Philips Semiconductors: Understanding Our Success

Arthur van der Poel

Chairman & CEO

Philips Semiconductors

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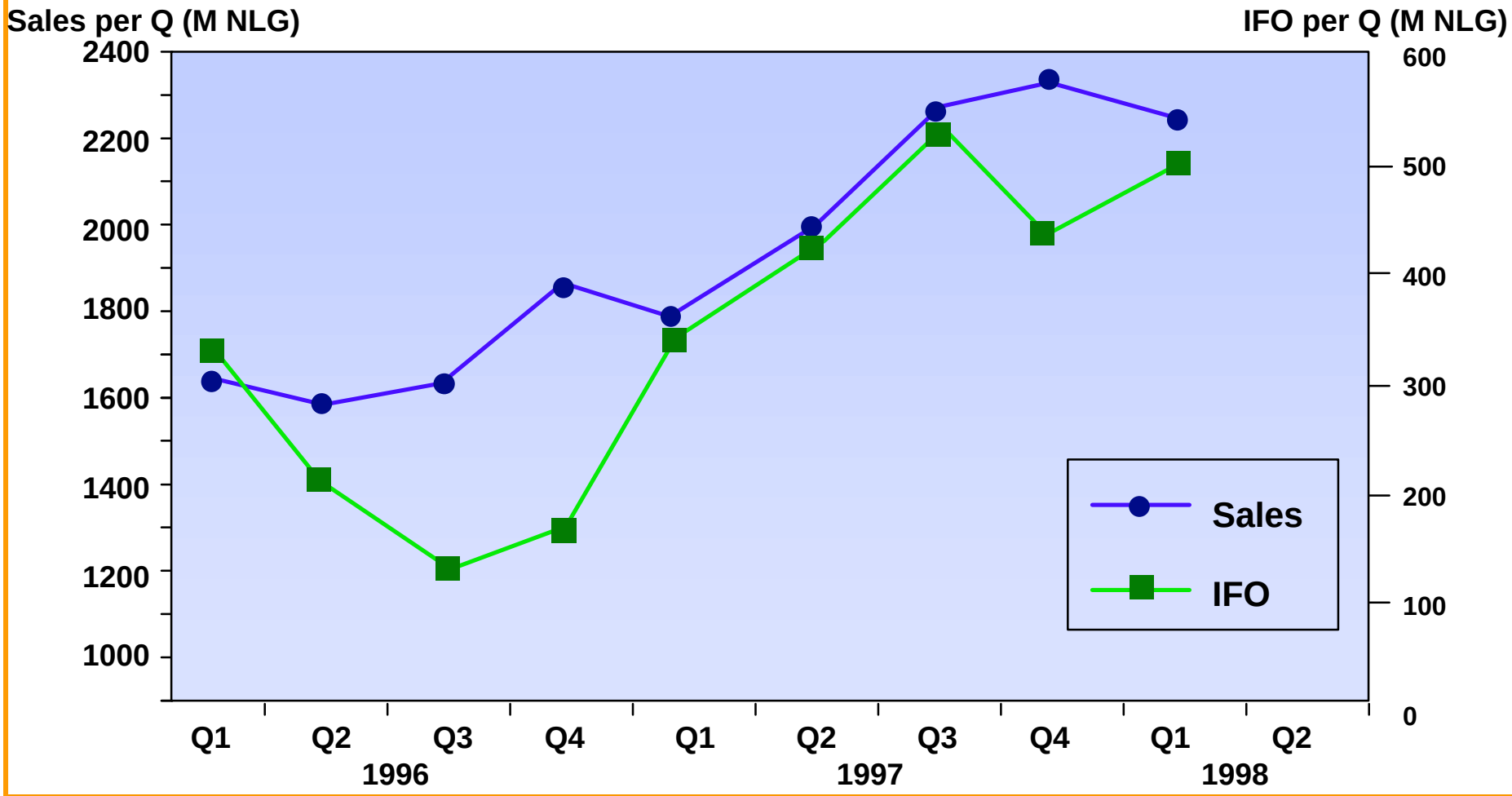
Contents

- Some facts and figures
- Understanding the current performance: Where?
- Understanding the current performance: Why?
- Near and long term growth opportunities
- Various elements of our strategy

Sales and IFO per quarter



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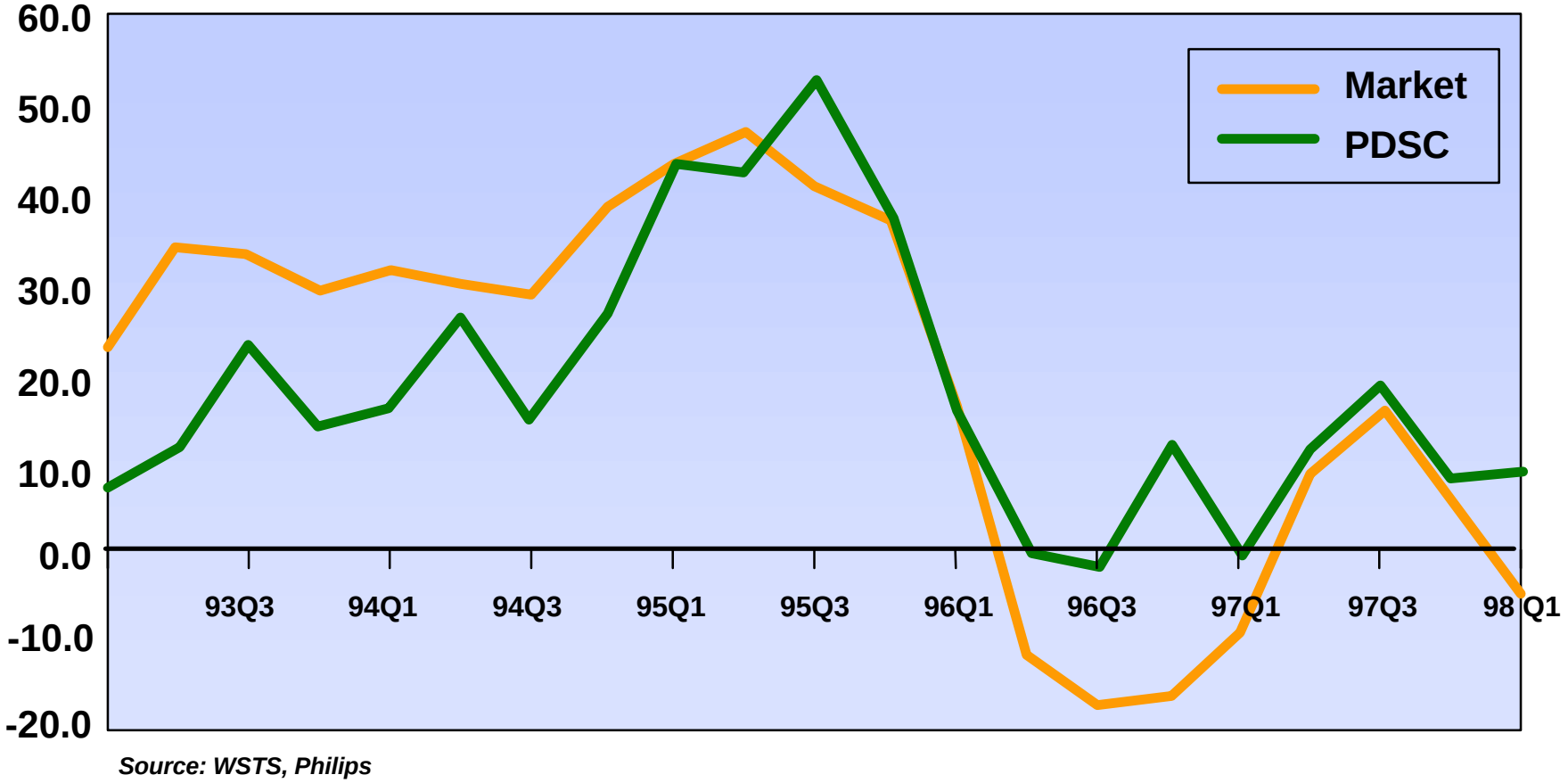
Our sales growth versus the industry

