



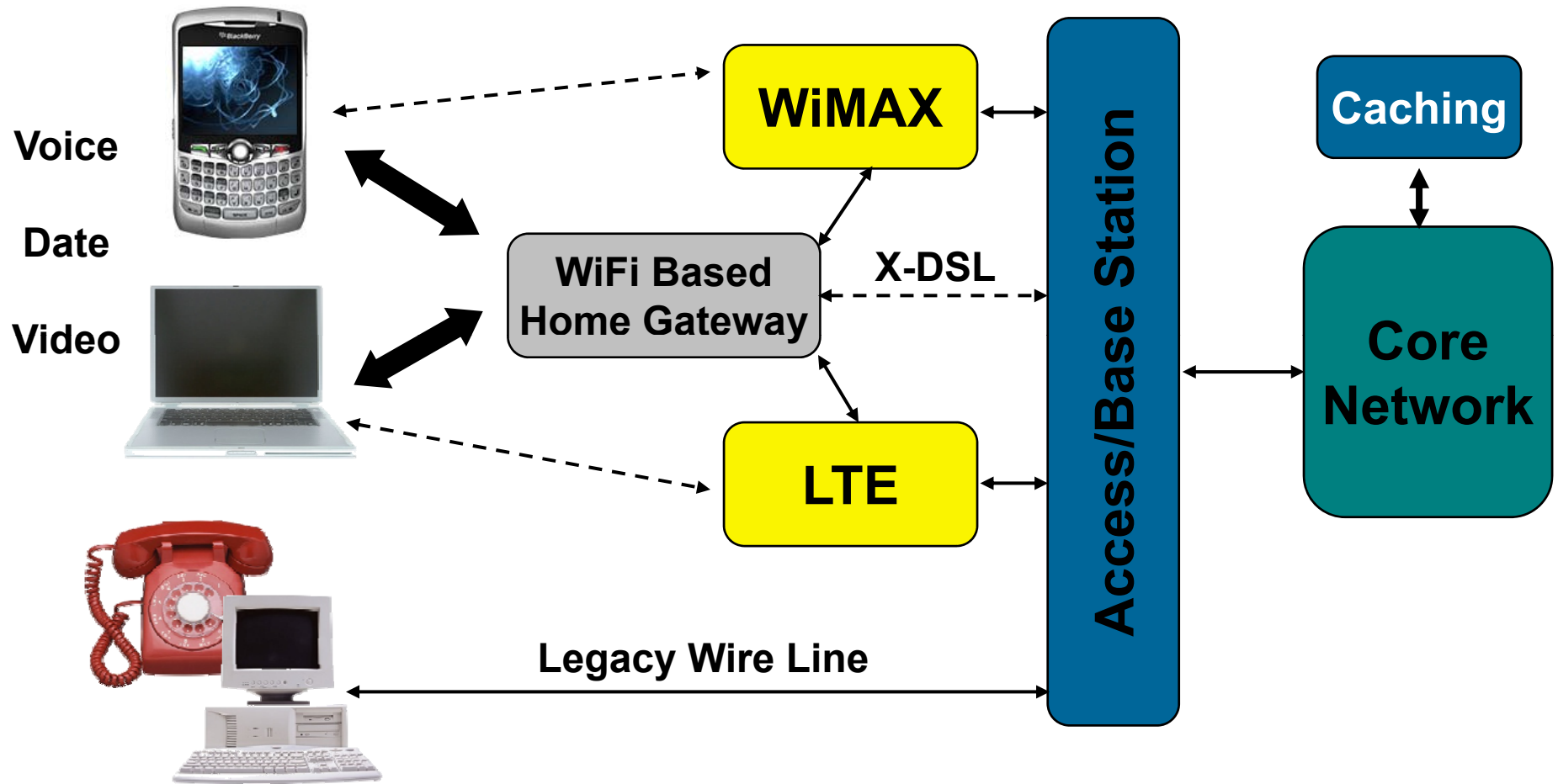
Trends in Telecommunications and Their Impact on VLSI

Dr. Santanu Das
Dale Montrone
Prosit Mukherjee

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Conference in Hyderabad, India
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- **The world will be increasingly “Wire-less”**
 - **Especially in access space**
- **Home Gateway / Femtocell will be pervasive**
 - **WiFi interface to the client / Handset**
 - **X-DSL / Cable / WiMAX / LTE to network**
- **WiMAX and LTE will rival X-DSL / Cable modem in cost / performance**
- **Intelligence will migrate to Handset / Home Gateway**
 - **Expert Systems and AI Concepts Will Be Incorporated In Handsets**
- **Low power design / process will dominate the semiconductor industry**
- **These trends will have impact throughout the semiconductor industry food chain**

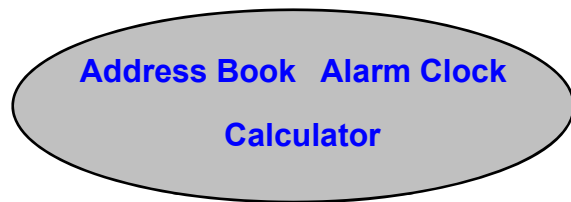
We are Migrating to a World Without Wire!



Objective: Seamless Mobility

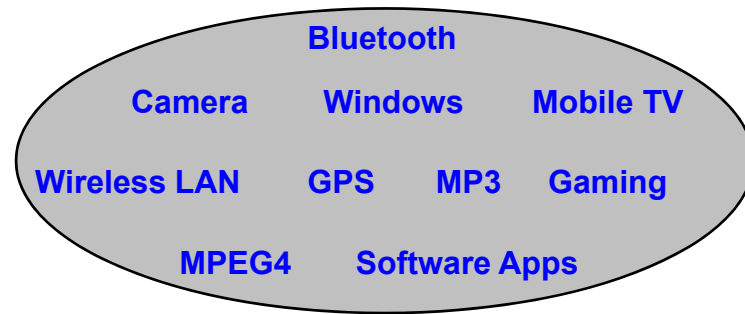
Intelligence Will Migrate More to the Handset

