

AKA Embedded 沙龙

后PC时代的嵌入式应用

Embedded Applications for Post-PC Era

谭军

ARM 中国总裁

清华大学，2003年10月26日 北京。

ARM

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内容提议

- 1. 后PC时代的到来
 - Post-PC Era resulted from Moore's Law
 - 后PC时代: the 3rd Era of Computing
 - The Era for Embedded Systems
- 2. 嵌入式技术和市场需求的趋势分析
 - It is a wonderful new world
- 3. 嵌入式系统在医疗/医学/生物仪器产品中的应用
 - Values: Software & Applications
- 4. ARM在嵌入式中的应用
 - 公司简介
 - ARM知识平台
- 5. 问答

后PC时代的到来 (The arrive of Post-PC Era)

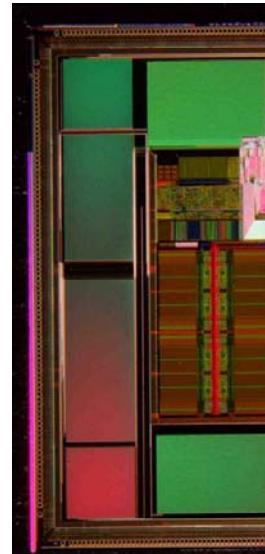


ARM

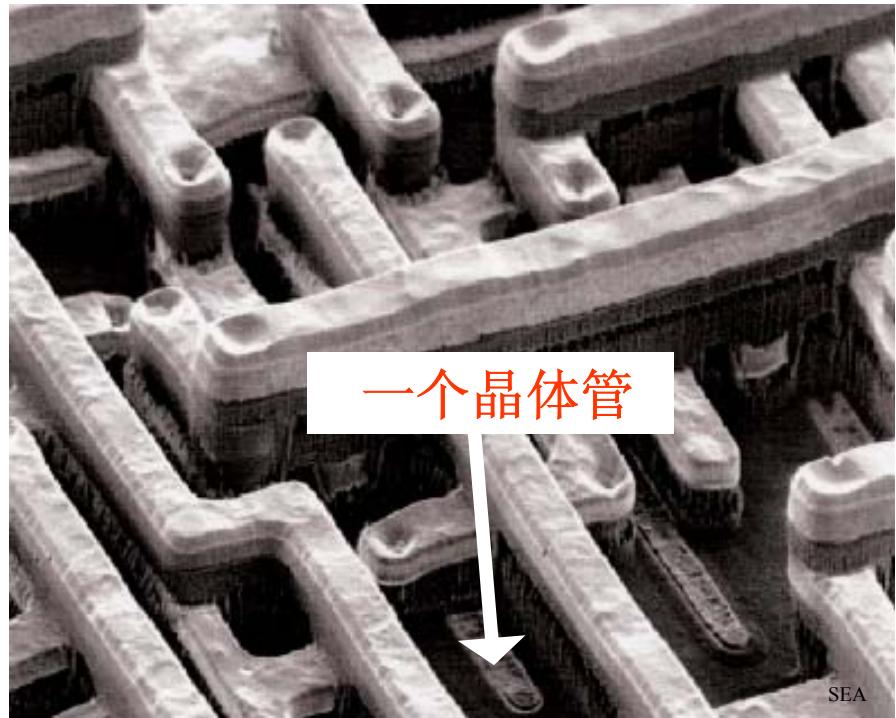
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CMOS技术



SEMATECH



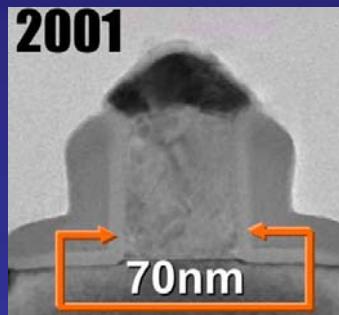
SEA

硅芯片加工工艺发展

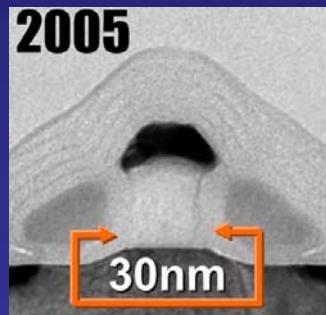
- 10亿个晶体管、 0.01μ 加工工艺
- 远紫外（EUV）技术

“随着科技的进步，我们已经开始谈论如何向 0.01μ 工艺进军了。”

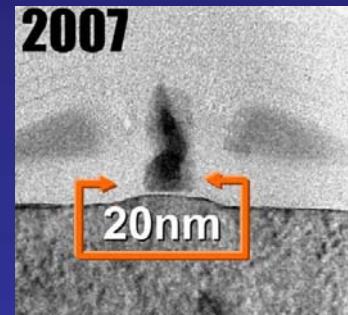
2002年2月28日，英特尔开发者研讨会上首席技术官
Patrick Gelsinger先生评论。



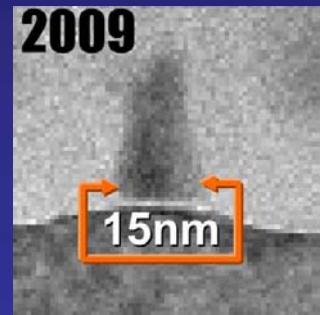
0.13μ process



65nm process



45nm process



32nm process

Source: Intel

See ... ARM7TDMI 'System-Chip'

A Commercial GSM Base-Band Processor Chip

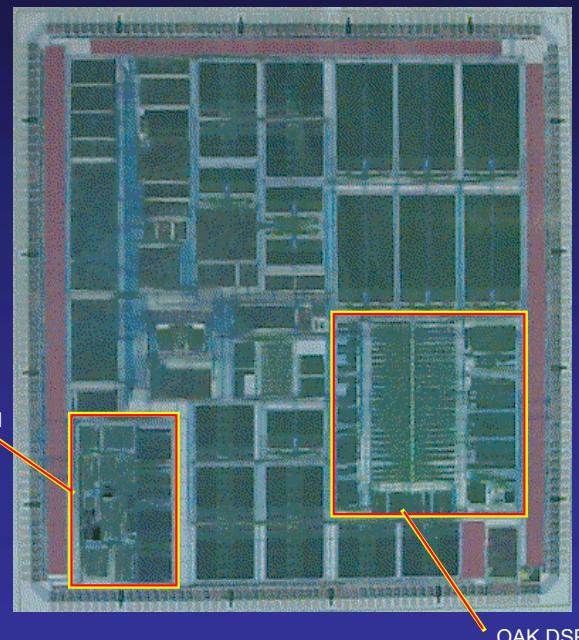
System-Level Integration (Dataquest '95)

- A Compute engine
- 100k used gates
- Significant on-chip memory

GSM Base-band Processor (circa '96)

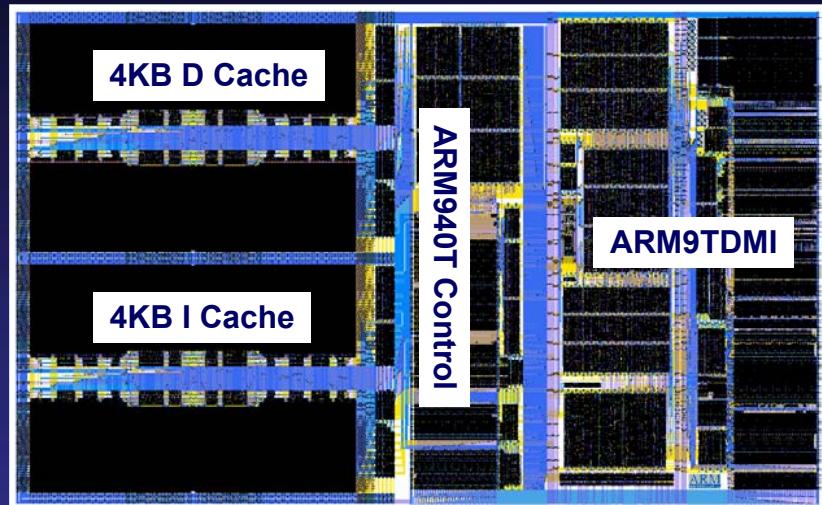
- Two Compute Engines (ARM & OAK)
- ~ 400k gates
- ~100 kB on-chip memory

... A 'full-chip' on 0.5u (~9x9 mm)



See ... ARM940T Macrocell

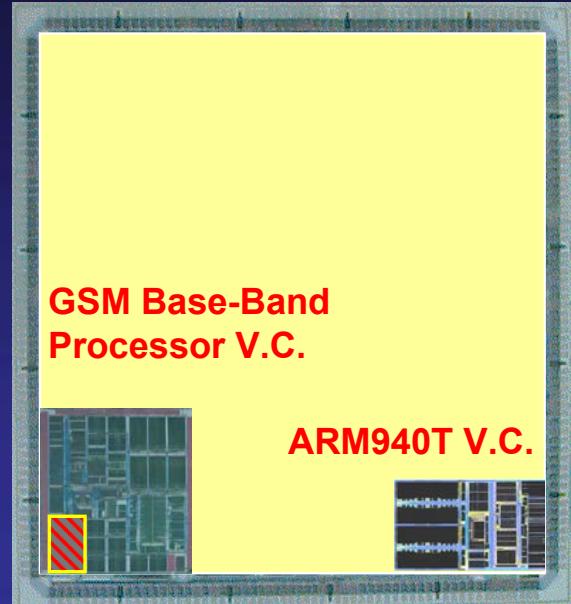
- ARM9TDMI Harvard Architecture, CPU Core
- 2x4KB Harvard Cache with lock-down
- AMBA on-chip-bus interface
- ~240MIP at 200MHz
- Memory protection unit
- ARM/Thumb instruction set
- EmbeddedICE debug support



~ 8 mm² on 0.25u ...

