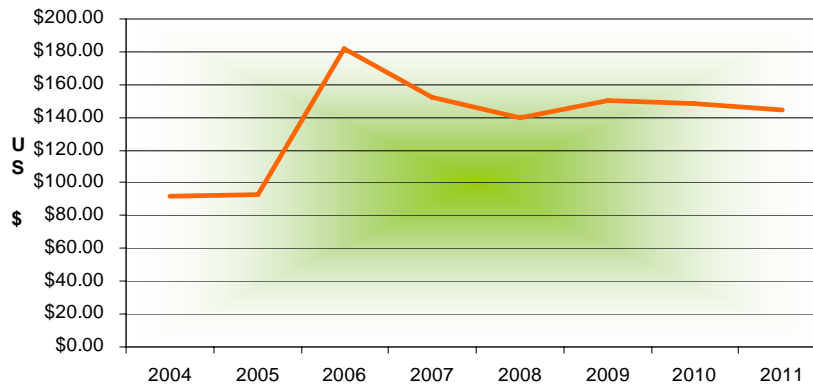
Source: Semico MAP Model

Table 3: SoC Vendors

| Tier 1 | Tier 2 | Teir 3 |
|-------------------|----------------|------------|
| PMC-Sierra | MIPS | TigerJet |
| Texas Instruments | VeriSilicon | Marvell |
| Infineon | Legerity | Conextant |
| Freescale | Analog Devices | Centillium |
| Broadcom | DSP Group | |
| Agere | Renesas | |

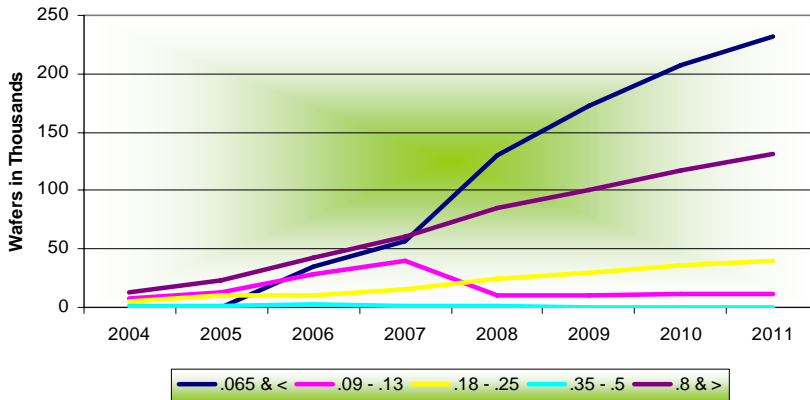
Source: Semico Research Corp.

Figure 8: IP PBX Semiconductor Content per Device



Source: Semico Research Corp.

Figure 9: IP PBX Wafer Production by Process Node



Source: Semico Research Corp.

Since Micro Logic and Other Logic provide for the largest percentage of content within an IP PBX, .065 and finer process nodes have the largest percentage of

growth. Analog and Discretes maintain .8 and higher process nodes growth. Wafer demand at 65nm and finer will grow at a CAGR of 59.6% from 2007 to 2011. This is due mainly to more advanced processors needed for voice quality as well as custom SoCs.

VoIP Handsets

The handset market is migrating to a mobile market. VoIP desk phones have an RJ-45 Ethernet connector instead of a RJ-11 connector. Each vendor includes different security solutions and most also include Power over Ethernet, to ensure the phone systems will still work in a power outage. Example of VoIP handsets are as follows:

Table 4: Illustrative VoIP Handsets

3Com 3102 Business Phone



Image Source: 3Com

Features:

- 802.3af
- 10/100
- RJ-9 Headset
- Jitter Buffer
- G.711
- ADPCM
- G.729a/b

Protocols:

- NBX H3
- SIP

Cisco Unified IP Phone 7970G



Image Source: Cisco

Features:

- 10/100
- RJ-9 Headset
- 802.3af
- G.711
- G.729a

Protocols:

- CallManager 3.3
- SCCP

IP Phone 2004



Image Source: Nortel

Features:

- 10/100
- 802.1ab
- RJ-11 Headset jack
- 802.3af
- G.711
- G.723.1
- G.729a

Protocols:

- E.164
- UDP
- SIP

Source: Semico Research Corp.

Table 5: VoIP Handset Vendors

| Tier 1 | Tier 2 | Tier 3 |
|-------------------|------------|-------------|
| 3Com | Aztech | Cortelco |
| Texas Instruments | TalkSwitch | Vertical |
| Cisco | Zinwell | Grandstream |
| D-Link | Avaya | |
| Nortel | SignalSys | |
| | Siemens | |

Source: Semico Research Corp.

Voice over Wi-Fi

VoIP phones for services like Skype and Vonage use Wi-Fi and have the VoIP software built into the phone, connecting to the Internet without a computer. These phones have sound quality as good as the average cell phones, yet are contingent on the Internet connection. Examples of Voice over Wi-Fi phones follow:

Table 6: Illustrative Voice over Wi-Fi Phones

Wi-Fi UTStarcom F1000 Phone



Image Source: Vonage

| | |
|------------|------------------------|
| Features: | 802.11b/g 2.4GHz |
| | Adaptive Jitter Buffer |
| | Echo cancellation |
| | 4hr battery talk time |
| Protocols: | |
| | SIP |
| | RTP/RTCP |
| | SDP |
| | RFC 2833/Inband DTMF |
| | STUN |

P-2000W2



Image Source: BroadVoice

| | |
|------------|-----------------------|
| Features: | 802.11b/g 2.4GHz |
| | Echo cancellation |
| | 4hr battery talk time |
| Protocols: | |
| | SIP v2 |
| | SDP |
| | RTP |
| | G711, G.729a |
| | STUN |

SMC Wi-Fi Phone & FON Router



Image Source: Skype

| | |
|------------|-----------------------|
| Features: | 802.11b/g |
| | WPA/2 w/PSK |
| | 3hr battery talk time |
| Protocols: | |
| | WSKP100 |

Source: Semico Research Corp.