Starting in 1992 with
Basic Handsets



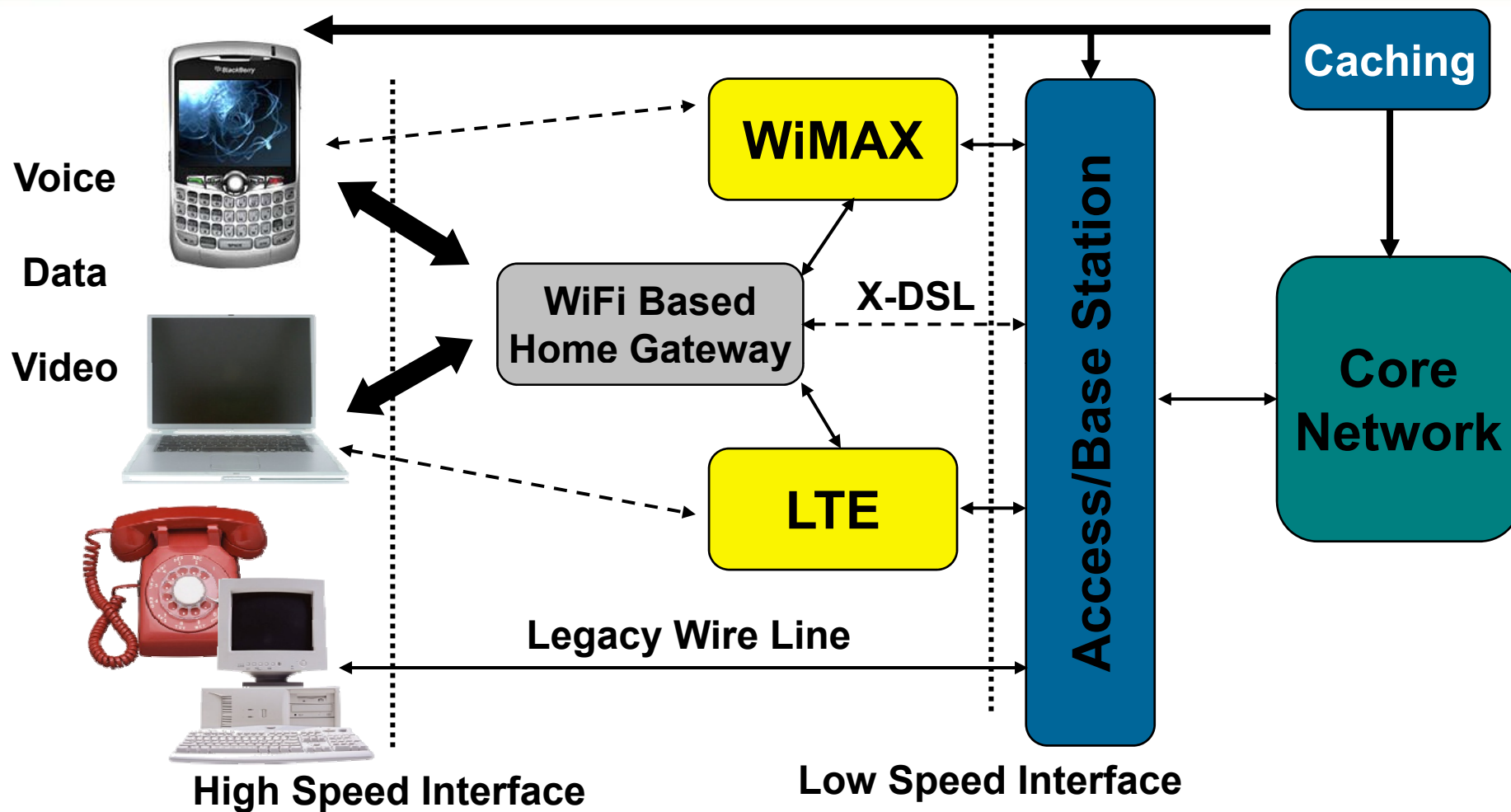
- 1- NEC Cellstar 500 (1992)
- 2- Nokia 2110 (1994)
- 3- Nokia 5120 (1998)
- 4- Kyocera 2135 (2002)
- 5- Audiovox CDM8300 (2002)
- 6- Samsung SCH-A650 (2004)

Intelligence is Moving to the
Handset (2007)



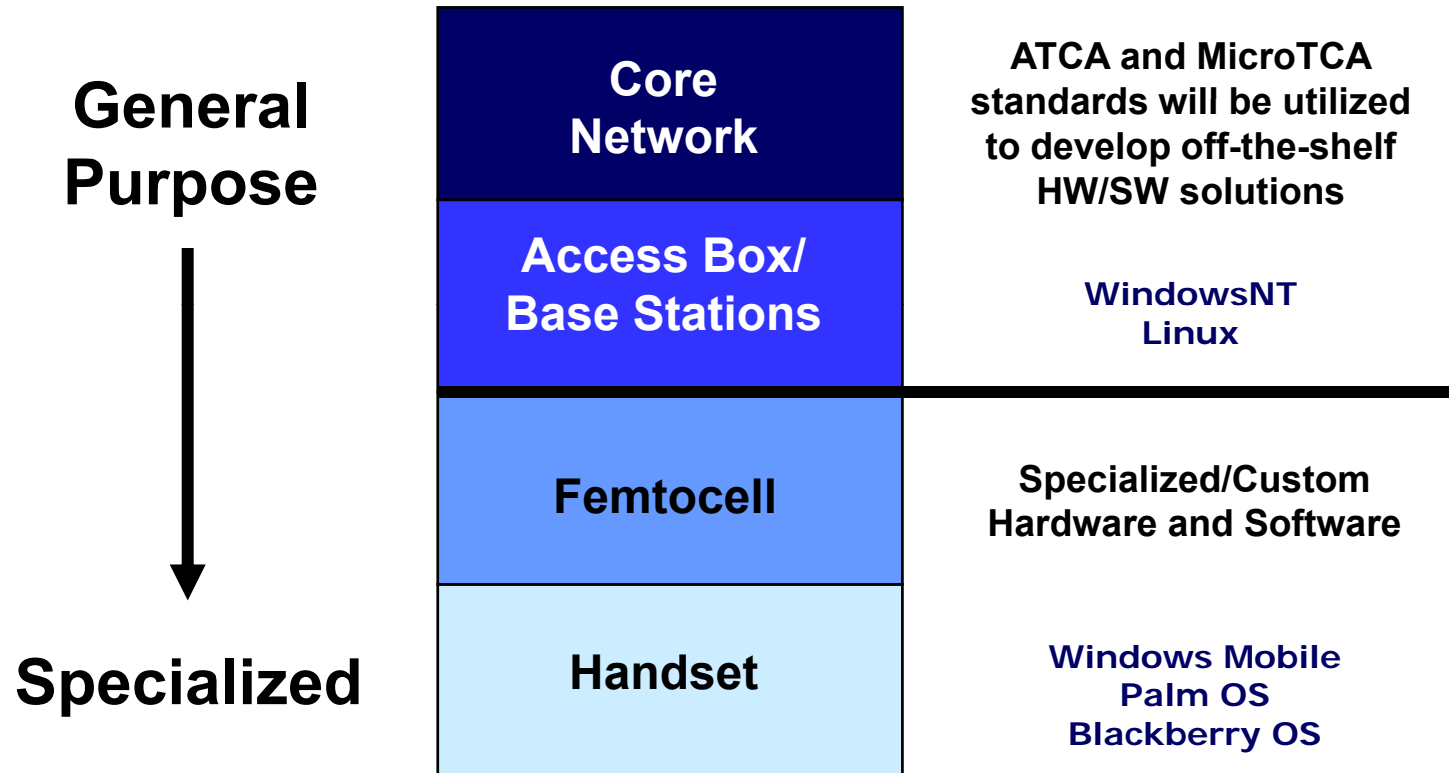
- 1- Blackberry Curve
- 2- Samsung Blackjack
- 3- Apple iPhone
- 4- Palm Treo