Believe ... The System on Silicon!

- The regular 100M ($0.10\text{-}0.12\mu$) transistor IC is here ...
 - 1Btr by 2007!
- Systems implemented out of *Components and Sub-Systems*.
- A *Functional alloys of HW & SW* not just hardware (logic/memory)
- An incredible design challenge using today's methods and tools



... Lead players face System-Level design today!

Latest Product Examples



NEC 3G Phone



Siemens MC60



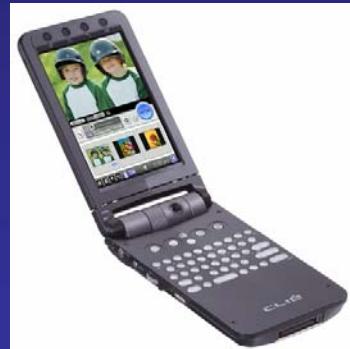
Palm Tungsten



Lipman POS terminal



Compaq h1930



Sony Clie PEG-NX80V

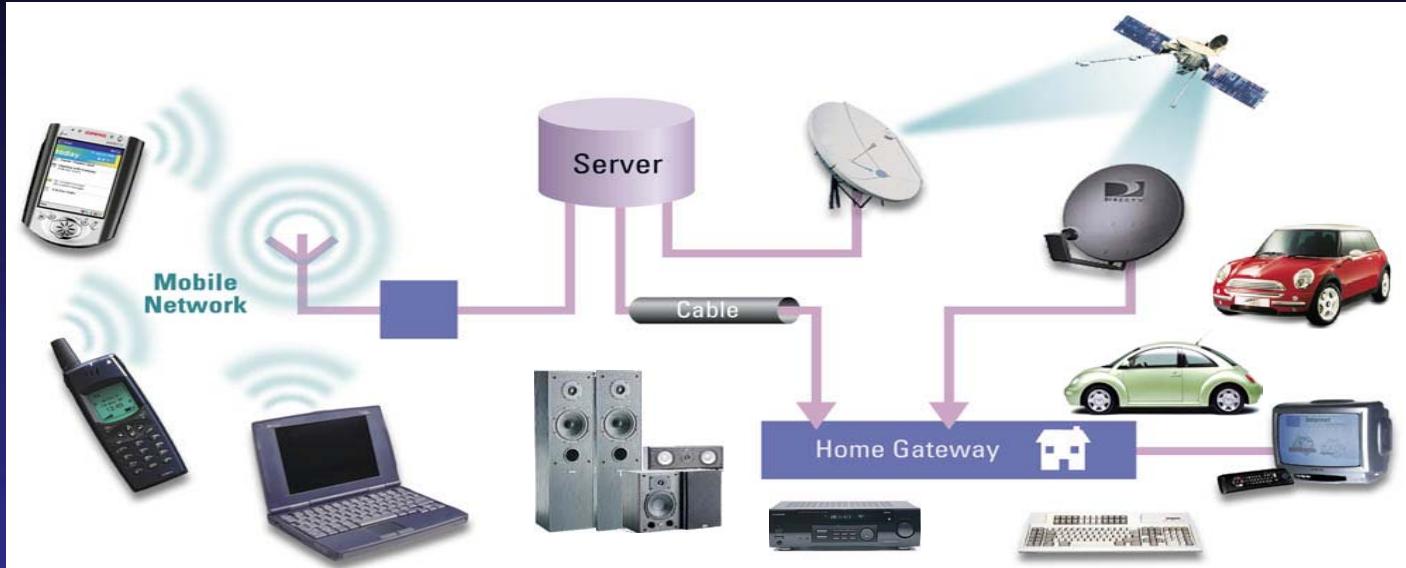


Palm Zire 71



Nintendo Gameboy player

From PAN to WAN It's a system



Wireless/Security

Voice Handset
Smartphone
PDA

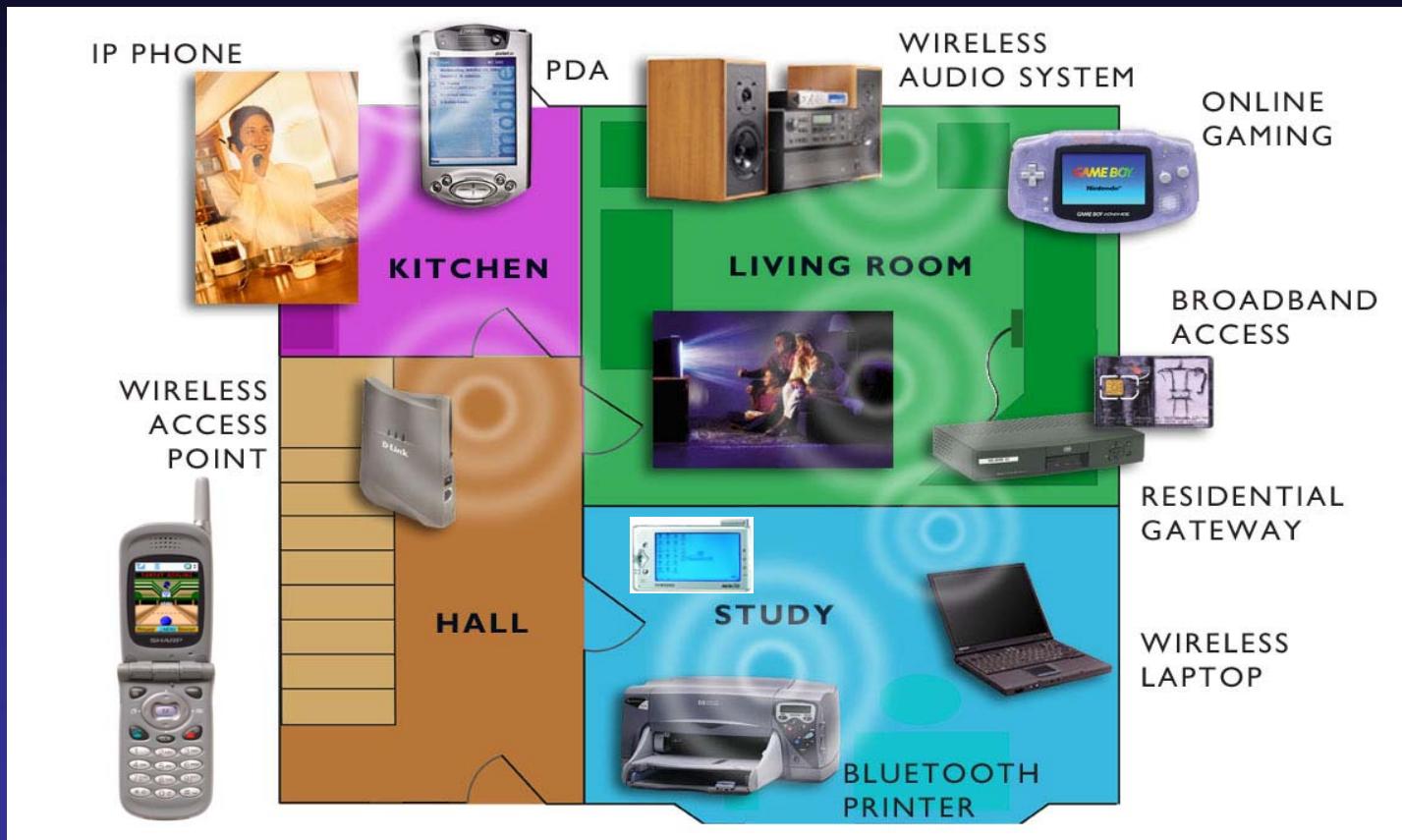
Consumer/Networking

Set-top box
Home gateway
Internet appliance
Audio systems

Automotive

Driver Info
Entertainment
audio / video
games

The Home today



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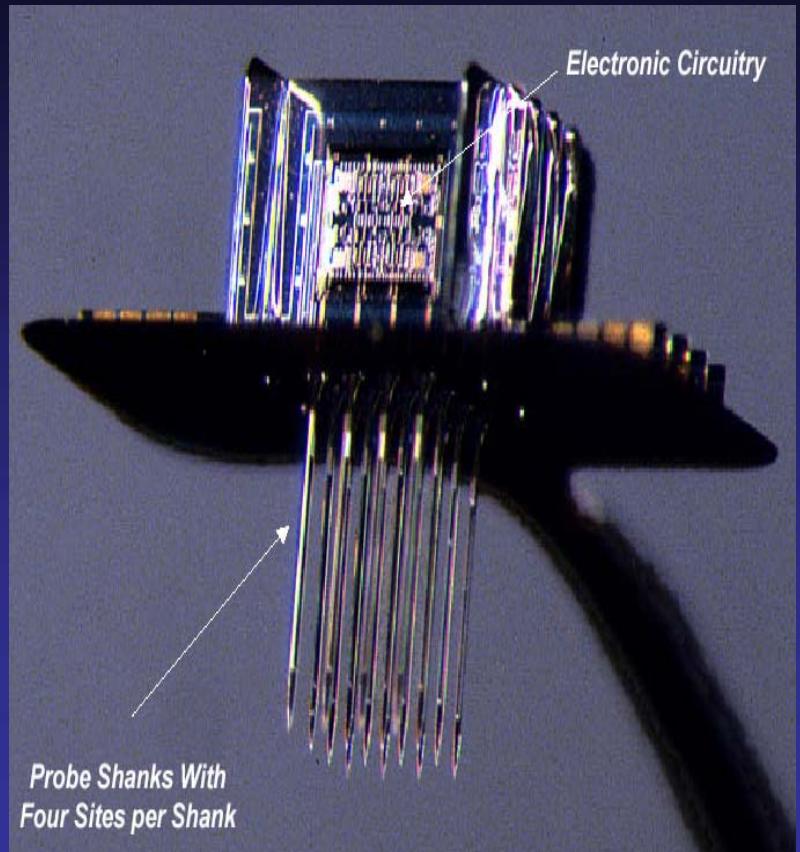
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Last Year

.....