As these phones develop, they will not evolve into their own market, but will instead merge into the cell phone market. Please review Semico's Cell Phone Executive Briefs for an overview of low-end, midrange, and high-end cell phones. This market will outpace the growth in the corded VoIP handset market. These handsets first entered the market in the 4th quarter of 2004.

Table 7: Voice over Wi-Fi Vendors

| |
|---------------|
| Tier 1 |
| Accton |
| UTStarcom |
| D-Link |
| SpectraLink |

Source: Semico Research Corp.

Analog Terminal/Telephone Adaptors

This is the most common and simplest way to connect a phone to the Internet. It is an analog to digital converter, enabling PSTN phones and fax machines to connect to a VoIP system. These are popular in SOHO (Small Office Home Office) applications. Examples of ATAs follow:

Table 8: Illustrative Analog Terminal/Telephone Adaptors

V310ATA VoIP ATA



Image Source: Aztech
Features:

- SOHO
- 1 FXS port
- 1 '10/100
- G.711
- G.726
- G.729a
- SIP
- Echo cancellation
- Jitter provisioning

ATA iAN-02EX



Image Source: UTStarcom
Features:

- SIP
- G.711
- G.726
- G.729a
- Echo cancellation
- 2 RJ-11 FXS ports
- 1 RJ-45

SP400 ATA



Image Source: SignalSys
Features:

- 4 Rj-11
- 1 RJ-45
- SIP
- G.711
- G.729
- G.726
- Echo cancellation

Source: Semico Research Corp.

Table 9: ATA Vendors

| Tier 1 | Tier 2 |
|---------------|---------------|
| Agere | Aztech |
| Motorola | UTStarcom |
| Cisco | Zinwell |
| D-Link | SmartLink |
| | SignalSys |
| | Zoom |
| | Grandstream |

Source: Semico Research Corp.

VoIP Gateways

There are multiple products capable of being a VoIP gateway, including: Switches, softswitches, routers, media gateways, and IP PBXs. As such, this is a general category used by many companies when describing their VoIP solution. Often, to switch to a VoIP system from a PSTN system, a consumer may add one type of gateway to obtain IP capability. For example, if a corporation already uses a circuit switched PBX, they can add a media gateway circuit board to obtain VoIP capability.

Consumer Broadband VoIP

Transfers at a rate of at least 0.2 Mbit/s in one direction and uses a cable or xDSL modem. In the OECD there are about 16 broadband users for every 100 people. When dealing with consumer VoIP it should be taken into account that consumers must download software or purchase separate hardware to obtain a VoIP connection. Although Consumer Broadband VoIP is not the focus of this report, Skype already has over 100 million people using its software.

VoIP Market Analysis

Market Drivers

Mobility: On the enterprise and consumer side mobility is an important factor, creating a need for Voice over WiFi. Users need to be able to travel anywhere in the world and still stay connected to their business at low cost.

Gaming: Multiplayer online games require services for gamers to communicate amongst each other. Some online games have over five million people subscribed. These gamers are increasing the familiarity of this fairly new technology amongst consumers. Examples include Xbox Live, Ventrilo, and TeamSpeak.

Cost – As consumers and enterprises become more global, they continue to look for products that will lower their long distance phone bills. Currently VoIP software can reduce the costs of international calls by 70%.

Barriers to Entry

Delay: FFT (Fast Fourier transform) has helped to create more tolerance towards delay, which is useful to Voice over WiFi. Otherwise delay can cause packet rebuilding issues, distorting conversations.

Jitter: As shown in the product samples, most products come with a jitter buffer that stores voice packets and shifts them to the codec processor to reduce distortion in the sound.

Packet Loss: While audio quality was a concern when VoIP technology was a developing market, currently audio quality may exceed the quality of PSTNs, depending on one's IP connection and location. Currently, the highest quality and reliability is provided by digital cable. ATAs are known to cause frontal clipping since they are voice activated, making the first few sounds lost.

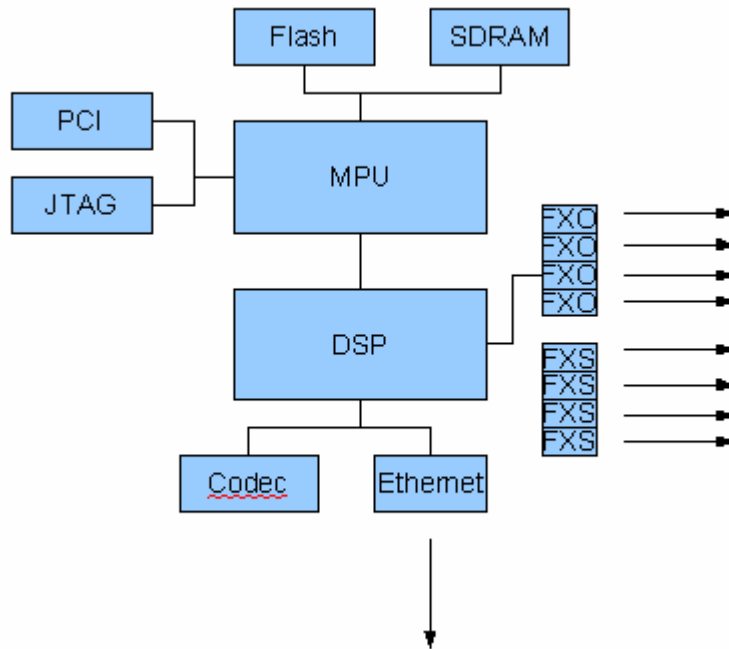
Echo: As shown in the product descriptions most products now come equipped with some form of echo cancellation. Echo can be caused by acoustic feedback, and is similar on both PSTN and VoIP networks; however, due to packet transmission, it is more noticeable on VoIP networks.