Effect of Intelligence migration!



**Handsets Will Be The Future Workstation
- AI / Expert Systems Will Be Used**

Standardized Core and Access Network Elements



Short Product Life-cycle will be the Norm

Semiconductor Technology in the Wire-less Food Chain

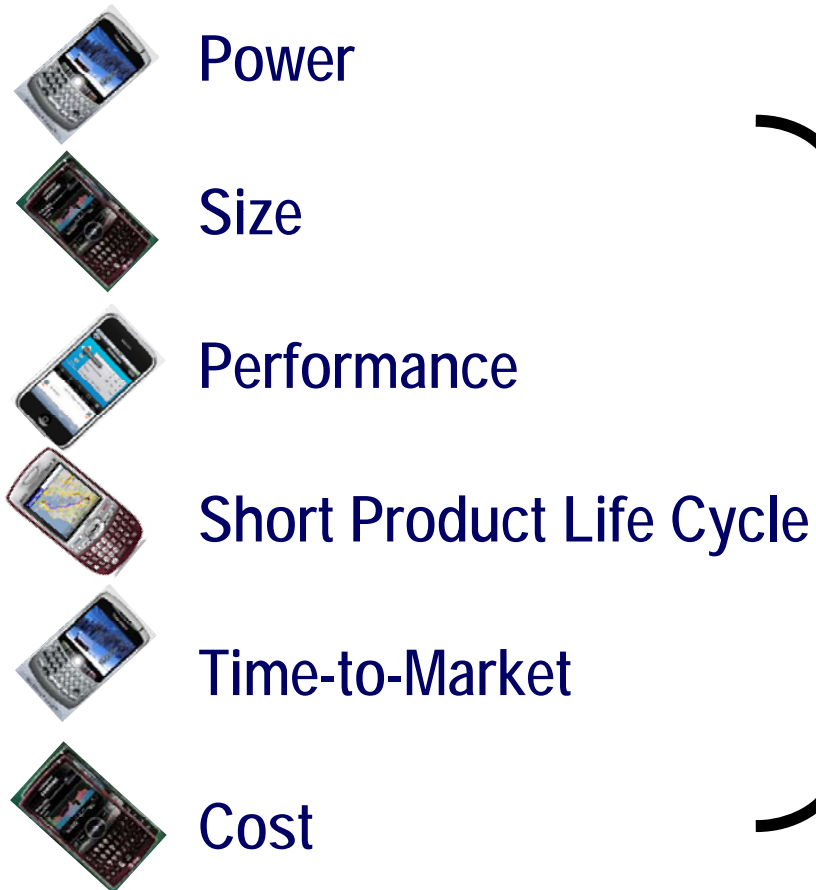
	Cost	Tech	Equipment Supplier	IC Supplier
Core ↕	10%	ASSP FPGA uProc	Alcatel Cisco Ericson Fujitsu Hewlett Packard Huawei IBM NEC Nortel Sun	TranSwitch Agere Altera AMCC Fujitsu Infineon Intel Mindspeed PMC Xilinx
Access ↕	30%	ASSP FPGA uProc		
Home Gateway ↕ Handset	60%	FPGA ASIC Custom IC Programmable Platforms	Apple LG Motorola Nokia RIM/Palm Samsung	Analog Devices ARM Freescale Infineon Qualcomm RFMD NXP/Philips Skyworks ST Micro Texas Instruments

Semiconductor Technology in the Wire-less Food Chain

	Cost	Tech	Equipment Supplier	IC Supplier	
Intelligence/ Caching ↓	Core	10%	Alcatel Cisco Ericson Fujitsu Hewlett Packard Huawei IBM NEC Nortel Sun	TranSwitch Agere Altera AMCC Fujitsu Infineon Intel Mindspeed PMC Xilinx	SHRINKING
	Access	30%			
	Home Gateway ↕ Handset	60%	Apple LG Motorola Nokia RIM/Palm Samsung	Analog Devices ARM Freescale Infineon Qualcomm RFMD NXP/Philips Skyworks ST Micro Texas Instruments	EXPANDING