growth % w.r.t. same quarter previous year



Source: WSTS, Philips

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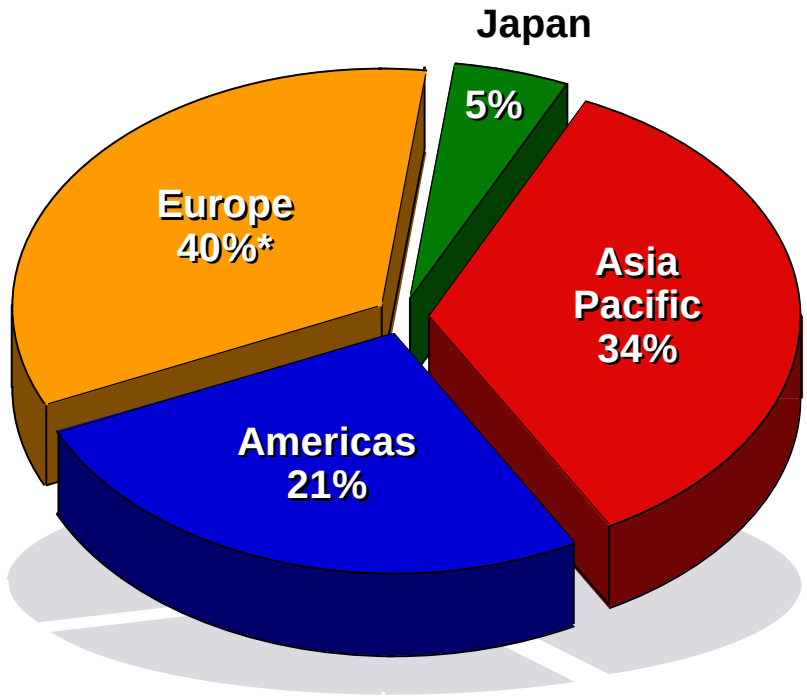
Questions about PS, asked by stakeholders

- Where did you grow: what products, what markets, what regions?
- Why did you grow; what are your strengths?
- Is the performance sustainable; what is the outlook for the near and longer term?
- Do you invest enough; in the right products, markets, technologies?
- What is the strategy?

Where did we grow?

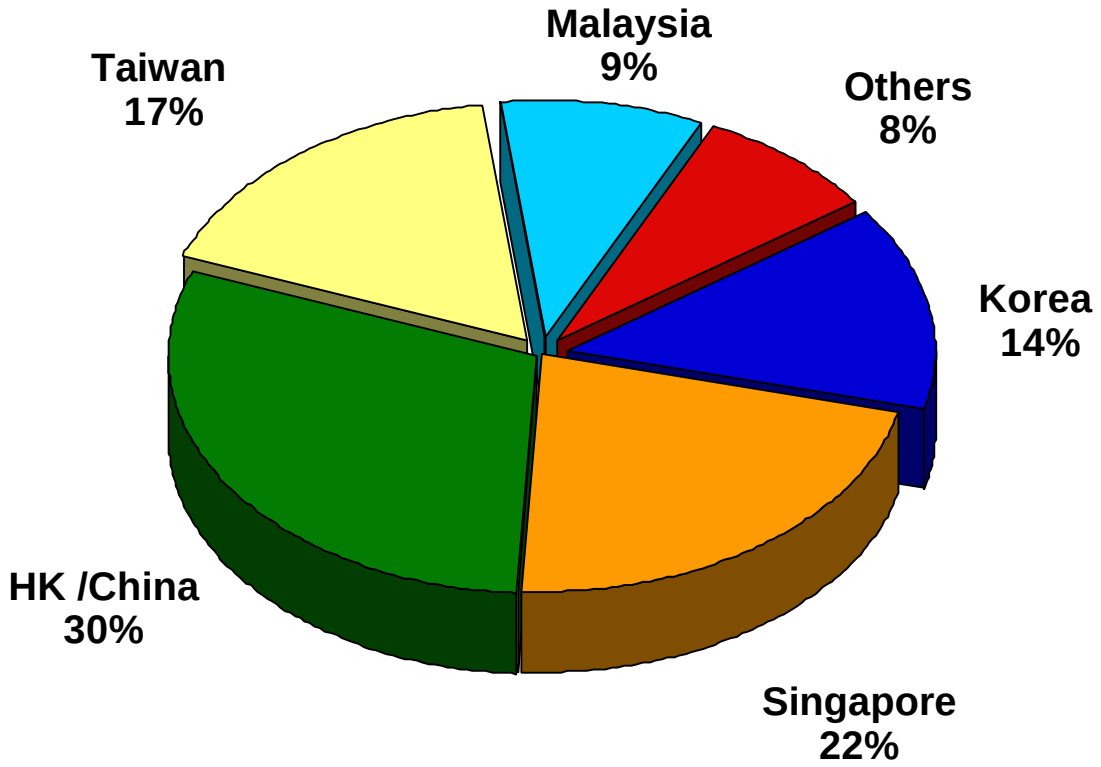
- Strong position in Asia, particularly in HK/China
- Internals, PCC
- Telecom: increasing participation in high growth market
- Consumer: consistent market share increase
- Discretes and multi-market ICs: price erosion compensated by volume growth
- Absence in DRAM market; moderately hurt by slow down in Japan