Power Outage: With an IP PBX if the power goes out, so too do the phones. This is addressed by Power over Ethernet, IEEE standard 802.3af.

Security: Anonymous dialing, DOS attacks, packing sniffing, restructure voice data, accessing and altering private logs, etc, are all issues that service providers must worry about when conducting secure voice conversations via the net.

Block Diagram

Figure 10: Typical Block Diagram



Source: Semico Research Corp.

VoIP routes voice conversations over Internet Protocol networks. VoIP takes the analog audio signals and turns them into digital data. The main difference between PSTN systems and VoIP systems is circuit switching vs. packet switching. PSTNs use circuit switching, requiring a series of wires, switches and connections that are dedicated for the duration of the call.

Packet switching does not have a dedicated connection throughout the call. Packets enable multiple people to share the same line, meaning millions of packets of different conversations can be transferred at any given moment. An estimated 50 packets transfer per one second of speech.

As shown, the IP PBX system is fairly simplistic, which is why software on a consumer computer can satisfy the same needs as a specialized product. There is also room for many specialized chips to help each vendor obtain a niche.

IP PBX Semiconductors

Codec: The codecs for VoIP determine the quality of decompressed speech, and may have their own dedicated DSP. The most popular codecs are G.723 and G.729.

- G.711 – ITU-T PCM half-duplex codec. Provides high quality and requires low processor power.
- G.723 – ITU-T double rate CELP codec. Provides medium quality and requires high processor power.
- G.726 – ITU-T ADPCM wave form codec. Provides good quality and requires low processor power.
- G.728 – ITU-T low delay CELP codec. Provides medium quality and requires high processor power.
- G.729 – ITU-T ACELP codec. Provides medium quality and requires high processor power.

DSP: Provides codec support, and is responsible for voice quality.

FXO/FXS: Foreign Exchange Office/Foreign Exchange Station. These are the interfaces to connect a VoIP device to a PSTN device. This includes any analog PBX extension, phones, and faxes.

MPU: Handles the application processing freeing up the DSP for voice quality.

PCI: PCI Slots are the standard means of updating IP PBXs.

Other Potential IP PBX Features

DMA (Direct Memory Access): Speeds up memory transfer, freeing up the MPU & DSP.

GPIO (General Purpose Input/Output): GPIOs can be a cheaper solution than an MCU to support serial buses.

SSP (Service Switching Point): Used by hybrid IP PBXs to generate PSTN messages to the network.

UART (Universal Asynchronous Receiver-Transmitter): Conducts parallel to serial conversion for digital data.

Roadmap

Over time, the VoIP market is drifting to a software-based industry such that software will continually outpace the need for new hardware. As consumers purchase more powerful computers it is an easy thing to install a software PBX system such as Asterix and turn their computer into an IP PBX. This enables consumers and corporations alike to host their own VoIP services. The only other thing they require outside of their own hardware is constant broadband access.

This does not mean that there will not be a hardware future for the VoIP market. For the consumer market this means a future of VoIP enabled cell phones, or Voice over WiFi, as well as VoIP enabled routers and ATAs. For the enterprise market IP PBXs will continue to be implemented for years to come, as well as VoIP enabled gateways, desk phones and Voice over WiFi phones.

The market is looking for greater performance, faster performance, greater density, lower power consumption, better heat dissipation, and lower cost.

MAP Model

The following tables are taken from the Semico MAP Model, Semico's online database containing production regional forecast, BOM, ASP, TAM, and Wafer Demand. Purchase of this report is combined with one year's access to all updates within the MAP Model on the VoIP market. Please call for details.

Table 10: IP PBX World Market Forecast

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| Units | 1.8 | 3.2 | 5.8 | 8.2 | 11.6 | 13.6 | 16 | 17.9 |
| % Change | 80.00% | 79.40% | 80.50% | 40.50% | 42.00% | 16.60% | 17.80% | 12.00% |
| Revenue | \$356 | \$615 | \$1,099 | \$1,524 | \$2,176 | \$2,467 | \$2,893 | \$3,237 |
| % Change | 62.70% | 72.70% | 78.80% | 38.70% | 42.70% | 13.40% | 17.30% | 11.90% |
| OEM ASP | \$197.77 | \$190.28 | \$188.54 | \$186.14 | \$187.08 | \$181.97 | \$181.06 | \$180.94 |
| % Change | -9.50% | -3.70% | -0.80% | -1.20% | 0.50% | -2.60% | -0.40% | 0.00% |