This Year



Last Year



This Year



2. 嵌入式技术和市场需求的趋势分析

——市场趋势：32位MCU将是主流

何谓嵌入式运用？

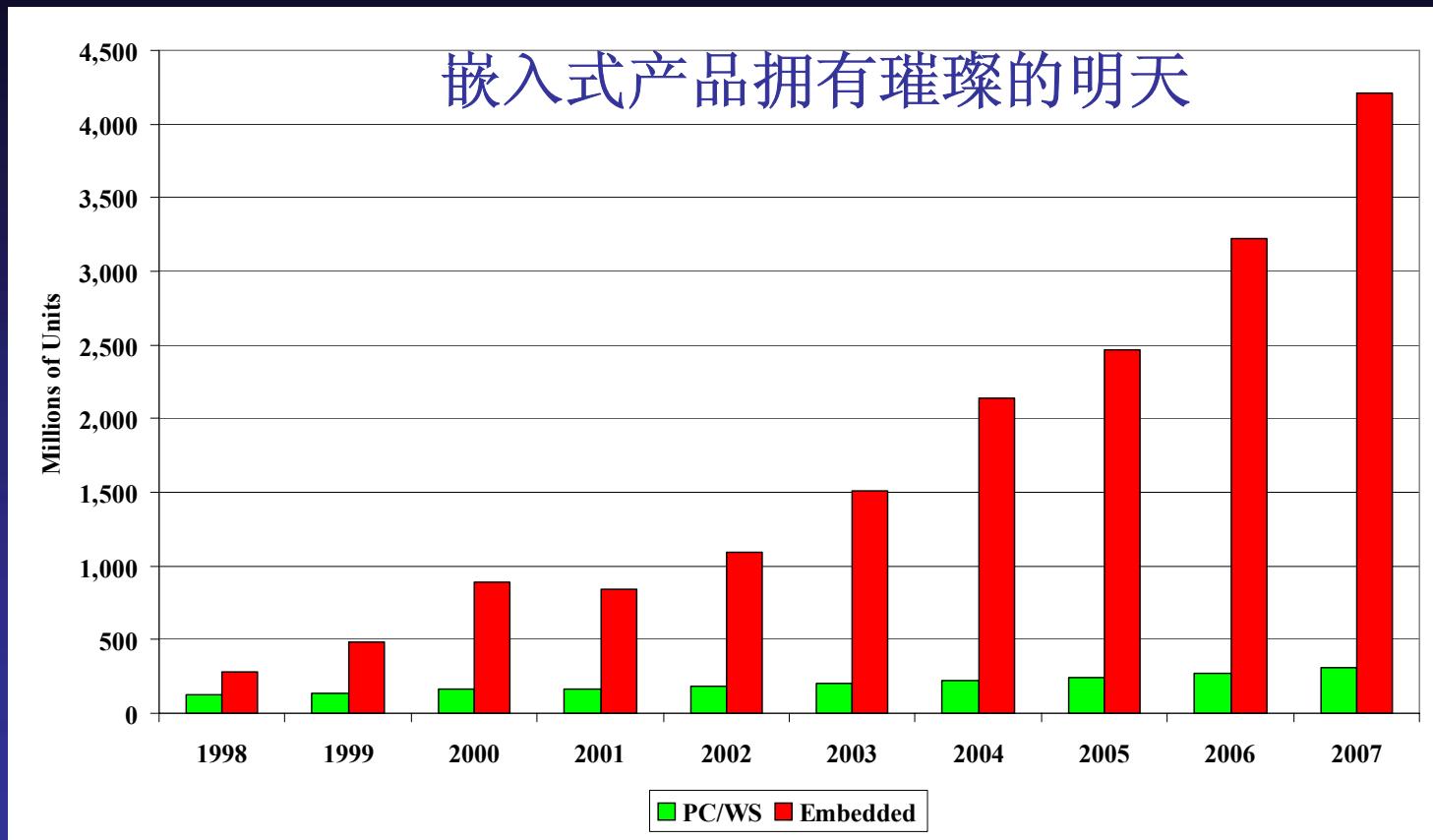
嵌入式控制指系统由输入/输出（I/O）、中断、嵌入式计算、数据处理、通话和数据传输等控制方案组成。



How long since you ‘touched’ a µC?

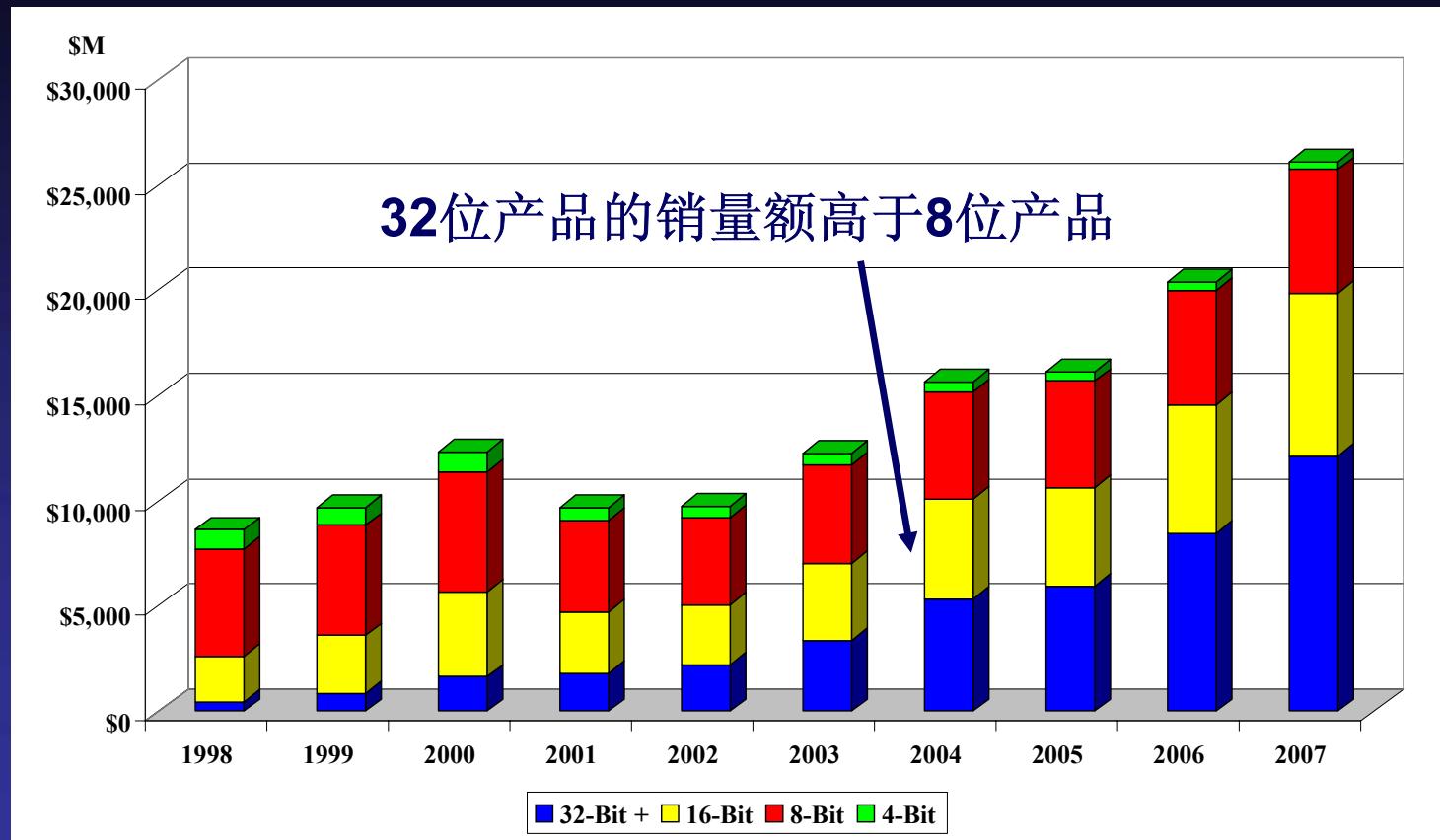
- It has been estimated that the average household contains more than several dozen microcontrollers ...
 - Microwave ovens - Blenders - Toasters - Refrigerators
 - Washing machines - Televisions - Radios - CD players
 - Personal computer - Remote control - Razors
 - Phones
 - ...even greeting cards
- The average family car may contain as many as two dozen ...
Luxury models, sixty or more
... By 2005 the average person is expected to come into contact with more than 300 MCUs a day !