Wire-less Issues that will Drive the Semiconductor Industry

Issues in the Wire-less World



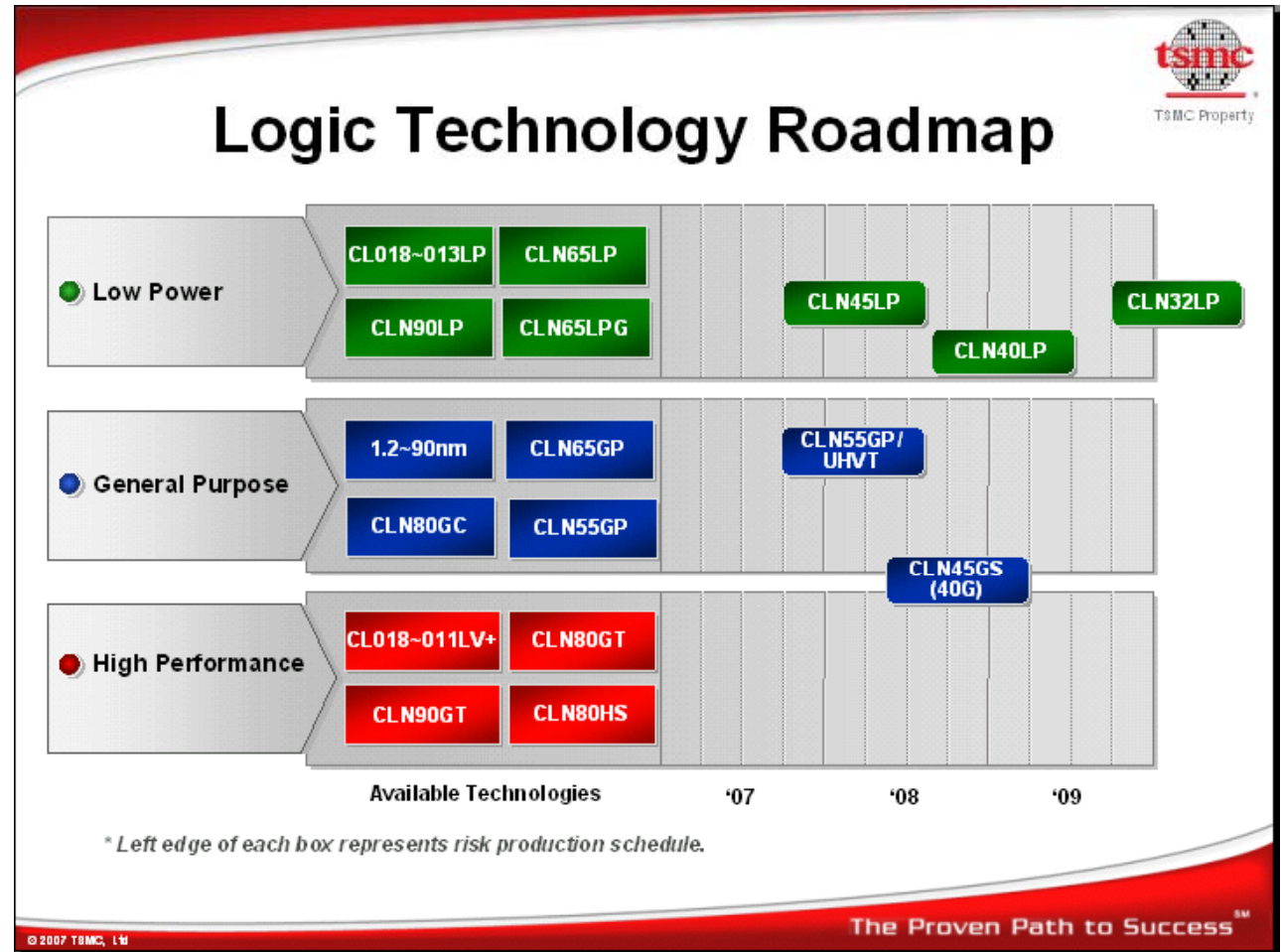
How the Semiconductor Industry will Respond

- ▶ **Ultra Low-Power Process Technology/Low-Power Design**
- ▶ **Package-less Packaging**
- ▶ **Higher Levels of Integration**
- ▶ **Standard Hardware and Software Platforms**
- ▶ **Highly Programmable Solutions**
- ▶ **Migration from SiGe and GaAs to CMOS**

Low Power Processes will Dominate

Low Power will Dominate

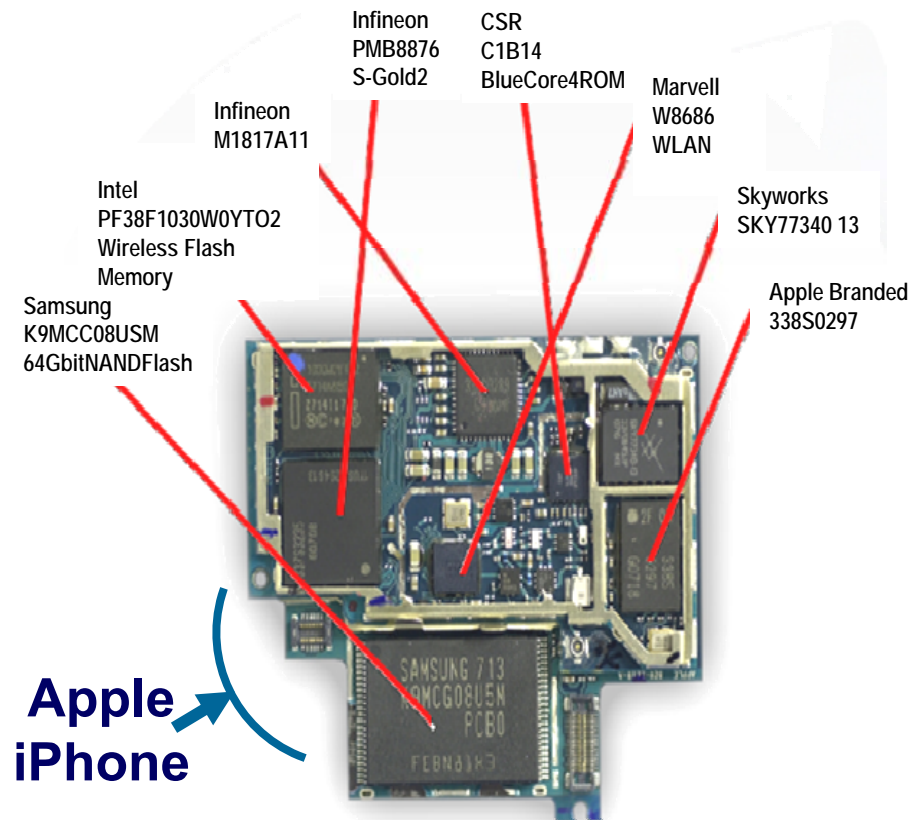
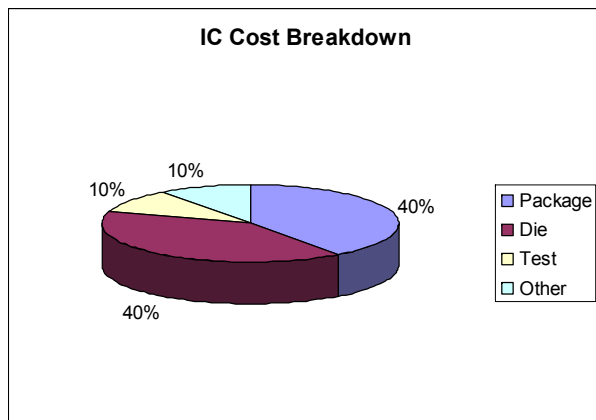
- ▶ TSMC's logic technology roadmap introduced at the 2007 Technology Symposium
- ▶ Low power technology nodes dominate the future
- ▶ Through 2009 there will be three low power nodes introduced while general purpose and high performance nodes will be combined for two nodes.