Source: Semico MAP Model

Table 11: IP PBX Regional Manufacturing Market Forecast

| VoIP PBX (Americas) | | | | | | | | |
|--------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| Units | 0.2 | 0.2 | 0.3 | 0.3 | 0.3 | 0.5 | 0.5 | 0.5 |
| % Change | 40.00% | 9.50% | 30.40% | 3.30% | 9.70% | 38.20% | 2.10% | 11.80% |
| Revenue | \$42 | \$45 | \$58 | \$59 | \$66 | \$88 | \$90 | \$94 |
| % Change | 27.40% | 6.00% | 30.00% | 2.00% | 10.20% | 34.50% | 1.60% | 4.80% |
| VoIP PBX (Asia Pacific) | | | | | | | | |
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| Units | 0.8 | 1.5 | 2.5 | 3.9 | 5.8 | 6.8 | 8 | 9.1 |
| % Change | 129.40% | 85.90% | 73.10% | 55.00% | 49.40% | 16.90% | 17.70% | 14.00% |
| Revenue | \$154 | \$277 | \$477 | \$730 | \$1,096 | \$1,246 | \$1,459 | \$1,677 |
| % Change | 108.80% | 79.90% | 72.50% | 53.00% | 50.10% | 13.70% | 17.10% | 14.90% |
| VoIP PBX (China) | | | | | | | | |
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| Units | 0.5 | 1.2 | 2.6 | 3.5 | 4.9 | 5.6 | 6.8 | 7.5 |
| % Change | 96.30% | 120.80% | 118.80% | 34.80% | 41.70% | 14.90% | 20.60% | 10.80% |
| Revenue | \$101 | \$216 | \$470 | \$626 | \$891 | \$997 | \$1,196 | \$1,327 |
| % Change | 78.70% | 113.60% | 118.00% | 33.10% | 42.50% | 11.80% | 20.00% | 10.90% |
| VoIP PBX (Europe) | | | | | | | | |
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| Units | 0.1 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| % Change | 9.10% | 25.00% | 13.30% | 11.80% | 5.30% | 15.00% | -4.20% | -10.50% |
| Revenue | \$25 | \$31 | \$35 | \$38 | \$40 | \$45 | \$43 | \$36 |
| % Change | -0.60% | 21.00% | 12.90% | 10.30% | 5.80% | 11.90% | -4.70% | -16.90% |
| VoIP PBX (Japan) | | | | | | | | |
| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
| Units | 0.2 | 0.2 | 0.3 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 |
| % Change | 23.10% | 43.80% | 26.10% | 20.70% | 11.40% | 15.40% | 13.30% | 5.20% |
| Revenue | \$34 | \$47 | \$59 | \$70 | \$78 | \$88 | \$99 | \$104 |
| % Change | 12.00% | 39.10% | 25.60% | 19.20% | 12.00% | 12.20% | 12.80% | 4.50% |

Source: Semico MAP Model

Table 12: VoIP Bill of Materials Roadmap

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|------|------|------|------|------|------|------|------|
| Discretes - Diodes and Small Signal Transistors | 63.8 | 64.5 | 54.1 | 53.6 | 54.6 | 52.1 | 52.8 | 53 |
| Discretes - Power Transistors, Rectifiers, Thyristors, Other | 4 | 4.5 | 4.3 | 4.3 | 4.3 | 4.2 | 4.2 | 4.3 |
| Optoelectronics - Lamps | 2.5 | 2.5 | 2 | 1.9 | 1.9 | 1.7 | 1.7 | 1.8 |
| Analog - Standard Linear | 6 | 7.2 | 5.7 | 5.5 | 5 | 4.6 | 4.6 | 4.5 |
| Analog - Interface | 5.1 | 5.2 | 9 | 9.5 | 9.5 | 10.6 | 10.6 | 10.5 |
| Analog - Voltage Regulators and Reference Circuits | 2.5 | 2.5 | 2.9 | 3 | 3.1 | 3.2 | 3.2 | 3.3 |
| Analog - Data Conversion Circuits | 1.5 | 1.5 | 1.9 | 2 | 2.1 | 2.2 | 2.2 | 2.3 |
| Analog - Application Specific Analog ICs (Small Scale Complexity) | 0.5 | 0.5 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| Analog - Application Specific Analog ICs (Medium Scale Complexity) | 0.5 | 0.5 | 0.3 | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 |
| MOS Micrologic (Computing MPU) - 64-bit, Desktop PC | 0 | 0 | 0.7 | 0.8 | 0.8 | 1 | 1 | 1 |
| MOS Micrologic (Embedded MPU) - 32-bit | 0.2 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| 32-bit, Communication | 0.5 | 0.5 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| DSP, Wired Communication | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| MOS General Purpose Logic | 3.5 | 3.5 | 3.4 | 3.4 | 3.3 | 3.3 | 3.3 | 3.3 |
| Standard Cells <= 2 Million Gates | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| MPRs - Computer, Computer | 1.5 | 1.5 | 1.1 | 1 | 0.9 | 0.8 | 0.8 | 0.8 |
| MPRs - Computer, Systems Support | 0.5 | 0.5 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| MPRs - Computer, I/O Interface | 11 | 11.1 | 7.5 | 6.9 | 6.5 | 5.5 | 5.5 | 5.5 |
| MPRs - Communications, Wireless Infrastructure | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| MPRs - Communications, Wired | 0.5 | 0.5 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 |
| DRAM (DDR SDRAM) - 128Mbit | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 256Mbit | 2 | 2.1 | 0 | 0 | 0 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 512Mbit | 0 | 0 | 2.3 | 2.2 | 1.8 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 1Gbit | 0 | 0 | 0 | 0 | 0 | 0.5 | 0.5 | 0.5 |
| DRAM (DDR2 SDRAM) - 128Mbit | 0 | 0.9 | 1.5 | 0.4 | 0 | 0 | 0 | 0 |
| DRAM (DDR2 SDRAM) - 256Mbit | 0 | 0 | 0 | 0.5 | 1.6 | 1.4 | 1.5 | 1.5 |
| Flash (NOR) - 4M | 0.5 | 0.5 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | 0.8 |
| Flash (NOR) - 16M | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flash (NOR) - 32M | 0 | 1.1 | 1.6 | 1.5 | 0 | 0 | 0 | 0 |
| Flash (NOR) - 64M | 0 | 0 | 0 | 0 | 0.6 | 0.5 | 0.5 | 0.5 |