嵌入式控制和计算机的芯片使用量比较（个）



Source: Semico Research Corp 2002

MCU销售量总计



Source: Semico Research Corp 2002

无线电的发展

BTH矿石收音机

单二极管



1923

Bush收音机

7个晶体管
单二极管



1957

Evoke DAB收音机

1亿个晶体管
2-3个嵌入式处理器



2002

电话的发展 (**voice only** to **3C**)

电话
无晶体管



1940

BT DECT

1千万个晶体管
3个处理器



2001

诺基亚手机
超过7亿个晶体管
(多数用于存储器)
5-6个处理器



2002

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计算机的发展

Apple Macintosh

黑白显示器
1 MIP 处理器



Acorn Archimedes

彩色显示器
10 MIP 处理器
... RISC集



惠普一康柏掌上电脑

彩色显示
200 MIP 处理器
64MB 内存
... 袖珍型



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航海仪器的发展 (**it is not sci-fi**)

地图、时钟、指南针

印刷及磁技术
无晶体管



1759

Raytheon
船用航海仪器



1999

GarminGPS定位器
约1亿个晶体管
2-3个处理器
... + 4个人造卫星!



2002

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日用电器的发展

Apple IPOD

100 张CDs
袖珍型
四处理器



HP 1315

照片质量彩色打印机
双处理器



GameBoy Advance

手持式彩色联网型
双处理器



始研发时间 1990
投产时间 2002

1996
2001

1993
2001

其他产品发展



Sagem
MorphoSmart



Konica Revio



Disc on Key

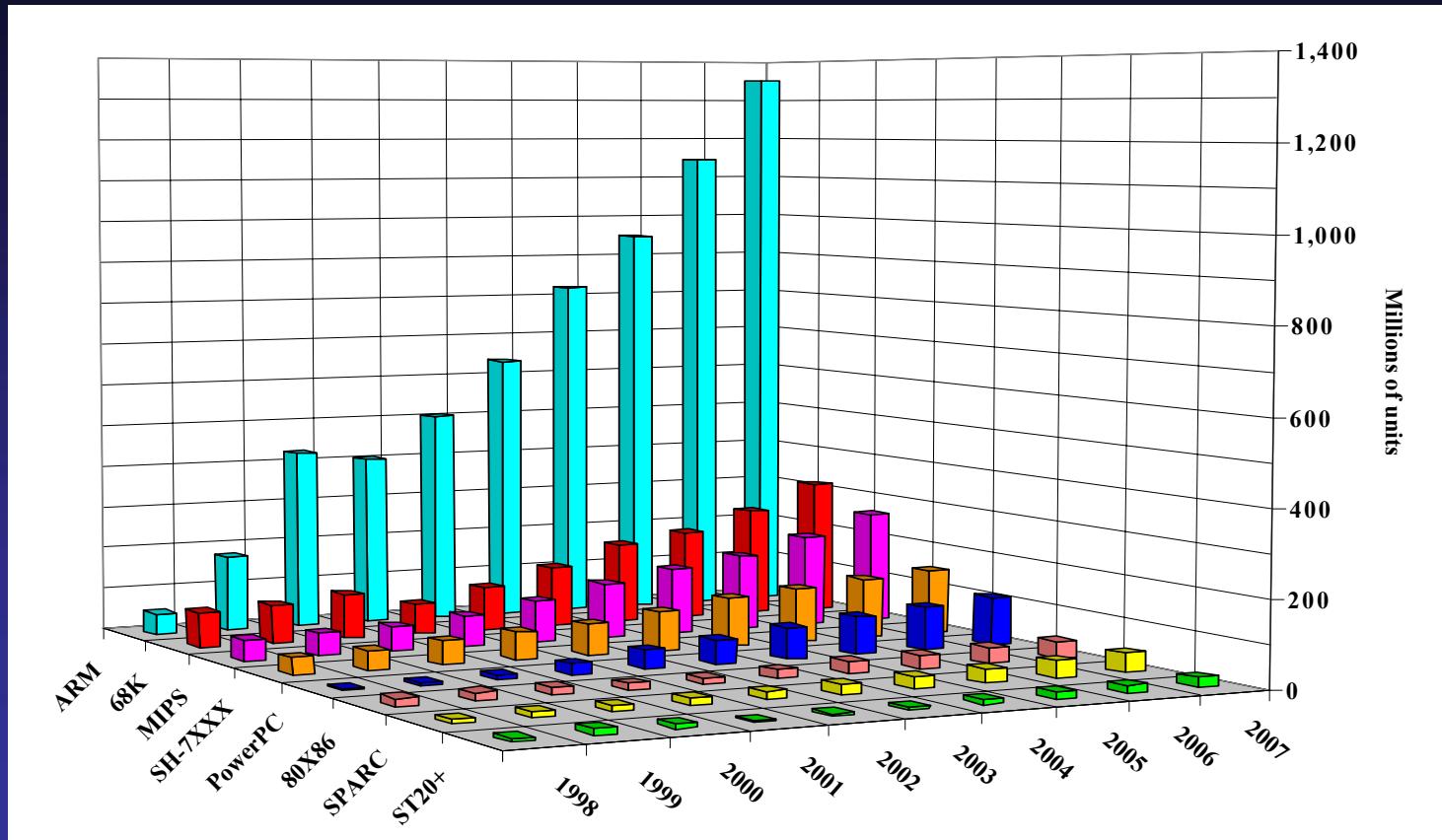


Seagate
Cheetah X15

32位CPU的需求驱动力

- 更复杂的控制算法
 - 快速复制带来矢量浮点
 - 有效的编译支持
- 网络 / 因特网通讯
 - 基于标准的软件 (TCP/IP)
 - 符合市场需求的 RTOS 支持
- 更成熟的人机界面
 - LCD 控制面板、触屏式界面
 - 操作系统支持, 如 WinCE、Symbian、Linux 等

不同体系结构的CPU在高端嵌入式控制



3. 嵌入式系统在医疗/医学/生物仪器 产品中的应用

What's the Role of Embedded Systems?

- Where patient care & drug administration are involved
 - Fewer mistakes = save lives
 - Let us focus on this topic today !
- In & on the body
 - Better monitoring, diagnosis & treatment
- In the home & remote medicine
 - Decrease cost of health care, improve access to information, reduce emergency cost

Smart Cards for eRecords



- Portable Medical Records (eRecords)
 - Europe: Smart cards being used for administrative health data
 - US: Smart card trials for insurance info
- Needs: Low price point, small form factor, light weight, power efficiency
- Challenges:
 - Ubiquity of card readers
 - Standards to determine how data is stored and accessed
 - Security of information but easy access

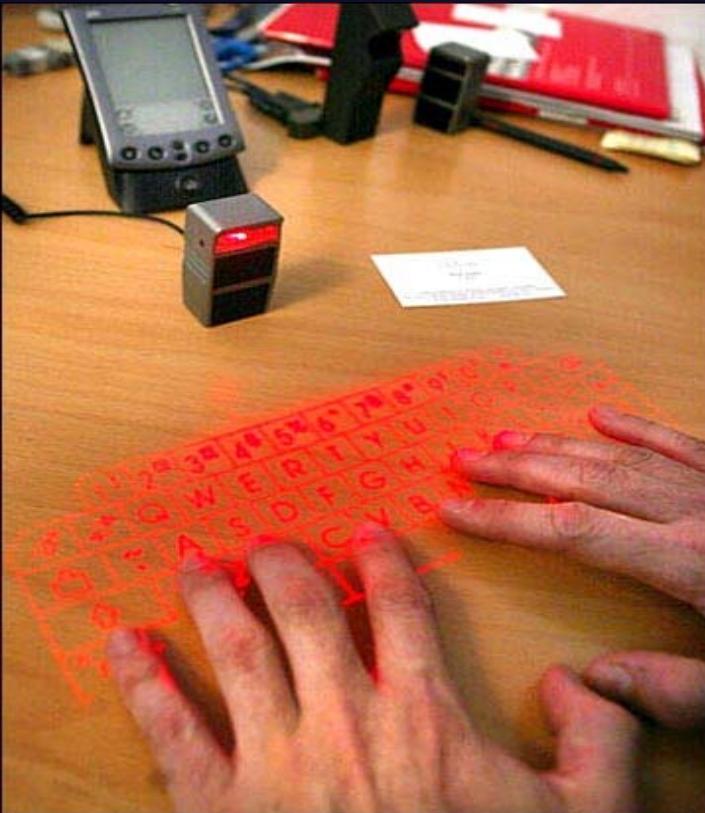
Tablet PCs for Hospital Data Flow



Eclipsys' Software on
Tablet PC

- Trials with 1000 hospital doctors
- Doctors can
 - Dictate notes
 - Handwrite prescriptions
 - Wirelessly access
 - Patient records
 - Lab results
 - X-rays
- Good:
 - High-quality display
 - Wireless access

How Do You Reduce The Weight?