Package Technology for the Handset and Home Gateway

Packaging will go through dramatic changes to address the key issues of power, size, performance and cost for the Handset and Home Gateway

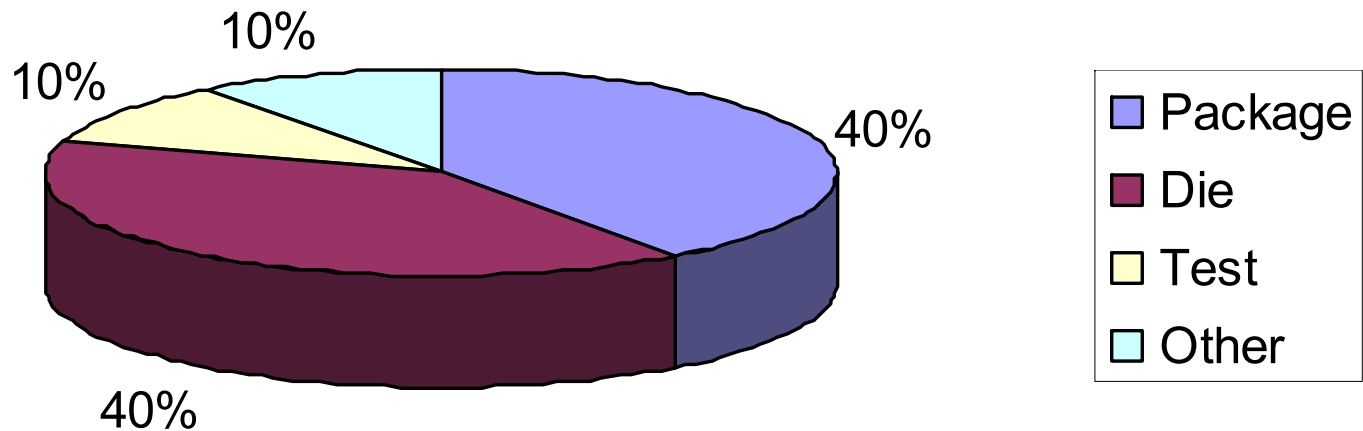
- ▶ Cost break down for a typical ASIC using a flip chip is dominated by the package
- ▶ Package sizes are prohibitive and must be reduced and even eliminated
- ▶ Migration to “Package-less Packaging” and Chip Scale technology will continue to be the future direction



As the industry shifts to higher levels of integration today's packages will vanish

Package Cost vs. the Die Cost

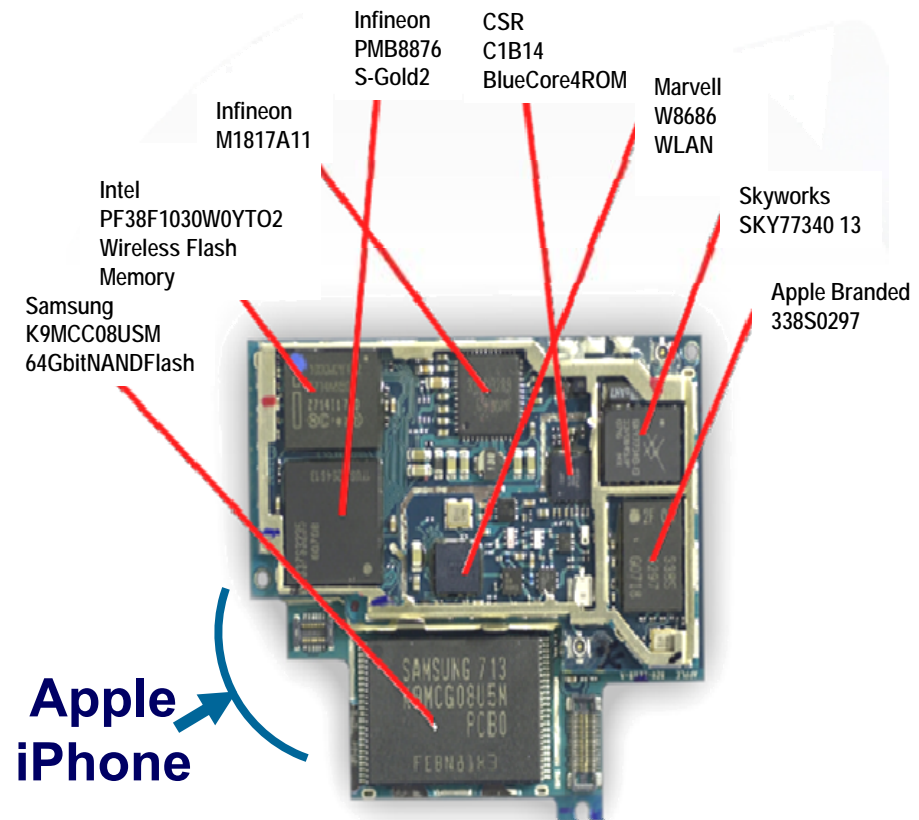
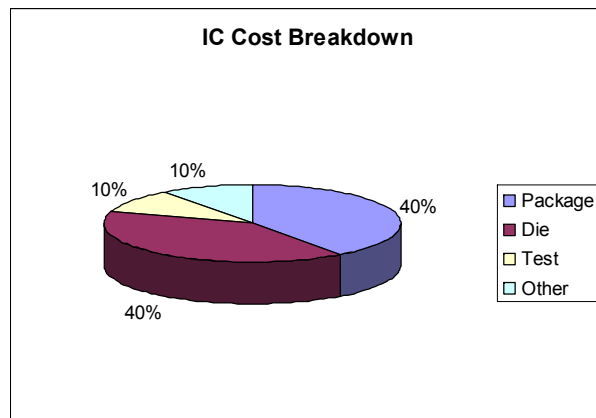
IC Cost Breakdown