Total sales 1997 by region
In %

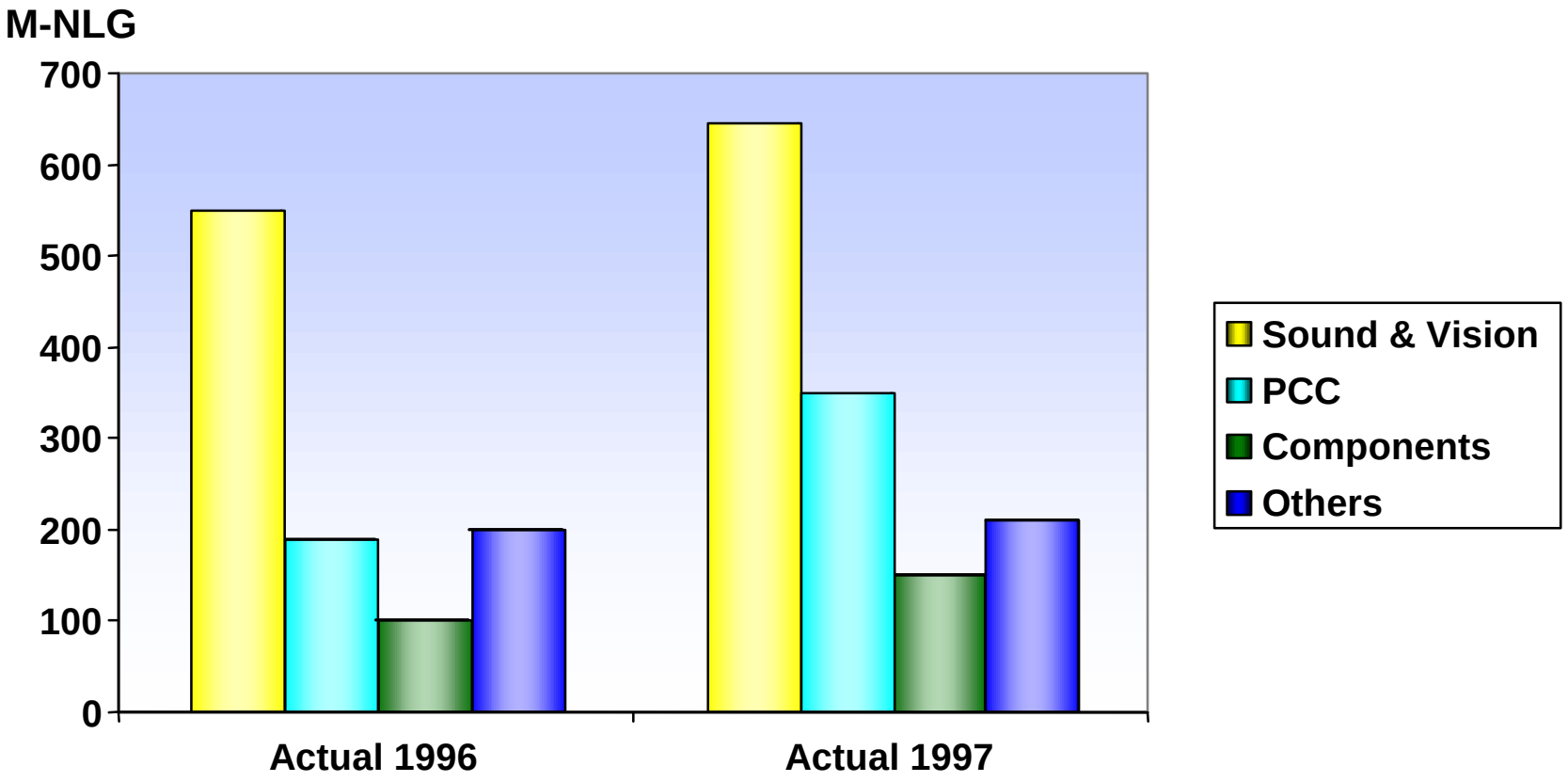


** Including licenses*

Sales in Asia 1997 by country
As % of Asia sales (excl. Japan)



Internal sales per account



Growth in Telecom Terminals Market

- Strong position in RF; volume growth with all the major players
- DSP position acquired in digital cellular & cordless
- ASICs in CDMA/TDMA
- Strong player in DECT
- Power amplifiers (modules and discrete)
- Major position in LCD drivers

We have an increasing participation in a high growth market

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Growth in Consumer

- Steady increase of market share in basic signal processing (one-chip TV)
- Feature TV: picture improvement, 100 Hz, PIP etc.
- Laser optics: solid growth in CD-ROM, Video CD and CD-R
- Audio power for carradio, audio, TV etc.
- Deflection and video ICs for monitors
- Leading position in tuner/tuning ICs

We have demonstrated growth at 20% or more by steady increase of market share in a market that grows single digit or low teens

Why did we grow; what are our strengths?

Our leading positions (#1 worldwide)

- **Small signal processing in TV**
- **Picture improvement and video processing**
- **Tuning**
- **LCD drivers for (a.o.) cellular phones**
- **Cable TV modules**
- **Monitor deflection ICs**

Why did we grow; what are our strengths?

We are among the world's top-3

- **(Car)radio, front end and DSP**
- **RF in telecom terminals**
- **Audio power for wide range of applications**
- **Power management (DC/DC converters, battery mgt, green SMPS)**
- **Decoders and motorcontrol in CD-audio, CD-ROM, Video CD, CD-R**
- **Consumer Systems**
- **Discrete Semiconductors**
- **CMOS Logic**
- **Microcontrollers**

Discretes and Multi Market ICs

- Significant investments done in Discretes (waferfabs and assembly)
- Advanced automated manufacturing lines (“BIM-lines”)
- Low cost manufacturing base for Logic ICs
- Price erosion compensated by volume increase
- ‘Feed the cow’ in microcontrollers, SMD Logic, small signal discretes
- Invest in CPLD, Discretes particularly Power MOS and RF

Common denominators

Bringing innovations to mass markets

- **Systems expertise**
- **Mixed signal processing**
- **RF**
- **Low cost manufacturing**

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Additional growth opportunities

- CPLD
- Identification (smart smart cards)
- PA modules for cellular
- Power MOS
- Buses (USB, IEEE 1394)
- LCD Monitor ICs
- Digital platforms / TriMedia

Do we invest enough?

- **Overinvestments are costly, ... very costly**
- **Underinvestments limit our growth opportunities**
- **With 20% subcontracting, you would expect us to spend at about 80% of industry average CAPEX spending**

- **We have spent smarter, with better " investment elasticity"**

Strategy

- Leadership
- Portfolio
- Growth
- Industrial strategy
- Technology

And obviously:

quality, environment, customer service

Leadership strategy

- Mindset change in market leadership
- Grow from the current number 9 position; top-3 position in Europe/SEA
- Solid progress towards our Ichi Ban goal in Discretes
- Recognized leader in Video processing, both conventional and new media
- Premier league technology
- Team up with leading players: customers, suppliers, competitors
- World class manufacturing
- Establish TriMedia as de facto standard for DTV

Portfolio

- We don’t plan to enter neither the DRAM nor the microprocessor market
- Basically satisfied with current portfolio, but we explore white spots
- Discrete Semiconductors: for us a business to invest in, rather than milk
- Accelerate investment in SW
- Silicon System Platform philosophy as basis for portfolio decisions

Growth

- Grow faster than the market
- Internally generated growth to lead to > 3.5 % share of TAM
- The new business unit Emerging Businesses shall generate non-traditional opportunities
- Relative higher growth at key customers and at disti's
- Cooperation with competitors for accelerated growth by saving cost, time or gain momentum