- A full-size virtual keyboard projected by light onto any surface
- Beams of light which detect the user's movements
- Very useful in sterile medical environments
- Projection units could be on device or in every room of hospital

Canesta

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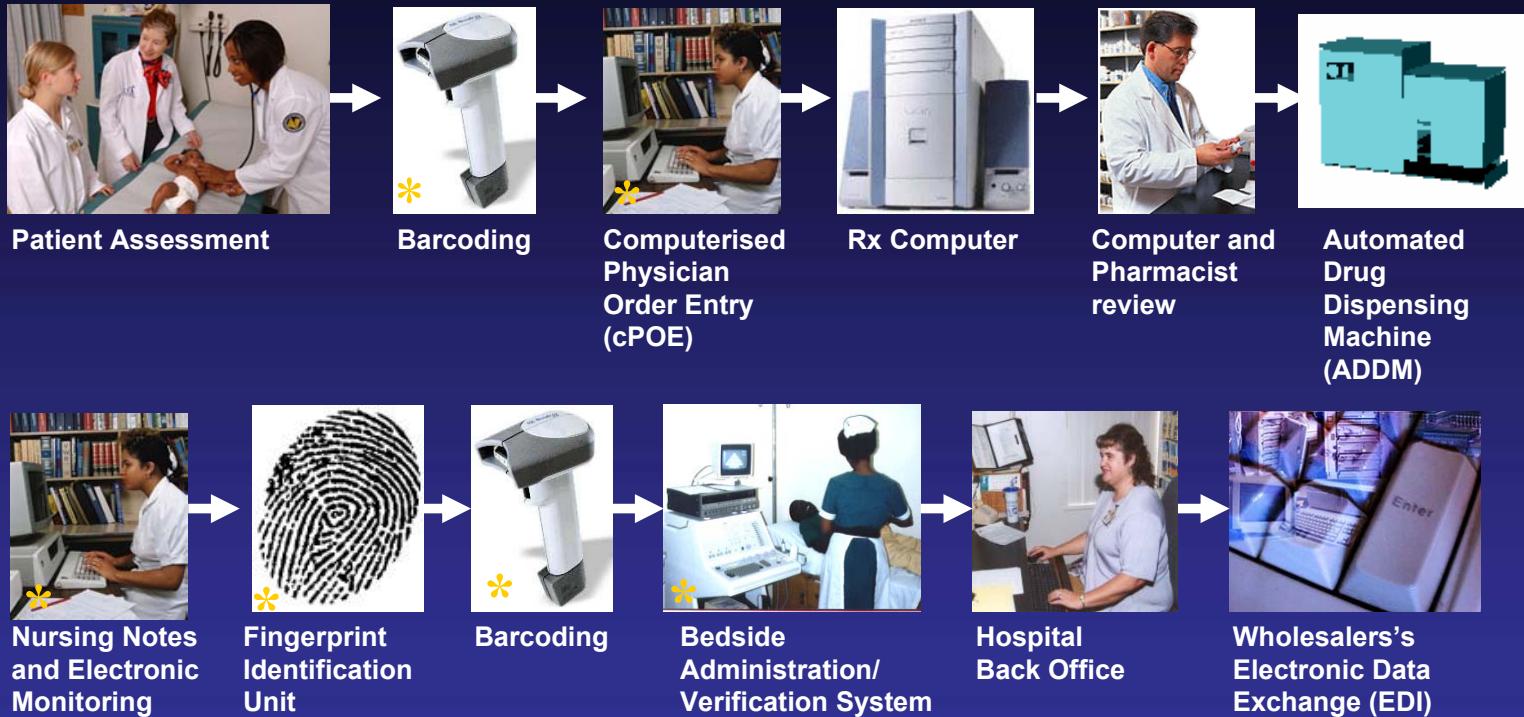
PDAs: Wireless Access to Critical Info



Displaying lab results

- X-Rays, lab results and medical records
- Good:
 - Form factor & weight
 - Battery life
 - Price
- Opportunity
 - Display resolution
 - Handwriting recognition

Computerised Physician Order Entry



* = Embedded Systems Opportunities

Security = Biometrics

- Automated methods of recognising a person based on a physiological or behavioural characteristic
- Facial features, fingerprints, hand geometry, handwriting, iris, retina and voice
- Biometrics is becoming the foundation of an extensive array of highly secure identification and personal verification solutions

Biometrics: Replacing PINS & Passwords



Sagem
MorphoSmart



ActivCard's
BioMouse™ Plus



Viisage FacePass™



Cypak's Smarter Card



Biometric Access Corp.
SecureTouch Advanced



Recogsys
HandPunch 4000

In Hospitals Iris Scan Wins

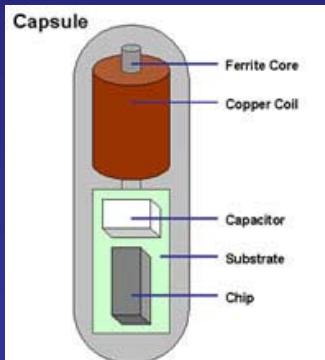


- Does not require interaction with the device (fingerprints don't work with gloves on)
- No germs spread
- Fast scanning from a distance,
 - one foot away
- Unique pattern
- Low cost:
 - Storage only 35 bytes of information
 - Cost: \$200 per device
 - Low error rate

Future: Implantable RFID – Animals today



VeriChip:
Used for secure-access applications



- Implanted in the body
- Each chip contains a unique verification number
- Scanner & chip communicate using radio
- Small size, hard to detect, hard to compromise
- The challenge is entirely human
 - Would you want one?

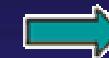
Hospital: 3D Imaging of Heart



Philips

- Live, instantaneous, 3D images of a beating heart without surgery
- Ultrasonics into the body via a handheld scanner
- Provides heart size, heart shape, and anatomic relationships
- Can rotate and crop image to see it from multiple perspectives

Hospital: Pre-Natal 3D Ultrasound



Freehand
Scanning

Series of
Images

3D Freescan
Image

- Builds 3D image from 2D slices
- 3D images are far more realistic & useful in diagnosis

Hospital: The Camera You Swallow



Given Imaging:
disposable imaging
capsule swallowed;
capsule moves
smoothly and
painlessly through
the GI tract. Lit by
LED in capsule



A wireless
recorder worn on a
belt around the
waist receives
signals transmitted
by the capsule
through an array of
antenna placed on
the patient's body

Workstation with proprietary software processes the data and produces a short video clip of the small intestine and digestive tract



M2A capturing normal folds of stomach



Capsule endoscopy reveals duodenal lymphoma

软件 —— 令产品工作，令您成功

- SoC片上系统需要使用硬件，芯片经常相同，但应用软件的不同带来了不同的功能。



HP Jornada



富士通扫描仪

- 即使设计简单的SoC片上系统产品，软件设计人员与硬件设计人员人数比例一般为3~4: 1

...如今，SoC片上系统设计必须将硬件、软件、体系结构及分析都考虑在内。（而过去许多因素并不考虑在内）

4. ARM公司概况

电子行业知识产权（IP）公司

ARM 近况

- **ARM Holdings** - 业界领先的半导体知识产权(IP)供应商 - (伦敦证交所: ARM; 纳斯达克: ARMHY)
 - 总部, 剑桥; 分部位于9个国家
 - 7个研发中心
 - 超过740雇员
- 引领**RISC**和嵌入式计算技术潮流
 - 1991年率先推出**RISC**内核
 - 已付运**20亿**个**ARM**内核微处理器
 - **2002**年贡献约**79%**市场份额
- 全球技术网络
 - **118+** 半导体和系统合作伙伴
 - **50+** 操作系统合作伙伴
 - **35+** 技术共享合作伙伴
- **2002年****ARM**在上海成立中国全资子公司



ARM: No.1 电子行业中的知识产权公司



SOC – 片上系统

```
always @(/*AUTONSENSE*/CoreWrCommsData)
begin
    if (!DBGEnIntD)
        CoreWrFlgNS = 2'b00;
    else
```

=

+



知识产权 (IP)