Package Technology for the Handset and Home Gateway

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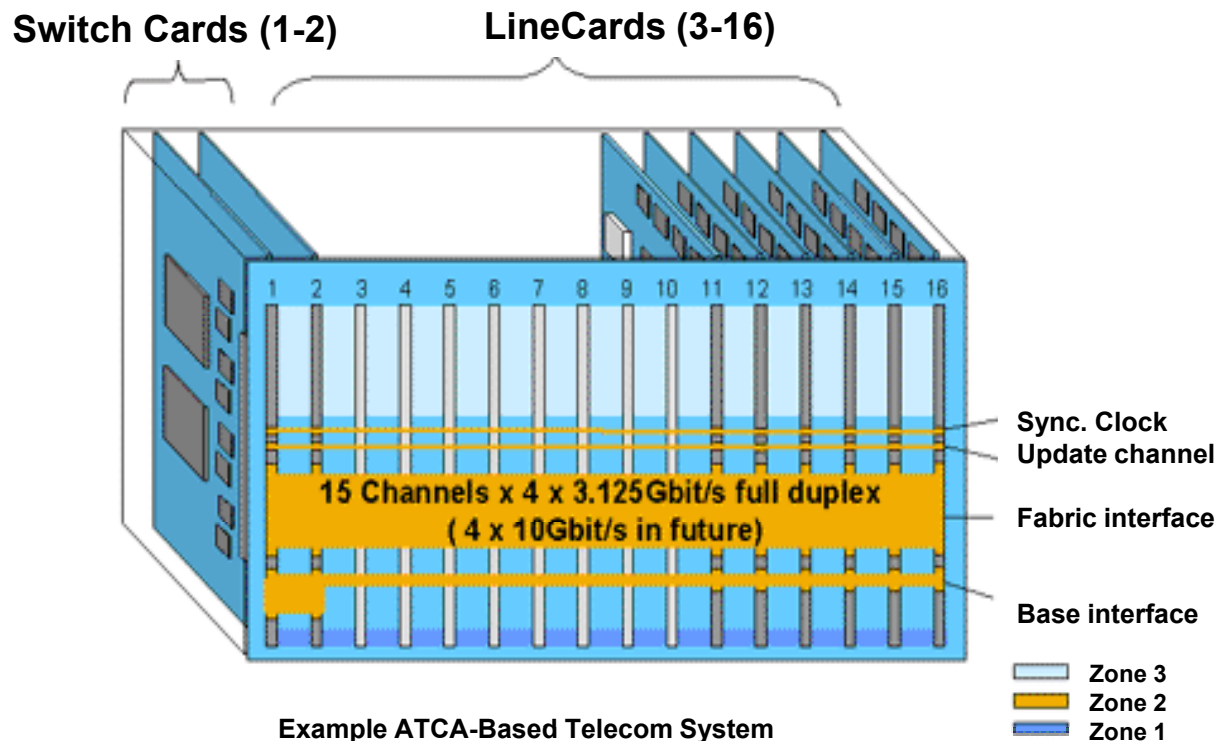


As the industry shifts to higher levels of integration today's packages will vanish

Access and Core Network Hardware Migrates to Standardized Platforms

Advanced TCA Standardization

- ▶ Standard Blades
- ▶ Standard Modules
- ▶ Push for open standards

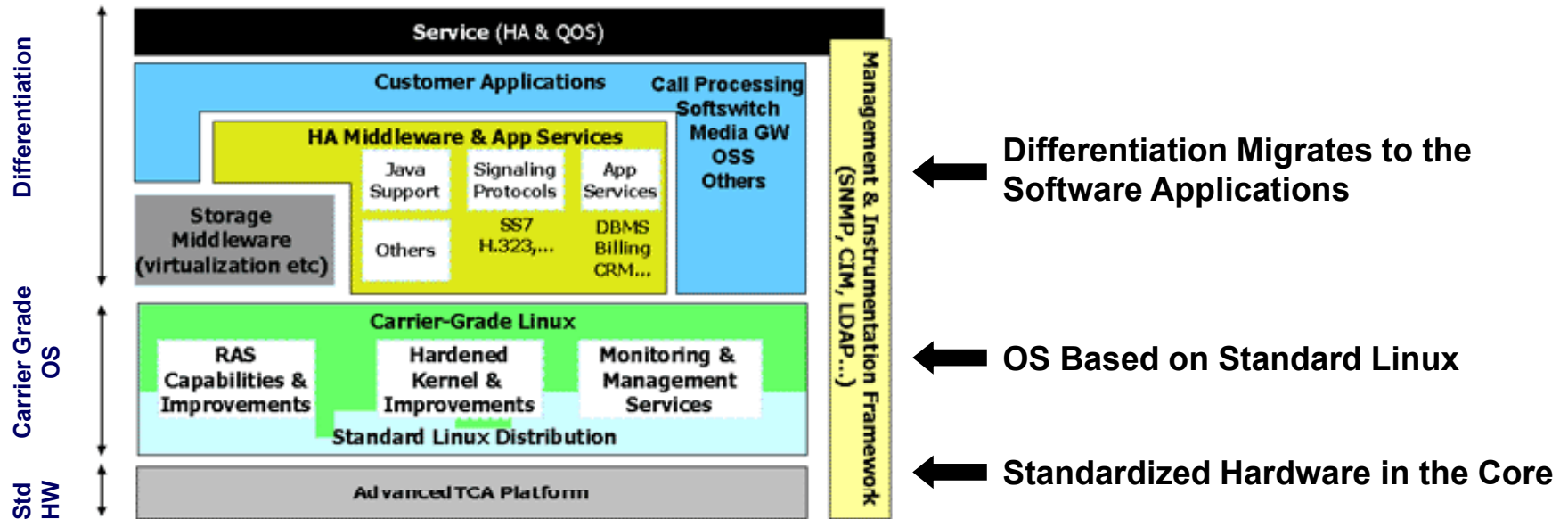


Example ATCA-Based Telecom System

Source: Light Reading

Access and Core Differentiation Migrates to Software Apps

Stack for Server Applications



Source: Motorola

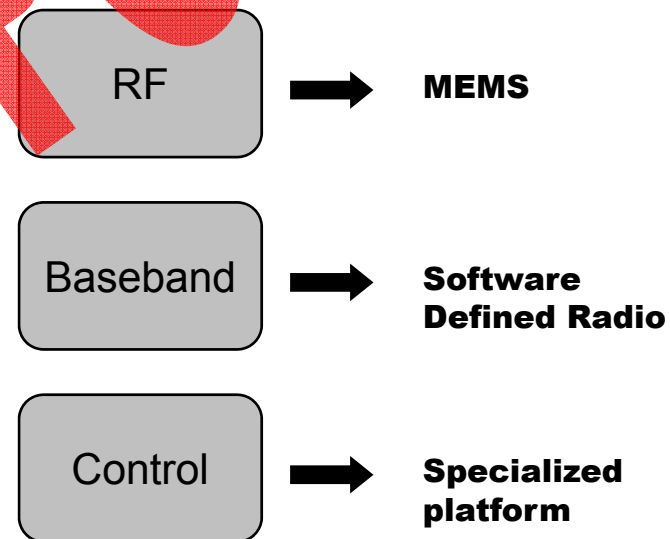
Specific Challenges in the Handset

The Issues

- ▶ **Power & Cost**
- ▶ **Very Short Product Life Cycles**
- ▶ **Continuous Drive to Add Functions, Features and Intelligence in very short time-frames**
- ▶ **Must Meet Multiple Geographic Markets with Different Standards with Little Change**