Source: Semico MAP Model

Table 13: VoIP Semiconductor Content ASP Forecast in US Dollars

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|---------|---------|---------|---------|---------|---------|---------|---------|
| Discretes - Diodes and Small Signal Transistors | \$1.30 | \$1.21 | \$1.03 | \$0.97 | \$0.96 | \$0.94 | \$0.90 | \$0.87 |
| Discretes - Power Transistors, Rectifiers, Thyristors, Other | \$0.57 | \$0.64 | \$0.58 | \$0.54 | \$0.59 | \$0.53 | \$0.52 | \$0.51 |
| Optoelectronics - Lamps | \$0.23 | \$0.22 | \$0.16 | \$0.12 | \$0.13 | \$0.11 | \$0.11 | \$0.10 |
| Analog - Standard Linear | \$2.10 | \$2.29 | \$1.78 | \$1.63 | \$1.47 | \$1.30 | \$1.27 | \$1.23 |
| Analog - Interface | \$2.37 | \$2.45 | \$4.09 | \$3.78 | \$3.65 | \$3.52 | \$3.33 | \$3.20 |
| Analog - Voltage Regulators and Reference Circuits | \$0.73 | \$0.67 | \$0.78 | \$0.77 | \$0.77 | \$0.73 | \$0.72 | \$0.70 |
| Analog - Data Conversion Circuits | \$2.48 | \$2.37 | \$3.04 | \$2.78 | \$2.96 | \$2.89 | \$2.84 | \$2.80 |
| Analog - Application Specific Analog ICs (Small Scale Complexity) | \$0.36 | \$0.36 | \$0.26 | \$0.24 | \$0.20 | \$0.18 | \$0.17 | \$0.16 |
| Analog - Application Specific Analog ICs (Medium Scale Complexity) | \$0.53 | \$0.49 | \$0.29 | \$0.26 | \$0.30 | \$0.23 | \$0.24 | \$0.25 |
| MOS Micrologic (Computing MPU) - 64-bit, Desktop PC | \$0.00 | \$0.00 | \$91.65 | \$73.33 | \$70.09 | \$88.53 | \$89.85 | \$88.06 |
| MOS Micrologic (Embedded MPU) - 32-bit | \$6.28 | \$5.93 | \$3.69 | \$1.73 | \$1.37 | \$0.97 | \$0.97 | \$0.99 |
| MOS Micrologic (MCU) - 32-bit, Communication | \$3.09 | \$2.29 | \$2.26 | \$1.98 | \$2.13 | \$1.90 | \$1.77 | \$1.49 |
| MOS Micrologic (DSP) - DSP, Wired Communication | \$9.53 | \$11.23 | \$11.91 | \$11.54 | \$10.05 | \$10.92 | \$9.91 | \$9.63 |
| MOS General Purpose Logic | \$0.34 | \$0.34 | \$0.32 | \$0.31 | \$0.32 | \$0.36 | \$0.29 | \$0.33 |
| Standard Cells <= 2 Million Gates | \$1.94 | \$2.79 | \$3.36 | \$3.03 | \$3.98 | \$4.05 | \$4.14 | \$4.20 |
| MPRs - Computer, Computer | \$3.30 | \$6.36 | \$3.25 | \$2.72 | \$2.31 | \$2.00 | \$1.92 | \$1.84 |
| MPRs - Computer, Systems Support | \$6.31 | \$5.51 | \$3.29 | \$3.05 | \$2.34 | \$2.11 | \$1.97 | \$1.84 |
| MPRs - Computer, I/O Interface | \$33.17 | \$30.80 | \$26.62 | \$24.76 | \$22.26 | \$18.59 | \$18.99 | \$19.39 |
| MPRs - Communications, Wireless Infrastructure | \$1.74 | \$2.32 | \$2.31 | \$2.78 | \$2.27 | \$2.14 | \$2.03 | \$1.90 |
| MPRs - Communications, Wired | \$2.77 | \$3.64 | \$2.95 | \$2.77 | \$2.25 | \$2.07 | \$1.86 | \$1.69 |
| DRAM (DDR SDRAM) - 128Mbit | \$1.65 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| DRAM (DDR SDRAM) - 256Mbit | \$9.65 | \$6.40 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| DRAM (DDR SDRAM) - 512Mbit | \$0.00 | \$0.00 | \$12.99 | \$9.58 | \$5.25 | \$0.00 | \$0.00 | \$0.00 |
| DRAM (DDR SDRAM) - 1Gbit | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$2.69 | \$1.71 | \$1.25 |
| DRAM (DDR2 SDRAM) - 128Mbit | \$0.00 | \$2.34 | \$3.14 | \$0.63 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| DRAM (DDR2 SDRAM) - 256Mbit | \$0.00 | \$0.00 | \$0.00 | \$1.09 | \$2.63 | \$2.14 | \$2.04 | \$1.95 |
| Flash (NOR) - 4M | \$0.53 | \$0.37 | \$0.40 | \$0.36 | \$0.35 | \$0.33 | \$0.24 | \$0.21 |
| Flash (NOR) - 16M | \$0.86 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Flash (NOR) - 32M | \$0.00 | \$1.82 | \$2.03 | \$1.73 | \$0.00 | \$0.00 | \$0.00 | \$0.00 |
| Flash (NOR) - 64M | \$0.00 | \$0.00 | \$0.00 | \$0.00 | \$1.01 | \$0.56 | \$0.39 | \$0.26 |

Source: Semico MAP Model

Table 14: VoIP Semiconductor Total Available Market (Units in Millions)