■ 蓝图Blueprints

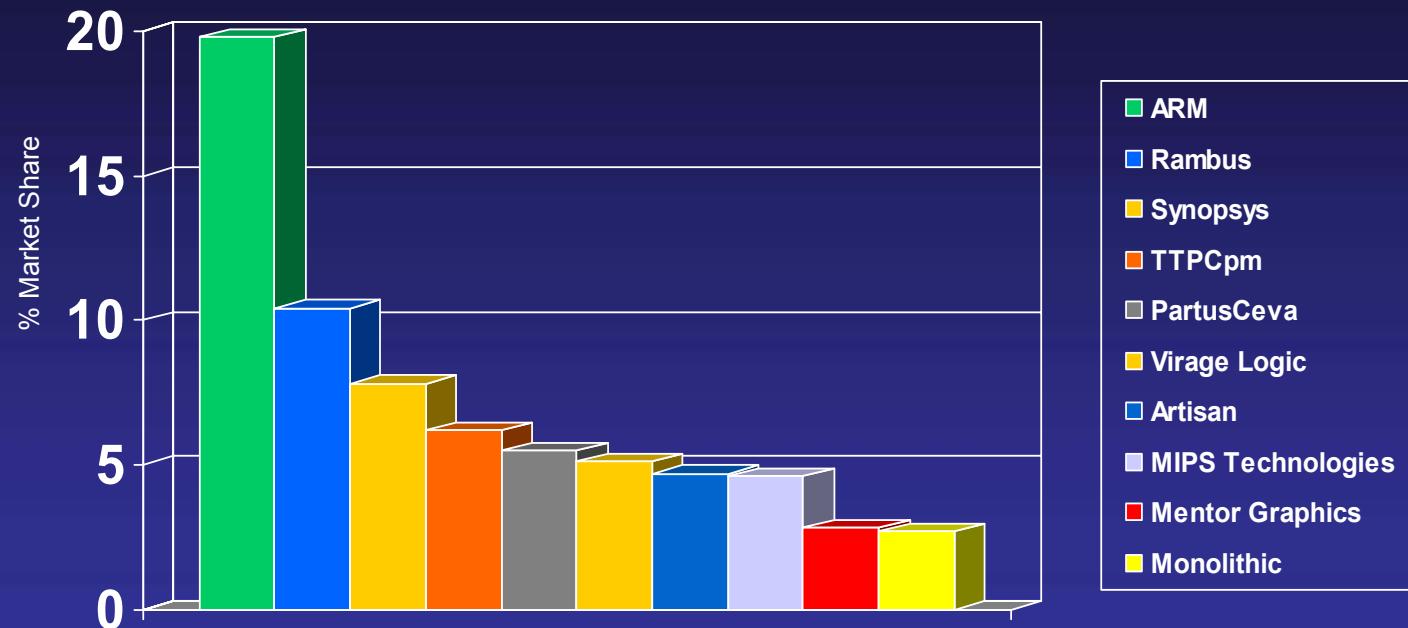
- 如何建立
- 如何使用
- 如何设计

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2002 半导体知识产权前10名公司

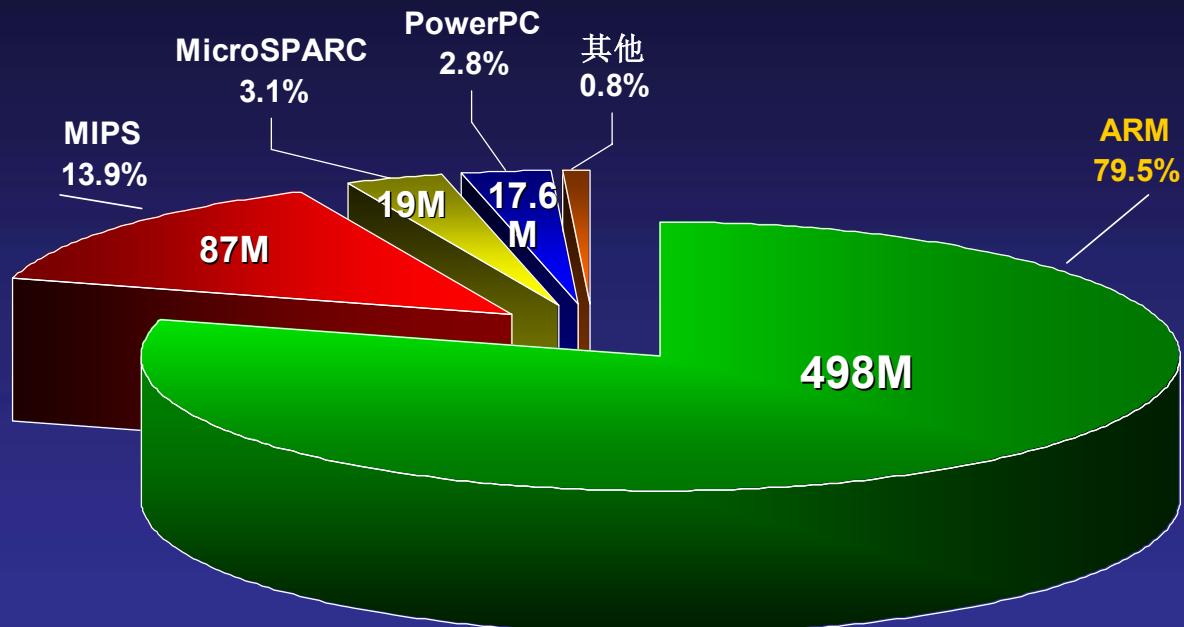


知识产权 → 硅芯片 → 原设备制造商

IP 供应商	硅芯片被授权方	原设备制造商	产品
ARM	英特尔 ● StrongARM ● XScale	● 华为 ● 惠普 ● 联想	● 网络产品 ● iPAQ ● XP100
ARM	德州仪器 ● Baseband ● OMAP	● 诺基亚 ● 联想	全球 80% 的 GSM/3G 手机
ARM	高通 ● CDMA	● 中兴 ● 海尔 ● 大唐	全球 99% 的 CDMA 手机
ARM	摩托罗拉 ● Dragonball MX1	● Palm	Palm 及其它 PDA
ARM	OKI ● OKI 微控制器	● 众多 OEM	嵌入式产品