Hardware and Software Platforms will be Deployed to Reduce Time to Market While Increasing Levels of Integration, Function and Programmability

Typical Platforms

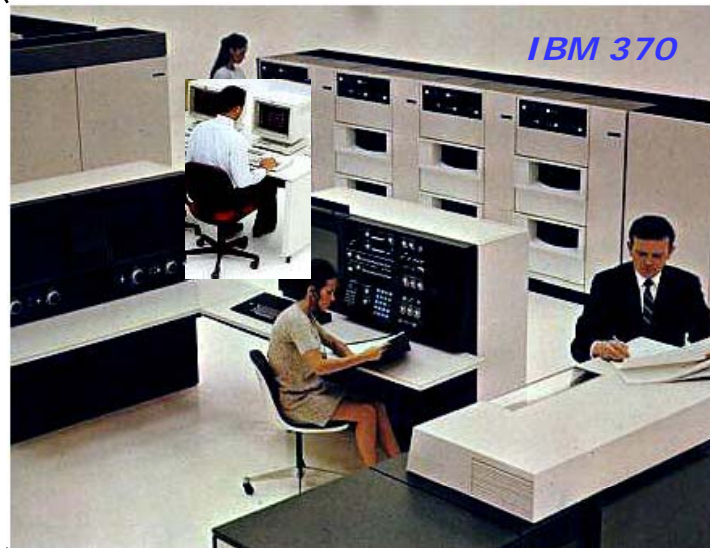


The 70's Main Frame Brought Vertical Integration

The Vertical Integration in the Main Frame Domain

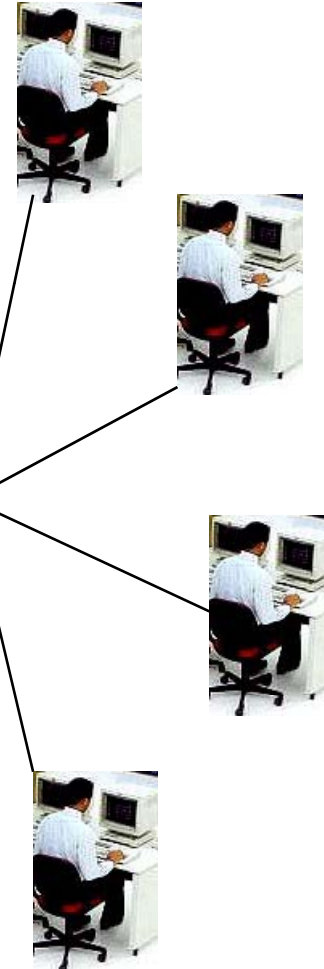


Large Corporate Installation



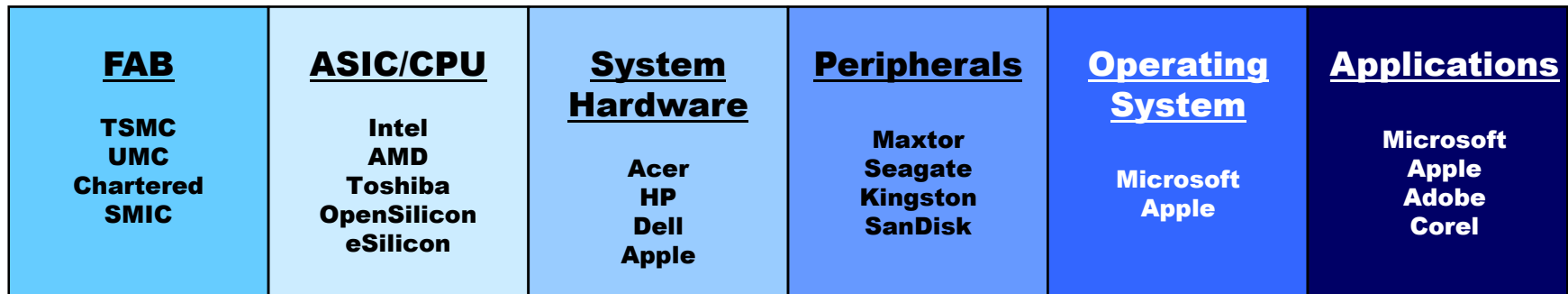
Main Frames Were Sold to Large Corporations and Not to the End Users

The End Users



The PC Deconstructed Vertical Integration

The Horizontal Deconstruction brought by the PC



System Integrator & Direct Sales



Direct Sales to the Customer

Diverse Customer Base from Corporations to Individuals

Seamless Mobility will have a Major Socioeconomic Impact

Pre-Industrial Revolution

- ▶ **The Company Provided the Space to Work**
- ▶ **The Workers Brought Their Own Tools**



We are Returning to a Pre-Industrial Revolution Model

Post-Industrial Revolution

- ▶ **The Factory Provides the Space and the Tools**



Seamless Mobility will have a Major Socioeconomic Impact

Modern Society of Today



The Personal Computer is the Primary Tool



Content Provided by Private and Corporate Servers

As more of the intelligence migrates to the handset it will become the primary tool of the office and personal life



Post-Modern Society



The Handset is the Worker's Tool

The "workers" will bring their own tools to the office



During this transition certain layers within the food-chain that are not adding significant value will disappear