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|-------|-------|-------|-------|------|-------|-------|-------|
| Discretes - Diodes and Small Signal Transistors | 114.9 | 208.2 | 315.5 | 439.3 | 635 | 706.5 | 843.7 | 948.2 |
| Discretes - Power Transistors, Rectifiers, Thyristors, Other | 7.2 | 14.4 | 25 | 34.8 | 49.9 | 57.4 | 67.8 | 76 |
| Optoelectronics - Lamps | 4.5 | 8 | 11.4 | 15.3 | 21.9 | 23.5 | 27.8 | 31.3 |
| Analog - Standard Linear | 10.9 | 23.2 | 33.1 | 44.7 | 57.9 | 62.6 | 72.9 | 80.5 |
| Analog - Interface | 9.1 | 16.7 | 52.2 | 78.1 | 111 | 144 | 168.7 | 187.8 |
| Analog - Voltage Regulators and Reference Circuits | 4.5 | 8 | 17.1 | 24.7 | 36.2 | 43.8 | 51.8 | 58.1 |
| Analog - Data Conversion Circuits | 2.7 | 4.7 | 11.3 | 16.5 | 24.5 | 30.2 | 35.8 | 40.3 |
| Analog - Application Specific Analog ICs (Small Scale Complexity) | 0.9 | 1.7 | 2.3 | 3 | 3.5 | 3.7 | 4.2 | 4.5 |
| Analog - Application Specific Analog ICs (Medium Scale Complexity) | 0.9 | 1.5 | 1.6 | 2 | 3.4 | 3.1 | 3.8 | 4.5 |
| MOS Micrologic (Computing MPU) - 64-bit, Desktop PC | 0 | 0 | 3.8 | 6.2 | 9.5 | 13.6 | 16 | 17.9 |
| MOS Micrologic (Embedded MPU) - 32-bit | 0.4 | 0.8 | 0.8 | 1 | 1.7 | 1.6 | 1.9 | 2.2 |
| MOS Micrologic (MCU) - 32-bit, Communication | 0.9 | 1.7 | 2.3 | 3 | 3.5 | 3.7 | 4.2 | 4.5 |
| MOS Micrologic (DSP) - DSP, Wired Communication | 1.8 | 3.2 | 5.8 | 8.2 | 11.6 | 13.6 | 16 | 17.9 |
| MOS General Purpose Logic | 6.3 | 11.4 | 19.8 | 27.6 | 38.4 | 44.3 | 52.1 | 58.1 |
| Standard Cells <= 2 Million Gates | 0.6 | 1.1 | 2.1 | 3 | 4.7 | 5.6 | 6.7 | 7.6 |
| MPRs - Computer, Computer | 2.7 | 4.9 | 6.2 | 8.1 | 10.4 | 10.4 | 12.1 | 13.4 |
| MPRs - Computer, Systems Support | 0.9 | 1.7 | 2.3 | 3 | 3.5 | 3.7 | 4.2 | 4.5 |
| MPRs - Computer, I/O Interface | 19.8 | 35.7 | 43.6 | 56.8 | 75.6 | 75.1 | 88.2 | 98.4 |
| MPRs - Communications, Wireless Infrastructure | 0.2 | 0.4 | 0.7 | 1.2 | 1.4 | 1.5 | 1.7 | 1.8 |
| MPRs - Communications, Wired | 0.9 | 1.7 | 2.3 | 3 | 3.5 | 3.7 | 4.2 | 4.5 |
| DRAM (DDR SDRAM) - 128Mbit | 0.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 256Mbit | 3.7 | 6.8 | 0 | 0 | 0 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 512Mbit | 0 | 0 | 13.6 | 18.2 | 20.9 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 1Gbit | 0 | 0 | 0 | 0 | 0 | 7.3 | 8.3 | 8.9 |
| DRAM (DDR2 SDRAM) - 128Mbit | 0 | 3 | 8.5 | 3.1 | 0 | 0 | 0 | 0 |
| DRAM (DDR2 SDRAM) - 256Mbit | 0 | 0 | 0 | 4.1 | 18.3 | 19.3 | 23.3 | 26.8 |
| Flash (NOR) - 4M | 0.9 | 1.5 | 3.6 | 5.2 | 8.1 | 9.9 | 11.8 | 13.4 |
| Flash (NOR) - 16M | 0.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flash (NOR) - 32M | 0 | 3.4 | 9.1 | 12.1 | 0 | 0 | 0 | 0 |
| Flash (NOR) - 64M | 0 | 0 | 0 | 0 | 7 | 7.3 | 8.3 | 8.9 |

Source: Semico MAP Model

Table 15: VoIP Semiconductor Total Available Market (Revenue in \$US Millions)

| | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|---|------|------|-----------|-----------|-----------|-------------|-------------|-------------|
| Discretes - Diodes and Small Signal Transistors | \$2 | \$4 | \$6 | \$8 | \$11 | \$13 | \$14 | \$16 |
| Discretes - Power Transistors, Rectifiers, Thyristors, Other | \$1 | \$2 | \$3 | \$4 | \$7 | \$7 | \$8 | \$9 |
| Optoelectronics - Lamps | \$0 | \$1 | \$1 | \$1 | \$1 | \$2 | \$2 | \$2 |
| Analog - Standard Linear | \$4 | \$7 | \$10 | \$13 | \$17 | \$18 | \$20 | \$22 |
| Analog - Interface | \$4 | \$8 | \$24 | \$31 | \$42 | \$48 | \$53 | \$57 |
| Analog - Voltage Regulators and Reference Circuits | \$1 | \$2 | \$5 | \$6 | \$9 | \$10 | \$11 | \$12 |
| Analog - Data Conversion Circuits | \$4 | \$8 | \$18 | \$23 | \$34 | \$39 | \$45 | \$50 |
| Analog - Application Specific Analog ICs (Small Scale Complexity) | \$1 | \$1 | \$2 | \$2 | \$2 | \$2 | \$3 | \$3 |
| Analog - Application Specific Analog ICs (Medium Scale Complexity) | \$1 | \$2 | \$2 | \$2 | \$3 | \$3 | \$4 | \$5 |
| MOS Micrologic (Computing MPU) - 64-bit, Desktop PC | \$0 | \$0 | \$53 4 | \$60 1 | \$81 5 | \$1,2 00 | \$1,4 36 | \$1,5 75 |
| MOS Micrologic (Embedded MPU) - 32-bit | \$11 | \$19 | \$22 | \$14 | \$16 | \$13 | \$16 | \$18 |
| MOS Micrologic (MCU) - 32-bit, Communication | \$6 | \$7 | \$13 | \$16 | \$25 | \$26 | \$28 | \$27 |
| MOS Micrologic (DSP) - DSP, Wired Communication | \$17 | \$36 | \$69 | \$95 | \$11 7 | \$14 8 | \$15 8 | \$17 2 |
| MOS Logic (MOS Logic) - MOS General Purpose Logic | \$1 | \$1 | \$2 | \$3 | \$4 | \$5 | \$5 | \$6 |
| MOS Logic (MOS Logic) - Standard Cells <= 2 Million Gates | \$3 | \$9 | \$20 | \$25 | \$46 | \$55 | \$66 | \$75 |
| MOS Logic (MOS Logic) - MPRs - Computer, Computer | \$6 | \$21 | \$19 | \$22 | \$27 | \$27 | \$31 | \$33 |
| MOS Logic (MOS Logic) - MPRs - Computer, Systems Support | \$11 | \$18 | \$19 | \$25 | \$27 | \$29 | \$31 | \$33 |
| MOS Logic (MOS Logic) - MPRs - Computer, I/O Interface | \$60 | \$99 | \$15 5 | \$20 3 | \$25 9 | \$25 2 | \$30 3 | \$34 7 |
| MOS Logic (MOS Logic) - MPRs - Communications, Wireless Infrastructure | \$3 | \$7 | \$13 | \$23 | \$26 | \$29 | \$32 | \$34 |
| MOS Logic (MOS Logic) - MPRs - Communications, Wired | \$5 | \$12 | \$17 | \$23 | \$26 | \$28 | \$30 | \$30 |
| DRAM (DDR SDRAM) - 128Mbit | \$3 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| DRAM (DDR SDRAM) - 256Mbit | \$17 | \$21 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| DRAM (DDR SDRAM) - 512Mbit | \$0 | \$0 | \$76 | \$79 | \$61 | \$0 | \$0 | \$0 |
| DRAM (DDR SDRAM) - 1Gbit | \$0 | \$0 | \$0 | \$0 | \$0 | \$36 | \$27 | \$22 |
| DRAM (DDR2 SDRAM) - 128Mbit | \$0 | \$8 | \$18 | \$5 | \$0 | \$0 | \$0 | \$0 |
| DRAM (DDR2 SDRAM) - 256Mbit | \$0 | \$0 | \$0 | \$9 | \$31 | \$29 | \$33 | \$35 |
| Flash (NOR) - 4M | \$1 | \$1 | \$2 | \$3 | \$4 | \$4 | \$4 | \$4 |
| Flash (NOR) - 16M | \$2 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 | \$0 |
| Flash (NOR) - 32M | \$0 | \$6 | \$12 | \$14 | \$0 | \$0 | \$0 | \$0 |
| Flash (NOR) - 64M | \$0 | \$0 | \$0 | \$0 | \$12 | \$8 | \$6 | \$5 |