今天 ARM 的位置：2002市场份额

2002嵌入式内核总量: 6.265亿



*包括用于32位、64位RISC结构的片上系统

ARM的成功 = 合作伙伴的成功

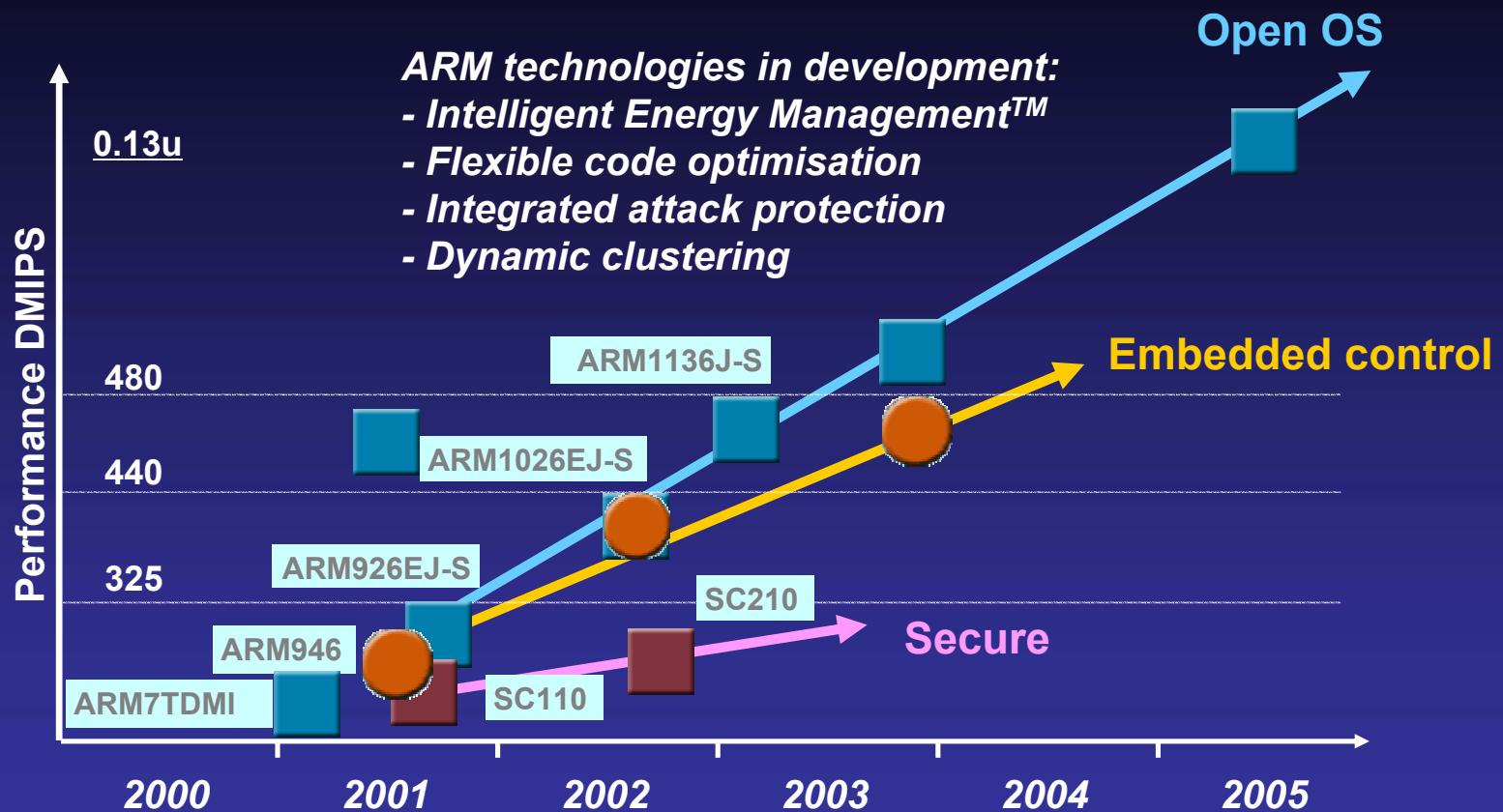


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CPU roadmap



ARM——无线设备的标准CPU

■ GSM / UMTS

- GSM850,900,1800,1900, GPRS, EDGE, UMTS (W-CDMA)
- 超过85%的市场占有率，主要为OEM客户

■ cdmaOne

- IS95A/B, CDMA2000 1X, EV-DO, BREW
- 超过99%的市场占有率，主要为OEM客户

■ Bluetooth™

- 超过75%的市场占有率

■ China TD-SCDMA

- Commit, T3G(Datang+Philips+Samsung), ST

■ PHS 小灵通

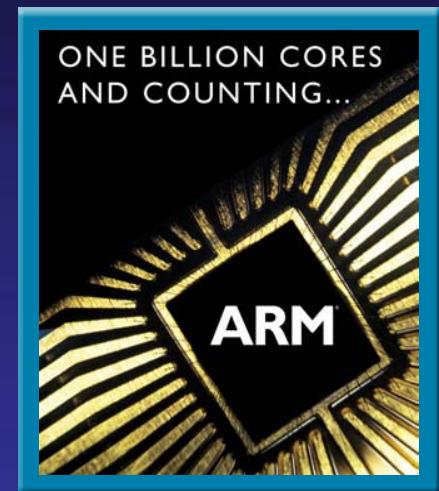
- UTStarcom将于2004年投产

■ SCDMA

- 大唐将于2004年投产

■ PDA / 应用处理器

- 基于ARM体系结构的操作系统 (OS)
 - PocketPC/Smartphone, Symbian, Palm
 - Java硬件支持



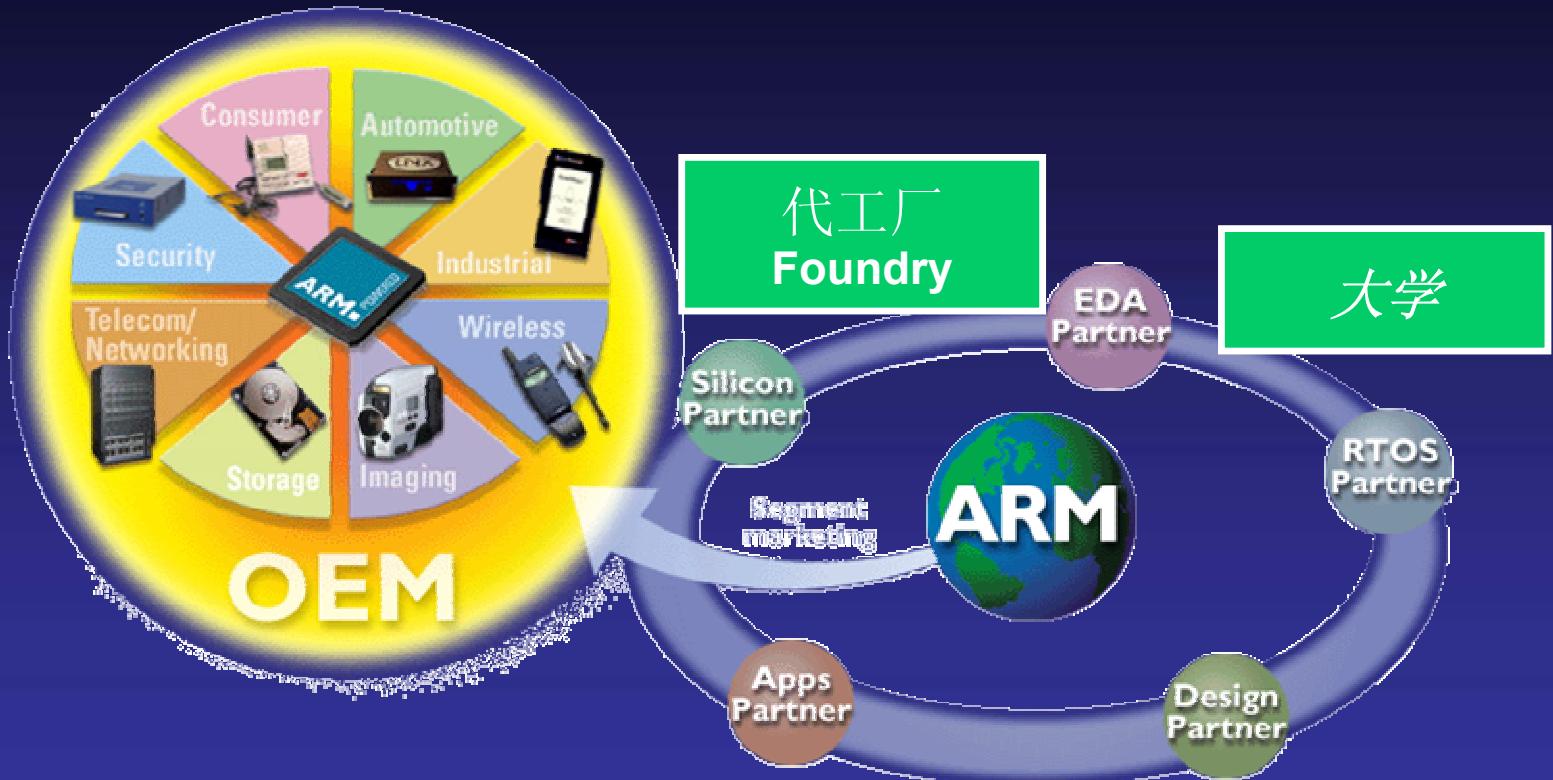
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从IP到产品的各种授权: 众多的合作伙伴



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ARM 价值链 (Everyone makes money)



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成功的 ARM 中国合作伙伴项目

- 中国无晶圆厂半导体公司
 - 中兴集成 购买 ARM922T™ CPU 授权, 用于网络系统芯片
 - 上海华虹集成电路 购买 ARM SC100™ CPU 授权, 用于 Java 智能卡
 - 大唐购买 ARM946E™ CPU 授权, 用于SCDMA基带芯片
- 晶原代工厂
 - 中芯国际
- 大学及政府机构
 - 东南大学
 - 上海集成电路研究中心
- ARM RealView™ 开发工具中国分销商
 - 香港科汇宏盛分部
 - 北京旋极
- 主要的中国原设备制造商均支持 ARM 结构
 - GSM, CDMA 手机制造商 (采用 ARM 工具)
 - PDA, POS, E-book, GPS 等
- RTOS 公司
 - 普天慧信, 科银京成、北京凯思昊鹏、中科红旗等
- 应用
 - 上海汉峰等