Our portfolio leads to sustainable and profitable growth

Industrial strategy

- Majority (80 %) in house
- Work towards “product flies only twice” infrastructure
- Next-door subcontractors
- Build on our low cost manufacturing capabilities
- Share “mega fab investments” when and where relevant, not only to share cost, but more importantly, to share ramp up risks
- Systems businesses drive fast learning curve
- Multi market businesses drive low cost capabilities/mindset

Technology

- Partner when and where relevant, particularly in ‘horizontal’ technologies
- Silicon System Platform strategy drives technology priorities
- Premier league technology
- Priority for digital technologies, but at the same time nurture RF and mixed signal expertise

Conclusion

- Our growth is understood on the basis of portfolio and regional presence
- Our performance is built upon specific strengths and leadership in “our markets”
- As before we remain cautious on the near term future
- Our current strategy is built on internally generated growth
- We have a solid technology and industrial strategy

We believe our better - than - industry performance is sustainable


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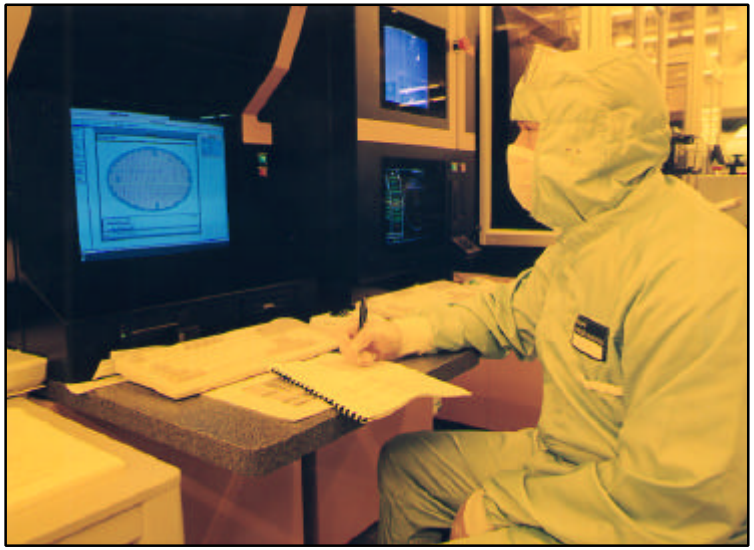
Philips Semiconductors: Operations Focus



Stuart McIntosh

Chief Operations Officer

Philips Semiconductors

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Contents

- Make vs Buy
- Growth and Investment
- Performance
- Partnerships
- Volume
- Speed
- Benchmarking

Manufacturing Strategy
Make/Buy

- **We make 80% and buy 20%**
- **We buy for flexibility and a window on the market**
- **We make for sound economic reasons**
- **We make because our specific technologies are not always available from foundries**
- **We make because our volumes are larger than the foundry market can easily supply**
- **We make for customer confidence - no top twenty player is fabless**
- **We make because we are good at it**

Profit through manufacturing
by investment

Market growth and investment

Industry	1993	1994	1995	1996	1997
Sales bln$	77	102	144	132	139
CAPEX bln$	15	23	40	42	41
% of sales	19	22	28	32	29

Philips Semiconductors					
Sales bln$	2.2	2.7	3.9	4.0	4.2
CAPEX bln$	0.13	0.38	0.96	0.72	0.4
% of sales	6	14	25	18	10

Industry source: Dataquest 1997

Profit through manufacturing
by investment

- **Market growth - 1993 to 1997**
  - **World Semiconductor market: +14% CAGR**
  - **Philips Semiconductors: +15% CAGR**
- **Capital investment**
  - **Industry: 27% of revenue**
  - **Philips: 12% of revenue**
- **Between 1995 and 1997 Philips increased investment level to 17%**
- **‘We saved’ the equivalent of about 2 wafer fabs**

Profit through manufacturing
by investment

- Market growth and investment
- The industry over invested in the period 1995 to 1997
- Portfolio, business cycle and timing play a part
  - The DRAM business needs a constant stream of leading edge fabs only
  - Intel needs a constant stream of leading edge fabs only
  - Philips Semiconductors also needs leading edge fabs but not only leading edge fabs

One can invest Wisely. . . . .

Or Unwisely . . . . . .

Profit through manufacturing
by utilisation

- **Fab utilisation**
  - **Industry norm is 85%**
  - **We achieve greater than 90% for our wafer fabs**

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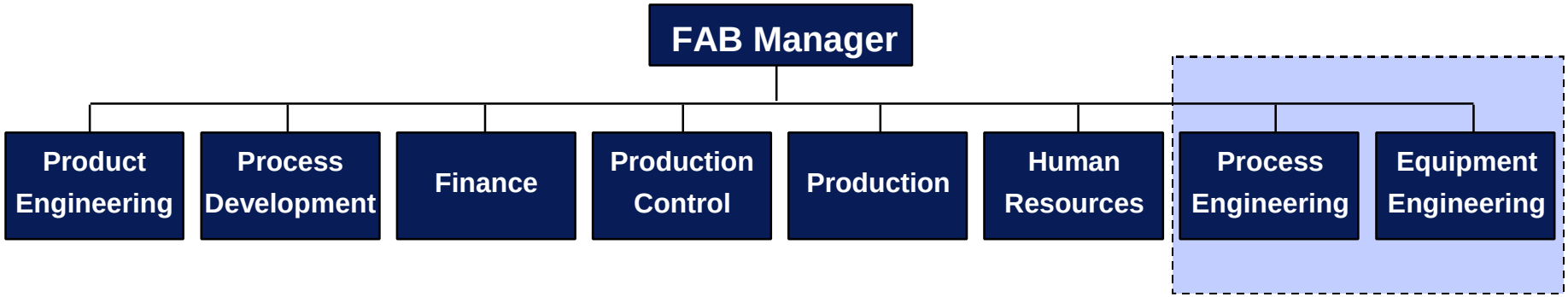
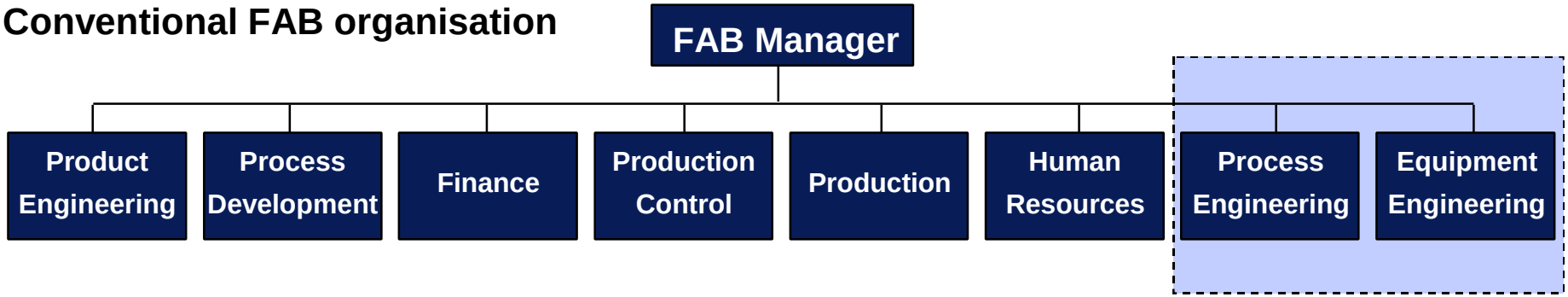
Conventional FAB organisation