Source: Semico MAP Model

Table 16: VoIP Semiconductor Wafer Demand (Wafers in Thousands)

| Semiconductor Device Type | Tech. Node | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|--|------------|------|------|------|------|------|-------|-------|-------|
| Discretes - Diodes and Small Signal Transistors | 1 | 5.1 | 9.3 | 14.1 | 19.6 | 28.4 | 31.6 | 37.7 | 42.4 |
| Discretes - Power Transistors, Rectifiers, Thyristors, Other | 0.8 | 2.6 | 5.1 | 8.9 | 12.3 | 17.7 | 20.3 | 24 | 27 |
| Optoelectronics - Lamps | 0.25 | 0.2 | 0.4 | 0.5 | 0.7 | 1 | 1 | 1.2 | 1.4 |
| Analog - Standard Linear | 2 | 2.3 | 4.9 | 7 | 9.4 | 12.2 | 13.2 | 15.3 | 16.9 |
| Analog - Interface | 1 | 2 | 3.7 | 11.5 | 17.1 | 24.4 | 31.6 | 37 | 41.2 |
| Analog - Voltage Regulators and Reference Circuits | 0.8 | 0.3 | 0.6 | 1.2 | 1.8 | 2.6 | 3.2 | 3.7 | 4.2 |
| Analog - Data Conversion Circuits | 0.25 | 2.2 | 4 | 9.4 | 13.7 | 20.4 | 25.2 | 29.8 | 33.5 |
| Analog - Application Specific Analog ICs (Small Scale Complexity) | 0.5 | 0.4 | 0.7 | 0.9 | 0 | 0 | 0 | 0 | 0 |
| Analog - Application Specific Analog ICs (Small Scale Complexity) | 0.35 | 0 | 0 | 0 | 1.2 | 1.4 | 0 | 0 | 0 |
| Analog - Application Specific Analog ICs (Small Scale Complexity) | 0.25 | 0 | 0 | 0 | 0 | 0 | 1.5 | 1.7 | 1.8 |
| Analog - Application Specific Analog ICs (Medium Scale Complexity) | 0.35 | 0.7 | 1.2 | 1.3 | 0 | 0 | 0 | 0 | 0 |
| Analog - Application Specific Analog ICs (Medium Scale Complexity) | 0.25 | 0 | 0 | 0 | 1.7 | 0 | 0 | 0 | 0 |
| Analog - Application Specific Analog ICs (Medium Scale Complexity) | 0.18 | 0 | 0 | 0 | 0 | 2.8 | 2.5 | 3.1 | 3.6 |
| MOS Micrologic (Computing MPU) - 64-bit, Desktop PC | 0.065 | 0 | 0 | 35.3 | 57.1 | 0 | 0 | 0 | 0 |
| MOS Micrologic (Computing MPU) - 64-bit, Desktop PC | 0.045 | 0 | 0 | 0 | 0 | 87.5 | 124.5 | 0 | 0 |
| MOS Micrologic (Computing MPU) - 64-bit, Desktop PC | 0.032 | 0 | 0 | 0 | 0 | 0 | 0 | 146.7 | 164.2 |
| (Embedded MPU) - 32-bit | 0.13 | 1.4 | 2.5 | 0 | 0 | 0 | 0 | 0 | 0 |
| (Embedded MPU) - 32-bit | 0.09 | 0 | 0 | 2.6 | 3.3 | 0 | 0 | 0 | 0 |
| (Embedded MPU) - 32-bit | 0.065 | 0 | 0 | 0 | 0 | 5.5 | 5 | 0 | 0 |
| (Embedded MPU) - 32-bit | 0.045 | 0 | 0 | 0 | 0 | 0 | 0 | 6.8 | 8 |
| (MCU) - 32-bit, Communication | 0.18 | 2.8 | 5.7 | 0 | 0 | 0 | 0 | 0 | 0 |
| (MCU) - 32-bit, Communication | 0.13 | 0 | 0 | 7.3 | 9.1 | 9.9 | 0 | 0 | 0 |
| (MCU) - 32-bit, Communication | 0.09 | 0 | 0 | 0 | 0 | 0 | 9.9 | 11.2 | 12.1 |
| (DSP) - DSP, Wired Communication | 0.13 | 5.7 | 10.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| (DSP) - DSP, Wired Communication | 0.09 | 0 | 0 | 18.5 | 27.5 | 0 | 0 | 0 | 0 |
| (DSP) - DSP, Wired Communication | 0.065 | 0 | 0 | 0 | 0 | 36.8 | 42.9 | 53.6 | 60 |