ARM – Driving Innovative Applications



Siemens Sx56
Pocket PC Phone



Nokia N-Gage



Lexmark
T420d Laser
Printer



Trintech Payware
Smart 5000



Iomega
256MB Mini
USB Drive



Motorola A760



Samsung/Arcturus
Residential Gateway



TerraPlayer CR-100
Digital Audio Jukebox



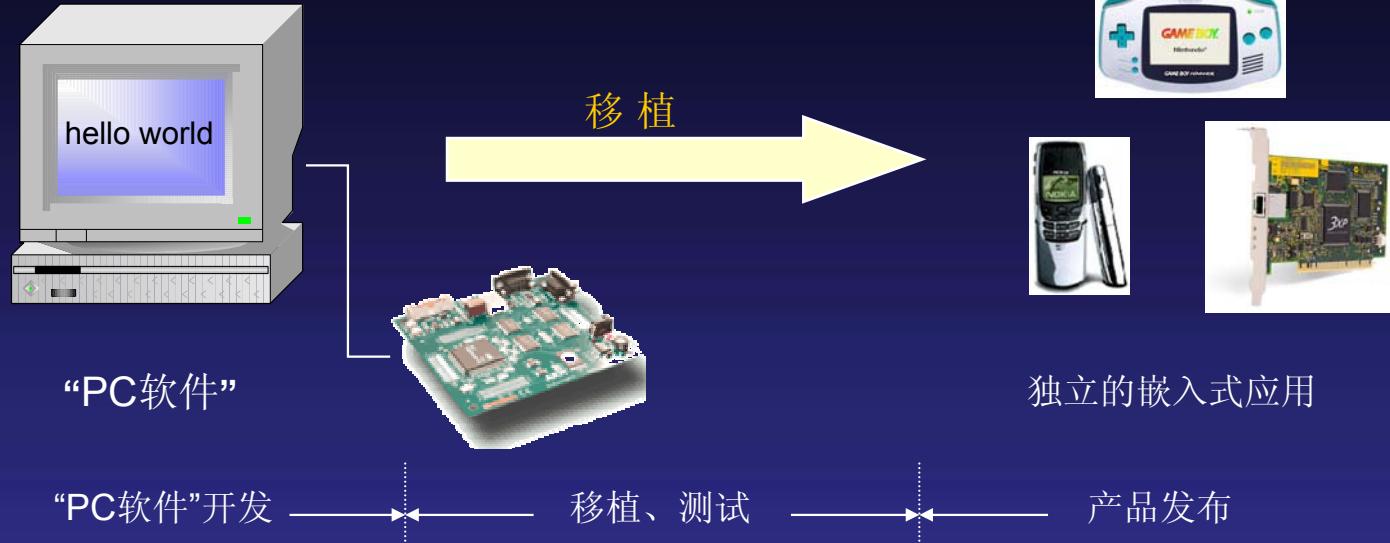
Nokia 7250

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嵌入式开发过程

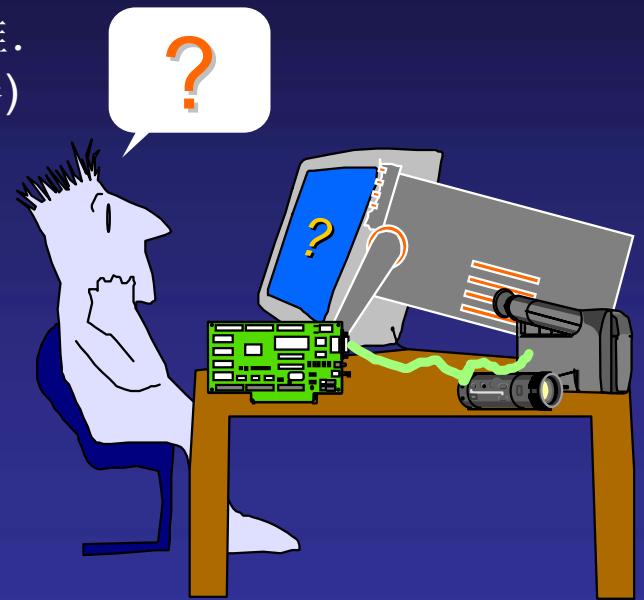


当程序员开始开发一个基于ARM应用的时候，你可以使用ARM的ADS编写类似于“HELLO WORLD”的程序，使用ARMulator或者在评估板上来调试，但当你把他移植到独立的嵌入式应用设备中时，下面这些问题就成为我们首要考虑的：

- 硬件环境中所使用的C库函数
- 目标板上的存储器资源
- 应用程序的初始化

问题

- 没有外部可见的片上**ASIC** 总线
- **ICE** 版本必须在全速系统速度下运行
 - 随着处理器速度的增加, **ICE**越来越难.
 - 同时必须提供**ICE** 工具 (例如, 触发器)
- 实时跟踪需要确定的带宽接口
 - 需要地址总线, 数据总线和控制信号
 - 对于 ARM7TDMI , 有**80多个** 引脚
- 很多 **ASICS** 使用相同的处理器核
 - **ICE**必须为每一个 **ASIC**定做



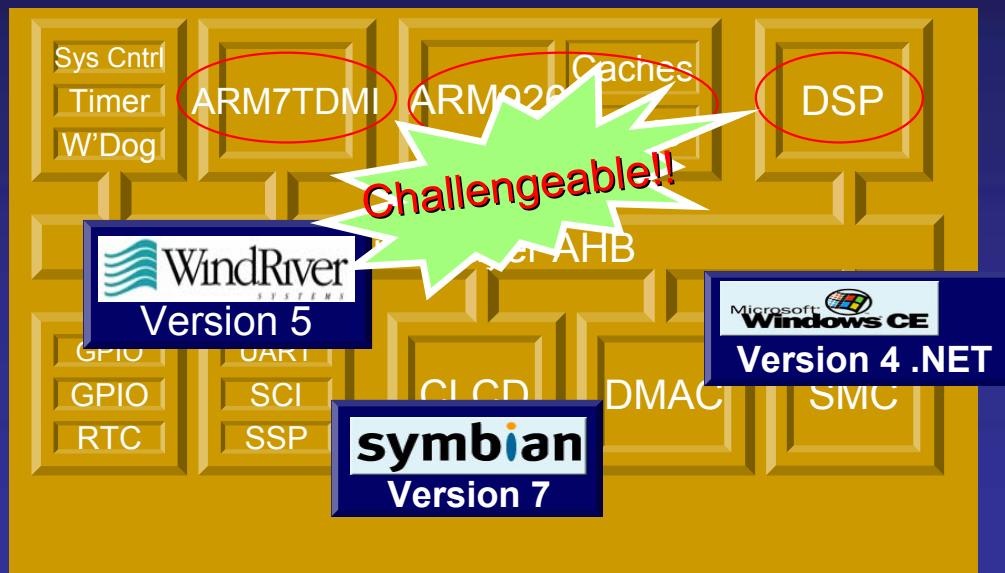
完整的嵌入式系统调试技术方案



更高的调试要求

更复杂的系统，带来更多的调试问题！

- ✓ 多内核调试
- ✓ DSP 支持
- ✓ OS 支持



ARM知识平台：高手之路，梦想开始的地方



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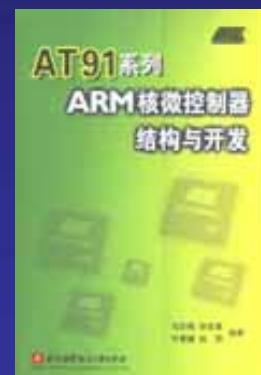
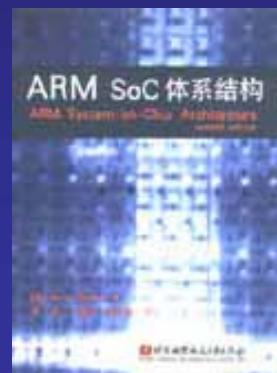
ARM 中国大学计划 = 建立知识平台

- ADS+Multi-ICE+E7T 套件 (999 USD)
 - Send email to info-china@arm.com
- ARM Lab texts
 - Course materials based on ADS+Multi-ICE
- 技术支持
 - Resources available from ARM to support the courses
- 联系大学和ARM的芯片公司
 - 众多的芯片公司的联系
- IP Licensing
 - SoC Design (e.g., 东南大学)

掌握**ARM** 的嵌入式应用平台 = 商机



众多的中文版ARM图书



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如何联系

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- Web: www.arm.com
- Web: www.arm.com/Chinese
- Tel: 021 6235 1296
- Fax: 021 6235 1207

结束语：

- 后PC时代：嵌入式领域具有巨大的发展潜能
- 嵌入式应用：未来32位CPU将成为主流
- 嵌入式系统：结合软件的硬件产品将获得成功及带来利润
- 嵌入式系统在医疗/医学/生物仪器产品中的应用
 - Fewer mistakes = save lives
- ARM及中国大学计划 = 建立嵌入式系统知识平台

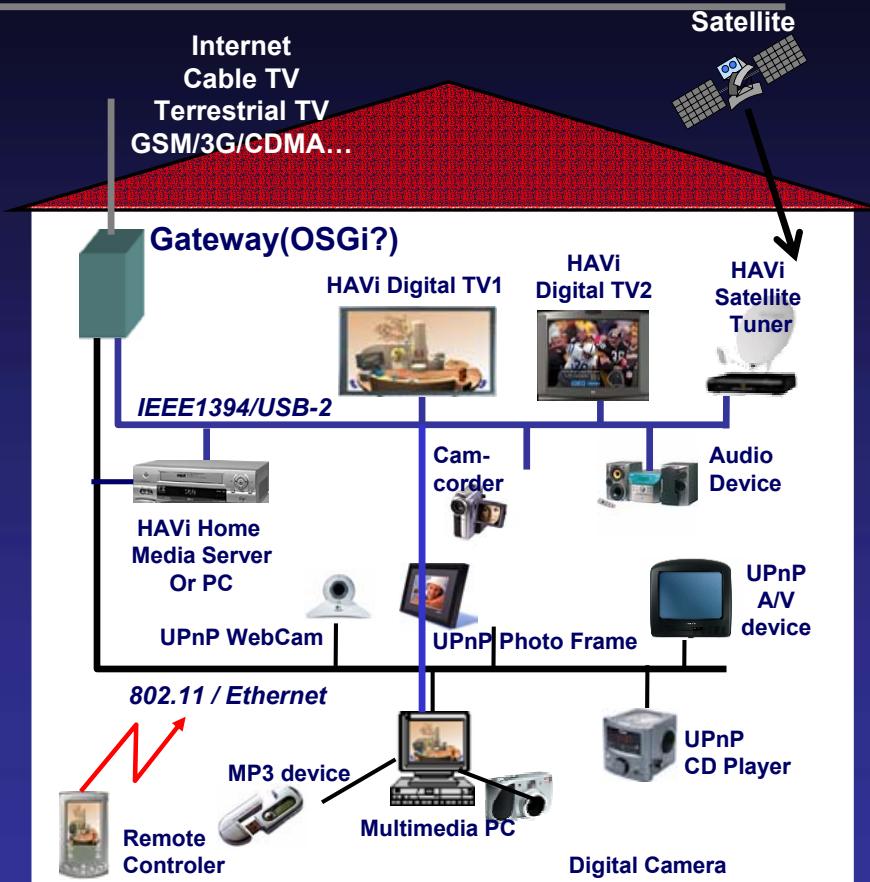
Connected Devices and the Home

24% of PC households have two or more PCs

- Driving home networking

PC network standards, UPnP will encourage smarter equipment

- Allow devices to “talk” to each other
- Evolution of Java & .NET software standards helps interoperability



Bringing It All Together



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