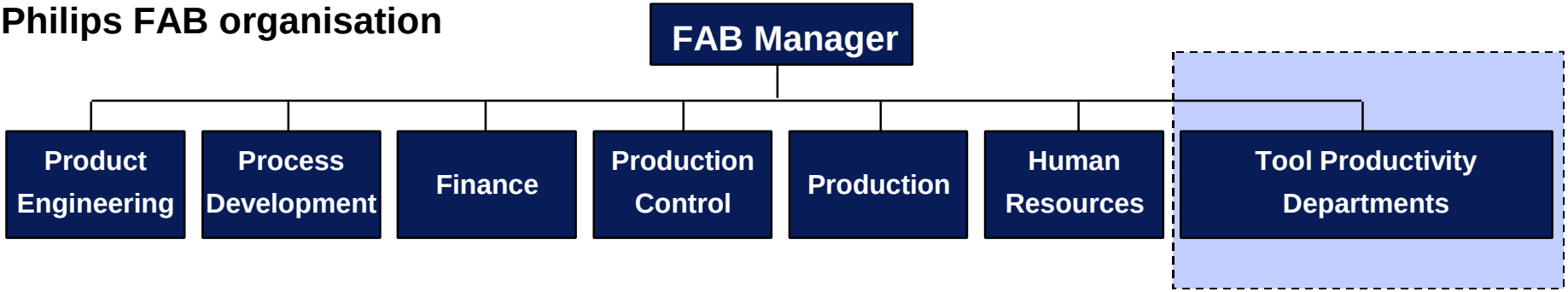


Conventional vs Philips FAB organisations

Conventional FAB organisation



Philips FAB organisation



Profit through manufacturing
by cost control

Costs

- **Thin corporate overheads**
  - **Headquarters staff** — **0.01% of employees**
  - **COO staff** — **0.0006% of employees**

Manufacturing Strategy
Improvement Yields

- **Line Yield**
  - **Industry benchmark is 97% for new fabs**
  - **We budget 95% for our diverse mix of fabs**

- **Defect density**
  - **Half Micron industry benchmark is 0.4 defects per cm^2 or better**
  - **Our budget is 0.32**
  - **Our actual Q1 is 0.3 defects per cm^2**

Profit through manufacturing
by yield

Whole yield chain

- **Joint responsibilities throughout the manufacturing chain:**

  - **Wafer fab line yield: fab + product engineers**
  - **Die probe yield: fab + product engineers**
  - **Final test yield: product + test engineers**

- **Assembly yields 99+ %**

Profit through manufacturing
by technology migration

- **Shrink of base CMOS processes give large productivity gain**
- **Example baseband GSM product**

200mm wafer	Potential good die per wafer
0.5µm	570
0.4µm	960
0.35µm	2240

Four fold improvement in 1 year!

The 300 mm issue

- 300mm will be mainstream by about 2003
- Early adopters will pay the price
- 300mm economics favour large volume products specifically DRAMs and microprocessors
- By about 2006 we expect the economics to favour 300mm vs 200mm generally

We will carefully monitor our product roadmaps to be alert to changes which might influence our timing of entry to 300mm

Profit through manufacturing
by partnership

- ”Cost effective" partnerships
- Development:
  - STM Crolles - process technology
  - NEC - MIPS technology
- Manufacturing:
  - SMST - IC wafer fabs (Joint venture IBM)
  - ASMC - IC wafer fabs (Joint venture NorTel and Chinese partners)
  - SMP - Discrete assembly (Joint venture Motorola)
  - TSMC - IC wafer fabs

Profit through manufacturing
by volume

- **High volumes**

440 Bln package leads per year

Profit through manufacturing
by volume

High silicon outs: 90 wafers per sq metres

Example:

- **In 1987 a new fab in Nijmegen, MOS3, was built:**
- **The plan:**
  - **Technology: 1 micron CMOS 6” wafers**
  - **Capacity: 200 wafers per day**
- **Reality in 1998:**
  - **Technology: 0.6 micron**
  - **Capacity: 720 wafers per day**

MOS3

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Profit through manufacturing *by volume*

High silicon outs per Wafer Fab

- **Into the same building as MOS3 we 'slipped' MOS4:**
- **Technology: 8” wafers 0.5 to 0.25 micron**
- **Capacity: 700 wafers per day**
- **Capacity from "same building" is 2000 per day**
- **60,000 per month**
- **720,000 per year**

MOS3

MOS4

Profit through manufacturing
by speedy technology migration

March 1996	0.5 micron
March 1997	0.35 micron
March 1998	0.25 micron

Profit through manufacturing
by competitiveness

- **Benchmarking**

- **Constant benchmarking both internally and externally of many parameters:**
  - **Yields**
  - **Delivery performance**
  - **Cycle times**
  - **Wafer costs**

Profit through manufacturing
by competitiveness

Benchmarking with:

- **Customers - price performance curve (Moore's law)**
- **Partners - IBM, TSMC**
- **Competitors - STM, Motorola, Siemens, MEC**
- **New personnel hires from the industry**
- **Via International Sematech**
- **Market analysis and surveys**
- **Material and equipment supply companies**
- **Ourselves - 'the best of the best' technique**

Conclusion

- We operate in a global cyclical market
- We plan to:
  - Improve: constantly and quarterly
  - React: fast
  - Inspire: our people
  - Track: world class competitiveness
  - Service: our customers

- Our manufacturing is increasingly a service business
- Our manufacturing is a clear competitive edge

Conclusion

Some make money on IPR.

Some make money on manufacturing.

And then there is us.


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Philips Semiconductors: Products and Technology Focus

Dr. Theo A.C.M. Claasen
Chief Technology Officer
Philips Semiconductors

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Contents

- **Some facts from the past**
- **Trends in our markets**
- **Our response: Silicon System Platforms**
- **Conclusions**

Our track record

- **Recent growth and profitability have been the result of a well balanced portfolio of skills:**
  - **process and design technology**
  - **cost effective manufacturing and packaging**
  - **customer service**
- **And above all: systems knowhow**
  - **analog and digital architectures**
  - **analog and digital signal processing**
  - **cost effective implementations**
  - **application knowhow in focused market segments**

Process technology

Strategy

- **We co-develop CMOS with our partner STM at Crolles**
- **We add specific technology variants, like non-volatile memories**
- **We develop advanced bipolar and BiCMOS technologies based on fundamental contributions from our Research Labs**

This program has brought us at par with the premier-league companies in the industry in CMOS and to be a recognised leader in analog, RF and low power applications

Design technology

Strategy

- **We have adopted a uniform design technology based on tools from Cadence and other vendors, complemented with own tools where we are leading *(analog, test)***
- **We bring these together in a "Qualified Design Flow" used in all design centres**
- **We have an ASIC service group to develop libraries of cells and blocks, including memories, analog blocks, CPU and DSP cores**