Content Provided by Open and Public Suppliers

You Must Add Value in the New World to Survive

Examples of Who Will Face Threat in the Food Chain



The Laptop



The Handset



Retailers



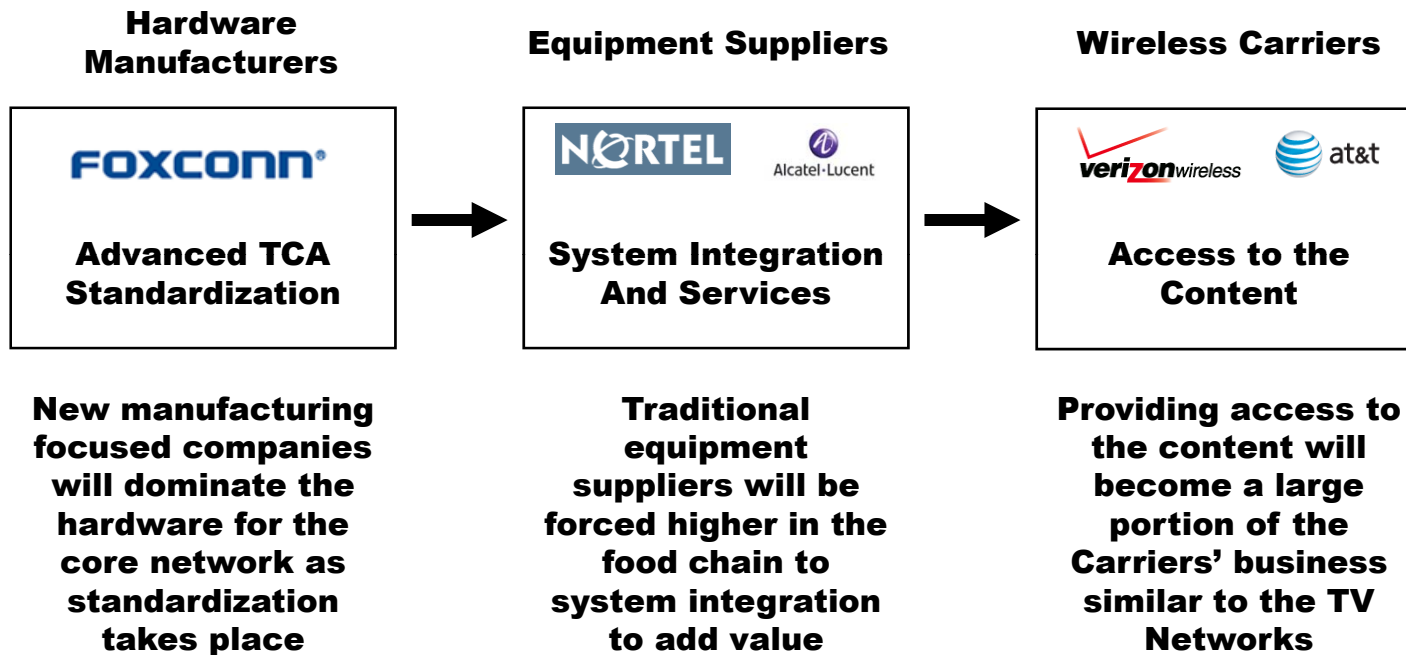
Wireless Carriers

**The Middlemen Will Be Under Threat
- Package Vendors, Distributors, & Reps**

Business Model Will Have Dramatic Change

You Must Add Value in the New World to Survive

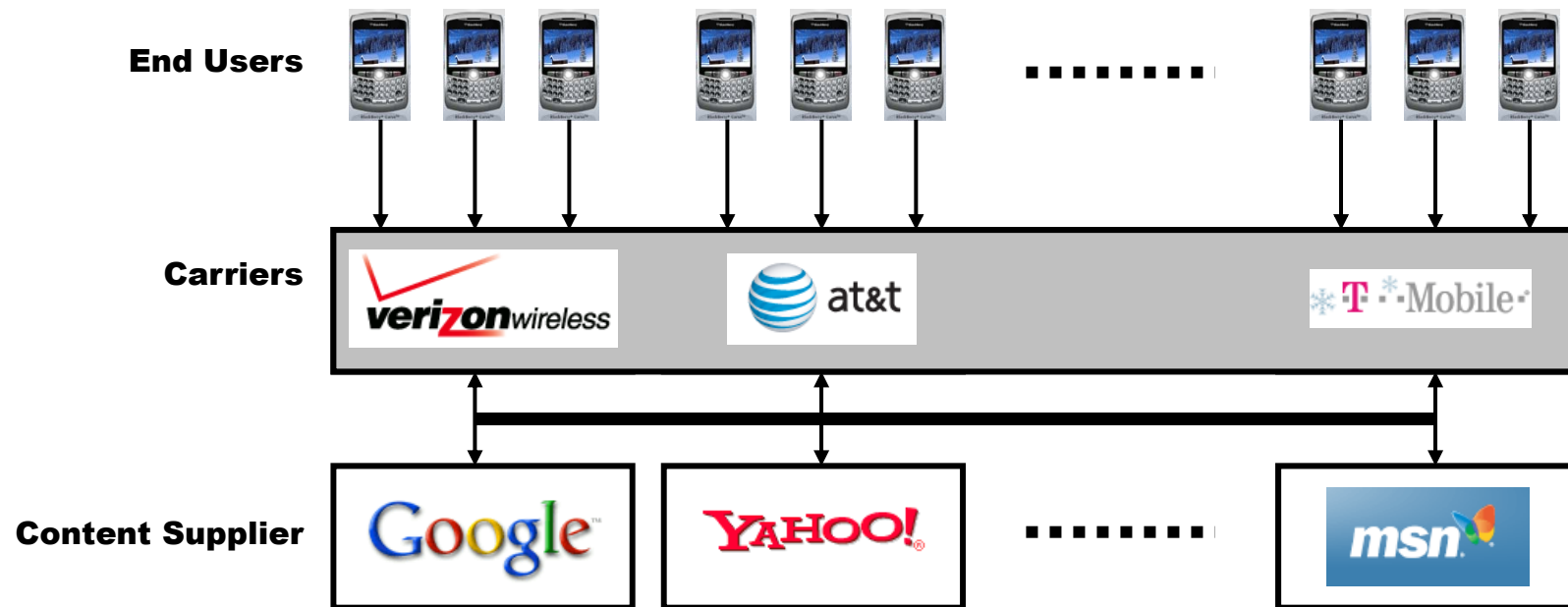
What will happen to the Equipment Suppliers to the Core Network?



Equipment Suppliers Will Become System Integrators

You Must Add Value in the New World to Survive

What will happen to the Carriers' Business Model?



Carriers Must Give the End User Seamless Mobility and Seamless Access to Content

What Will the World Look Like in the Future?

- **It will be a world without wire**
- **It will be a Mad-berry world**
- **Certain layers that dominate the food chain today will disappear**
- **And the workers will bring their own tools to work with him**

- **It will be a world without wire**
- **Intelligence will migrate more to the handset**
 - **Expert System and AI Concepts Will Be Incorporated**
- **Core and access network will be based on standardized hardware and software platforms**
 - **Differentiation Will Be In Applications and Managements SWR**
- **FPGA / ASSPs used mostly in the core and access**
 - **ASSP Business Future?**
 - **Platforms concept will dominate**
- **Volume is in the Handset / Home Gateway requiring specialized software programmable IC's**
- **SiGe / GaAs will face threat... CMOS is IN ?**
- **“Package-less Packaging” and chip scale technology will dominate**
- **In the End, Low-Power will be King!**



Thank You