Source: Semico MAP Model

Table 16: VoIP Semiconductor Wafer Demand (Wafers in Thousands) Continued

| Semiconductor Device Type | Tech. Node | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 |
|--|------------|------|------|------|------|------|------|-------|-------|
| MOS General Purpose Logic | 1 | 1.4 | 2.5 | 4.3 | 6 | 8.3 | 9.6 | 11.3 | 12.6 |
| Standard Cells <= 2 Million Gates | 0.25 | 0.8 | 1.4 | 0 | 0 | 0 | 0 | 0 | 0 |
| Standard Cells <= 2 Million Gates | 0.18 | 0 | 0 | 2.2 | 3.1 | 0 | 0 | 0 | 0 |
| Standard Cells <= 2 Million Gates | 0.13 | 0 | 0 | 0 | 0 | 4.3 | 5 | 0 | 0 |
| Standard Cells <= 2 Million Gates | 0.09 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6.8 |
| MPRs - Computer, Computer | 0.18 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MPRs - Computer, Computer | 0.13 | 0 | 12.2 | 12.3 | 0 | 0 | 0 | 0 | 0 |
| MPRs - Computer, Computer | 0.09 | 0 | 0 | 0 | 12.4 | 10.9 | 11 | 0 | 0 |
| MPRs - Computer, Computer | 0.065 | 0 | 0 | 0 | 0 | 0 | 0 | 12.8 | 14.1 |
| MPRs - Computer, Systems Support | 0.13 | 3.4 | 6.3 | 0 | 0 | 0 | 0 | 0 | 0 |
| MPRs - Computer, Systems Support | 0.09 | 0 | 0 | 8.4 | 11.1 | 0 | 0 | 0 | 0 |
| MPRs - Computer, Systems Support | 0.065 | 0 | 0 | 0 | 0 | 12.5 | 13.2 | 0 | 0 |
| MPRs - Computer, Systems Support | 0.045 | 0 | 0 | 0 | 0 | 0 | 0 | 14.9 | 16.1 |
| MPRs - Computer, I/O Interface | 0.18 | 25.8 | 46.5 | 56.8 | 0 | 0 | 0 | 0 | 0 |
| MPRs - Computer, I/O Interface | 0.13 | 0 | 0 | 0 | 74.1 | 96.2 | 95.6 | 112.2 | 125.2 |
| MPRs - Communications, Wireless Infrastructure | 0.13 | 1 | 1.8 | 0 | 0 | 0 | 0 | 0 | 0 |
| MPRs - Communications, Wireless Infrastructure | 0.09 | 0 | 0 | 2.8 | 5.1 | 0 | 0 | 0 | 0 |
| MPRs - Communications, Wireless Infrastructure | 0.065 | 0 | 0 | 0 | 0 | 5.7 | 6 | 6.8 | 7.3 |
| MPRs - Communications, Wired | 0.25 | 2.9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| MPRs - Communications, Wired | 0.18 | 0 | 5.3 | 7.1 | 0 | 0 | 0 | 0 | 0 |
| MPRs - Communications, Wired | 0.13 | 0 | 0 | 0 | 9.4 | 10.9 | 0 | 0 | 0 |
| MPRs - Communications, Wired | 0.09 | 0 | 0 | 0 | 0 | 0 | 11.4 | 12.9 | 13.9 |
| DRAM (DDR SDRAM) - 128Mbit | 0.13 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 256Mbit | 0.13 | 8.7 | 16.2 | 0 | 0 | 0 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 512Mbit | 0.09 | 0 | 0 | 37.2 | 0 | 0 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 512Mbit | 0.065 | 0 | 0 | 0 | 28.8 | 33.2 | 0 | 0 | 0 |
| DRAM (DDR SDRAM) - 1Gbit | 0.045 | 0 | 0 | 0 | 0 | 0 | 14.4 | 16.2 | 17.4 |
| DRAM (DDR2 SDRAM) - 128Mbit | 0.13 | 0 | 3.4 | 9.4 | 2.3 | 0 | 0 | 0 | 0 |
| DRAM (DDR2 SDRAM) - 256Mbit | 0.065 | 0 | 0 | 0 | 3.2 | 14.5 | 15.3 | 18.5 | 21.3 |
| Flash (NOR) - 4M | 0.25 | 0.7 | 1.1 | 2 | 2.9 | 4.5 | 5.5 | 6.6 | 7.4 |
| Flash (NOR) - 16M | 0.18 | 1.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flash (NOR) - 32M | 0.18 | 0 | 5.6 | 0 | 0 | 0 | 0 | 0 | 0 |
| Flash (NOR) - 32M | 0.13 | 0 | 0 | 12.2 | 16.2 | 0 | 0 | 0 | 0 |
| Flash (NOR) - 64M | 0.13 | 0 | 0 | 0 | 0 | 15 | 15.8 | 17.9 | 19.3 |

Source: Semico MAP Model