We are at par with the best in the industry

in our design capability

System competencies

Strategy

- **We specifically target the areas of Audio, Video, Telecom Terminals**
- **We develop new architectures with our system partners**
- **Our multimarket and discrete products complement the application specific IC's to offer complete system solutions (e.g. micro's, CPLD's, power transistors)**
- **We have Systems Labs with a wide range of system and software competencies for innovation and sales support**

We offer complete system solutions in the targeted markets

Signal processing

Strategy

- **We participate in system innovation based on signal processing** ***(standards for TV, CD, DVB, DAB, GSM)***
- **We make cost effective implementations** ***(one-chip TV, CD and CD-ROM, Set top box, GSM chip set)***
- **We mostly concentrate on embedded DSP**

We are less known as a DSP company, but have a broad embedded DSP experience

General purpose vs embedded DSP

General purpose

- Chip design compromise for applications across the range
- Memory size as large as possible
- Limited variety
- Extensive development tools
- Large application library
- Support and marketing

Embedded

- DSP Core tuned to specific application
- Dedicated on-chip memories
- Many variants (#bits, memory, I/O)
- Trade-off speed, power, silicon area
- Limited application library
- Compiler and scheduler tuned to application

Digital Signal Processing
Our strength is the combination of:

- **Algorithmic knowledge *(TV, audio, speech)***
- **Design skills *(Silicon compilers)***
- **AD/DA and mixed signal integration *(Bitstream)***
- **Embedded DSP and Media processors *(R.E.A.L., TriMedia)***

Emphasis on economical (low cost, low power) and easy to use realisations

Specific example
Melzonic: TV processor for 100Hz upconversion

- **100Hz upconversion in TV needed because flicker becomes visible with increased brightness**
- **Uses motion estimation based on innovative (simplified) algorithm *($10 vs $10,000)***
- **Developed on VSP *(video processor chip)***
- **Implemented with Phideo silicon compiler**
- **Used in Natural Motion TV *(innovation of the year 1997)***

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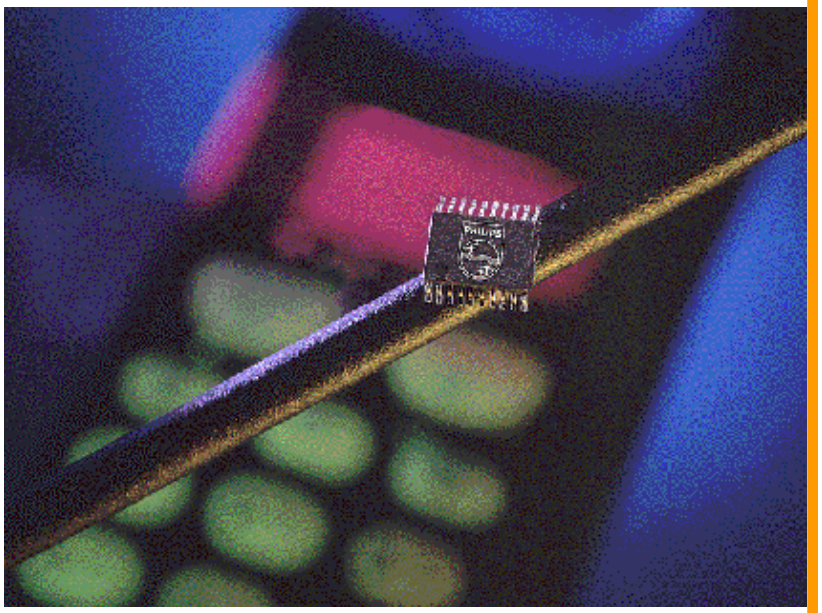
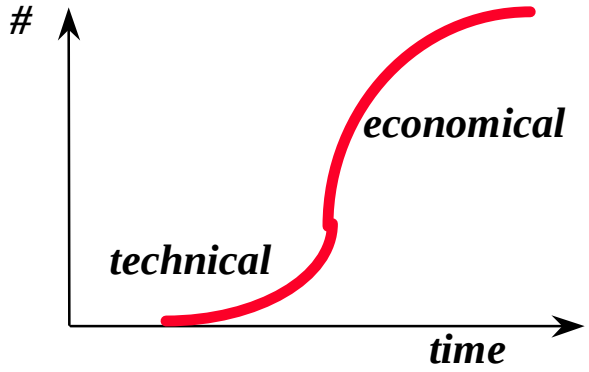
Market trends

- Consumer systems become digital:
  Time has come for video
- Applications converge
- Adaptivity & Interactivity
- Upgradable (via software)
- New services and applications
  - De facto standards
  - Being first is essential
- Higher degree of integration
  - From one-chip to system-on-a-chip
  - And beyond: Silicon System Platform



Consumer digital systems

- Consumer systems become digital if
  - Technically feasible
  - Economically viable: cheaper than analog



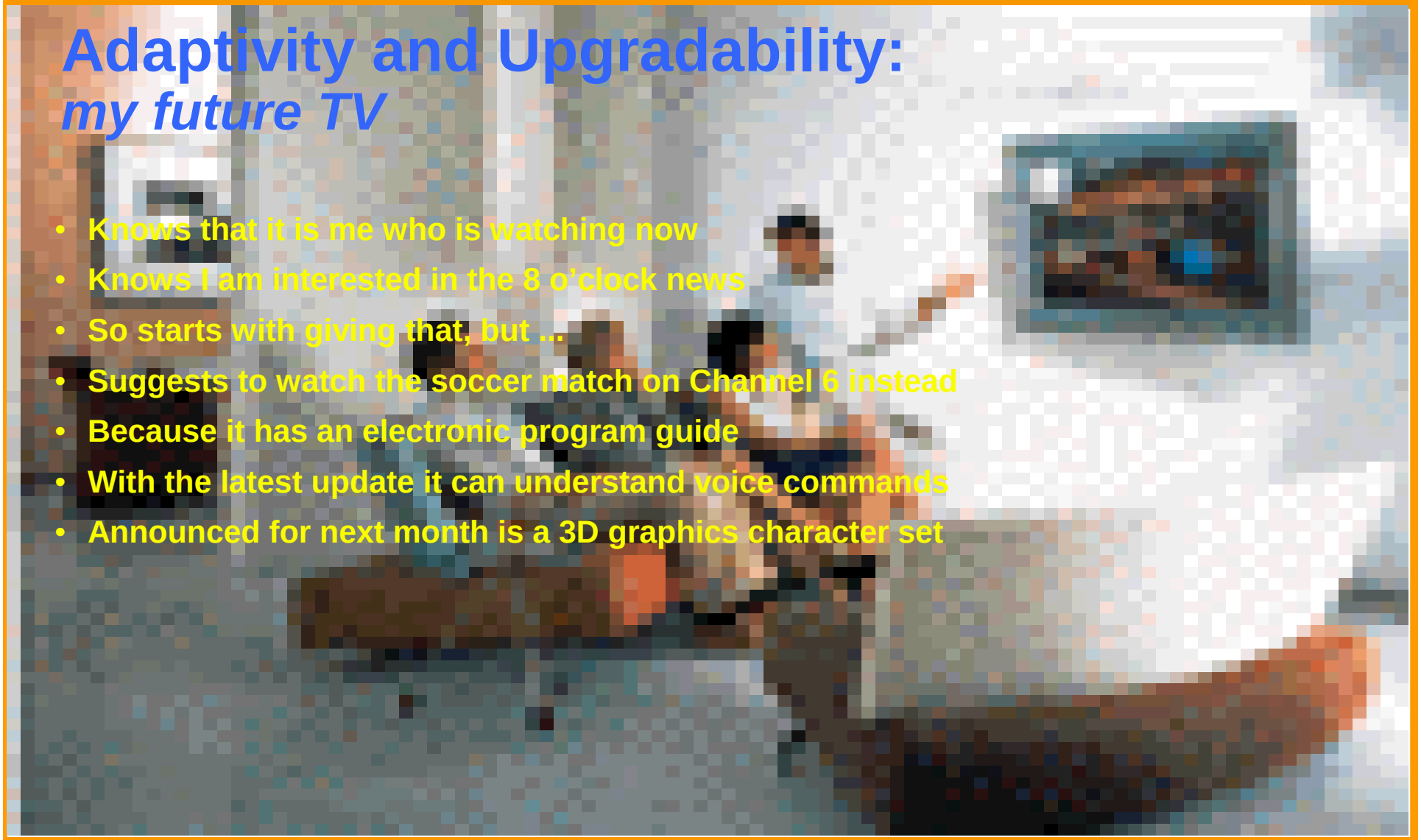
- At first digital implementations of analog functions
- Then additional features
- Early 70's: speech (digital telephony)
- Next audio (CD, 1983)
- Now is the time for video: DVD, Digital Video Broadcasting

Convergence of applications
TV, PC and telephone applications converge

- **This does not mean that “one box will do it all”**
- **All boxes will do a bit of everything**
- **A TV will get a modem for communication (web-access and videophone)**
- **A telephone will get video capability for video-mail and videophone**
- **A PC will get video functions for DVD-ROM and web-access**

But... a TV remains mostly an entertainment machine and a PC mostly a productivity machine, so that we will need them both

Adaptivity and Upgradability:
my future TV



- Knows that it is me who is watching now
- Knows I am interested in the 8 o'clock news
- So starts with giving that, but ...
- Suggests to watch the soccer match on Channel 6 instead
- Because it has an electronic program guide
- With the latest update it can understand voice commands
- Announced for next month is a 3D graphics character set

Adaptivity and Upgradability

The system adapts to the user and not vice versa

- **Such features are essential for acceptance of new technology**
- **No invention needs to be done: all features exist today, but...**
- **Today too complex for cheap implementation**
- **With next generation chips this can all be integrated on one or a few chips**
- **The major problem is the design complexity**

Traditional and New Services/Applications

Traditional *(Well defined, non-interactive)*	New *(Digital and/or interactive)*
• TV broadcasting	• Direct Broadcasting Satellite • Web-TV
• Telephony (POTS)	• GSM with Short Message Service and e-mail
• Car radio	• Car radio + navigation + GSM + route guidance service
• FM broadcast audio	• Digital Audio Broadcast + Data

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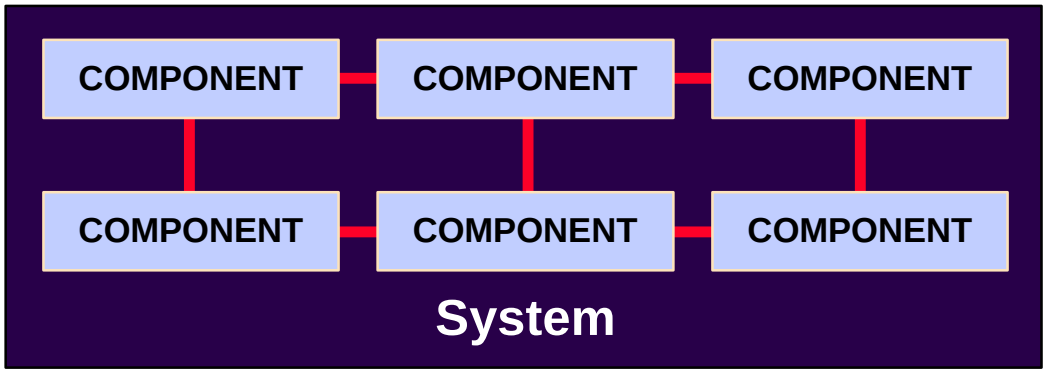
One-chip vs System-on-Silicon



Integration of functions (Si-board);

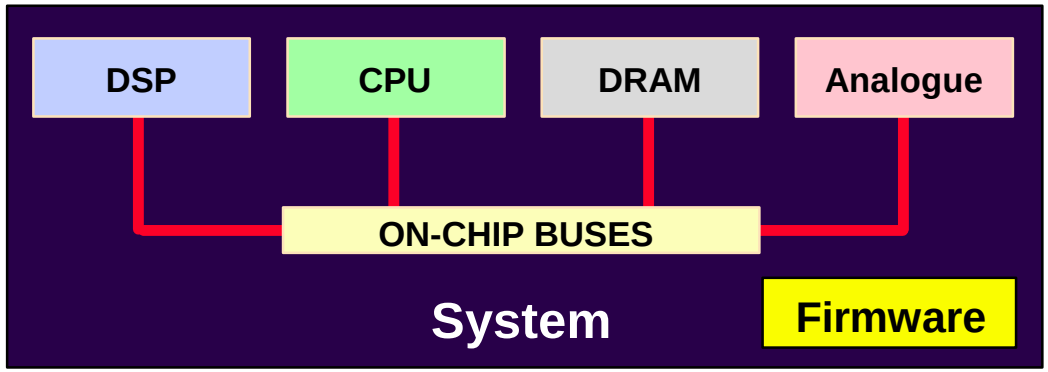
Dedicated design

One-chip (integrated system)

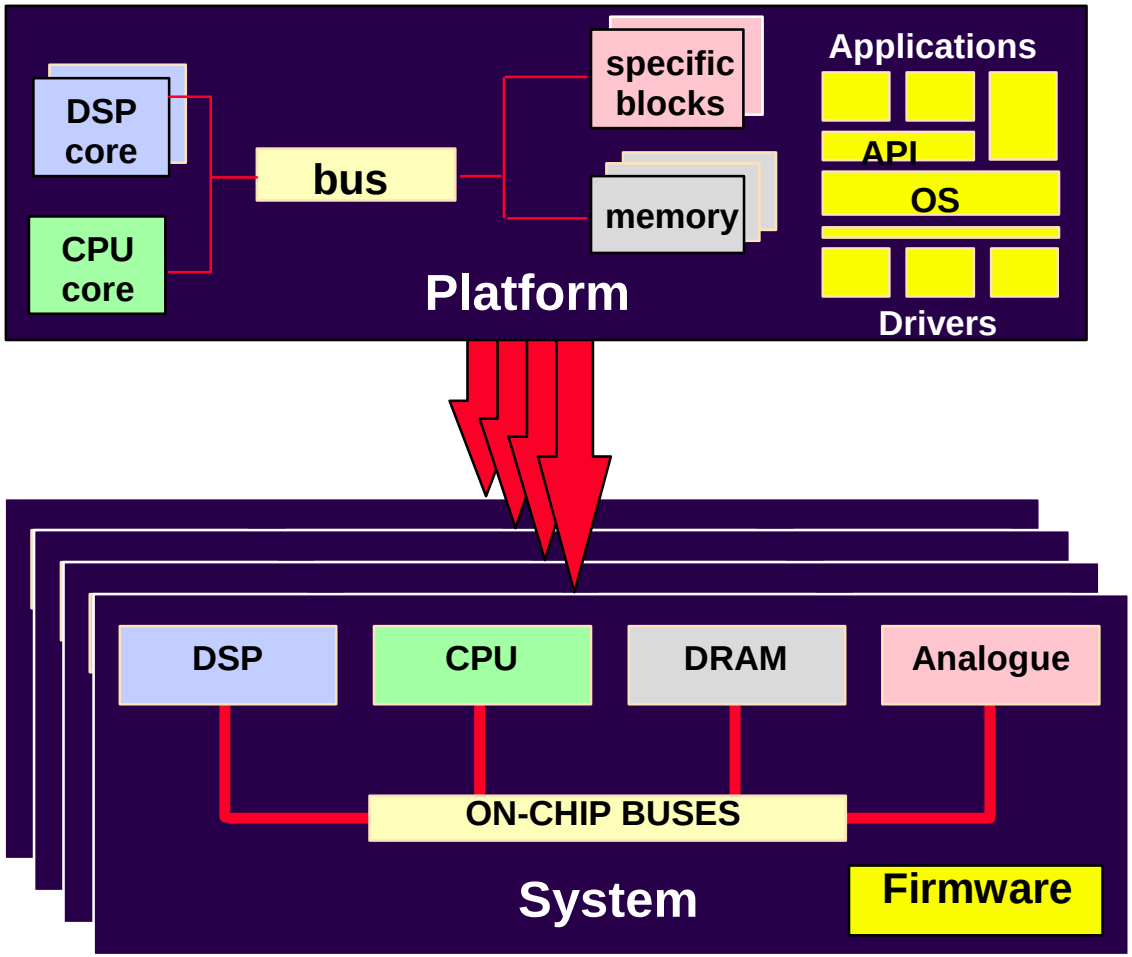
System-on-Silicon

Programmable elements with bus-interconnect;

HW-SW co-design



Silicon System Platform



One platform per application domain

Various different Systems-on-Silicon

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Silicon System Platform: Elements

- **Hardware**
  - ***CPU (core)***
  - ***DSP (core)***
  - ***Specific function blocks (digital and analog)***
- **Software**
  - ***Operating System***
  - ***API***
  - ***Drivers***
  - ***Specific software modules (application modules)***
- **Interface (System and on-chip bus(es))**

plus

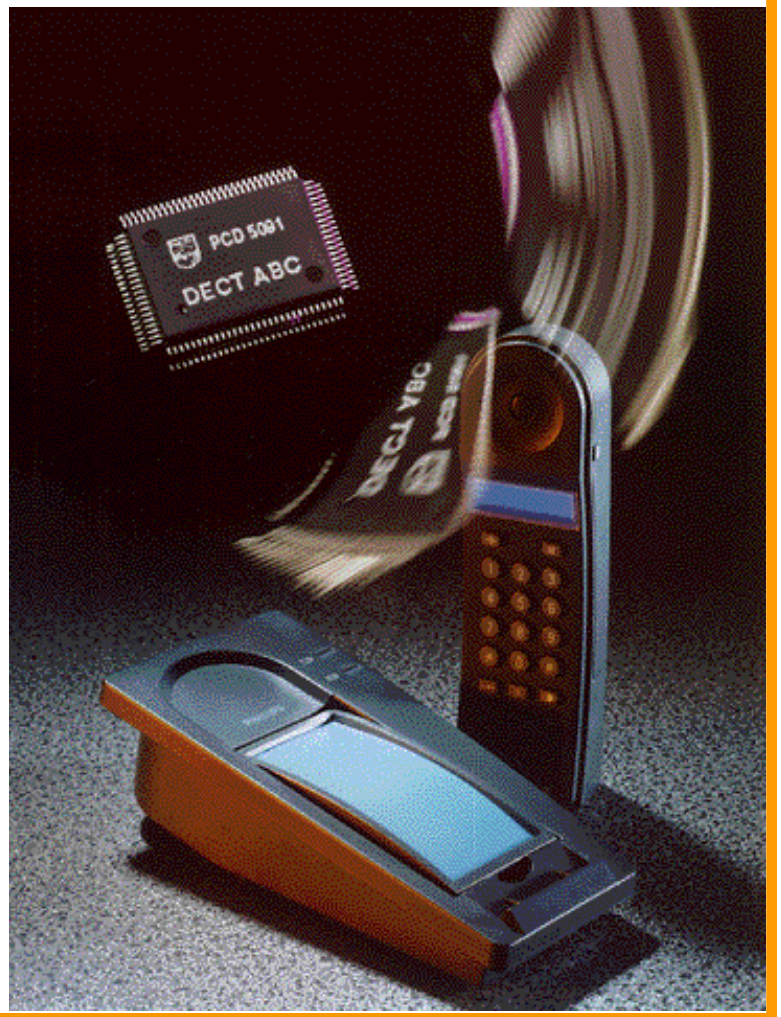
- **Development Tools (for HW and SW)**
- **Process Technology suited for the application**

Platform example: 1

- Application domain: Digital TV
- Specific applications: DTV, DVB, DVD-video, Set-top box
- CPU: MIPS
- DSP: TriMedia
- OS: pSOS/WinCE
- Buses: I^2C, USB, i-Link (IEEE 1394)
- Process: CMOS+DRAM

Platform example: 2

- Application domain: Telecom Terminals
- Specific applications:
  cellular telephony (GSM, TDMA, CDMA),
  cordless telephony (DECT)
- CPU: ARM
- DSP: R.E.A.L
  (Philips' proprietary DSP core)
- OS
- Buses: AMBA (ARM-bus)
- Process: CMOS+SRAM+NV; RF



Platform design: re-use of HW and SW

- Re-use is only possible within an application domain and when blocks are designed for re-use
- CoReUse is our approach to HW-IP re-use
- Is used in today's design
- MoReUse, concept for re-using software modules
- Introduction with TV/STB software

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Conclusions

- We are dominant in consumer markets because of our systems expertise and the well targeted process and design skills
- Our markets will change because of integration and digitization
- We will need to provide:
  - design of large number of applications
  - high level of re-use (HW and SW)
  - fast time to market

Silicon System Platforms is our answer


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