

Dr Ir Egbert-Jan Sol, adj-directeur TNO Industrie

Hoe creeren wij de opvolgers van Philips, Oce, ASML voor het jaar 2020 in (NL/Bel) Brabant?

TNO Industrie

Bits & Chips 2004 Eindhoven

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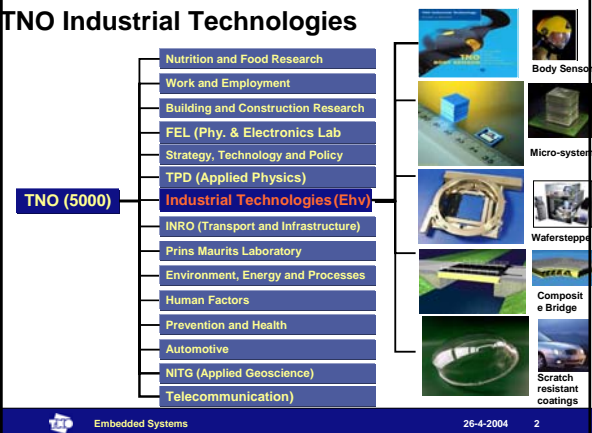
TNO Industrie – Eindhoven - 040 2650000



TNO Industrial Technologies

TNO (5000)

- Nutrition and Food Research
- Work and Employment
- Building and Construction Research
- FEL (Phy. & Electronics Lab)
- Strategy, Technology and Policy
- TPD (Applied Physics)
- Industrial Technologies (Ehv)**
- INRO (Transport and Infrastructure)
- Prins Maurits Laboratory
- Environment, Energy and Processes
- Human Factors
- Prevention and Health
- Automotive
- NITG (Applied Geoscience)
- Telecommunication



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De verantwoordelijkheid van de "bits & chips" wereld in Bel/NL

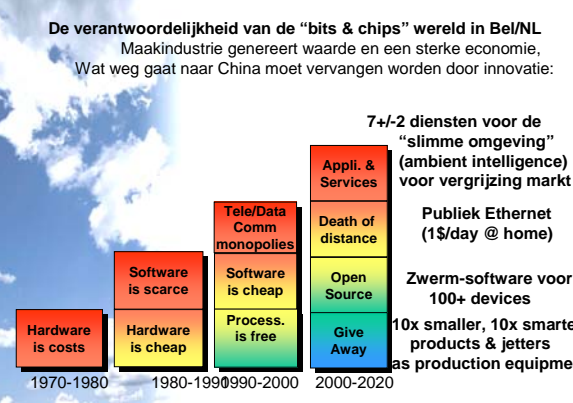
Maakindustrie genereert waarde en een sterke economie, Wat weg gaat naar China moet vervangen worden door innovatie:

7+/-2 diensten voor de "slimme omgeving" (ambient intelligence) voor vergrijzing markt

Publiek Ethernet (1\$/day @ home)

Zwerm-software voor 100+ devices

10x smaller, 10x smarter products & jetters as production equipment



1970-1980: Hardware is costs

1980-1990: Hardware is cheap

1990-2000: Software is scarce, Tele/Data Comm monopolies, Software is cheap, Process. is free

2000-2020: Appli. & Services, Death of distance, Open Source, Give Away

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TNO

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TNO Technische Menskunde

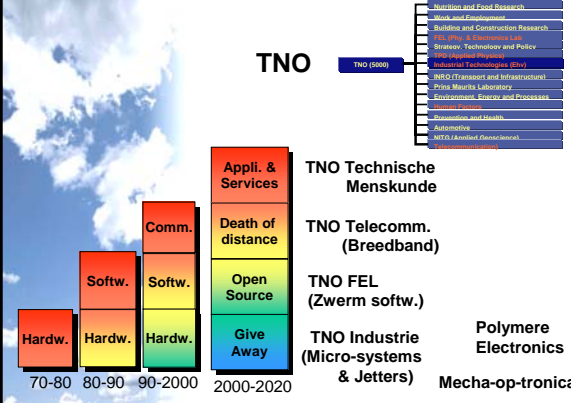
TNO Telecomm. (Breedband)

TNO FEL (Zwerm softw.)

TNO Industrie (Micro-systems & Jetters)

Polymere Electronics

Mecha-op-tronica



70-80: Hardw.

80-90: Softw.

90-2000: Softw., Comm.

2000-2020: Appli. & Services, Death of distance, Open Source, Give Away

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1st Generations ICT

Computers: Mainframe
Telecomm: Black Phone
Internet: Academic

2nd G: Microcomputers & WWW and Dial-in modems

3rd G: PDA's, Broadb. Mobile/UMTS

The 4th-G Ambient Internet

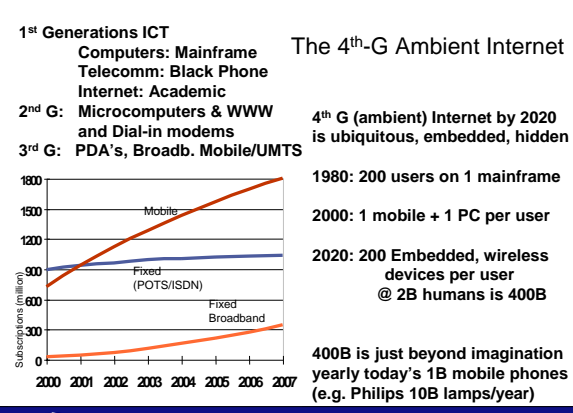
4th G (ambient) Internet by 2020 is ubiquitous, embedded, hidden

1980: 200 users on 1 mainframe

2000: 1 mobile + 1 PC per user

2020: 200 Embedded, wireless devices per user @ 2B humans is 400B

400B is just beyond imagination yearly today's 1B mobile phones (e.g. Philips 10B lamps/year)



Subscriptions (million)

2000 2001 2002 2003 2004 2005 2006 2007

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The 4th G Ambient Internet

"ambient intelligence" serving the user with care, comfort, control and communication

In Nederlands: De Slimme Omgeving

Logo van IOP Generieke Communicatie



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Ambitie voor ICT-NL/Belgie: De slimme omgeving

“It's the 100B+ ambient products + services/application”

- Ambitie 0 – “1 Dollar a day” breedband to every home
- Ambitie 1 – elektronische betalen, veilig en draadloos
- Ambitie 2 – intelligent verkeer
- Ambitie 3 - multi-media ontspanning
- Ambitie 4 - elektronische zorg

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Stellingen

- De Nokia van 2020 zit in (NL/Bel) Brabant met een maakindustrie die 10 Miljard productjes per jaar maakt.
- Maak ambient devices zo klein dat je hier in 24-uur/dag productie met automatische jettens en micro-system assemblage werkt, maar verdien geld met 7+/- 2 diensten.
- Wij zijn in 20 jaar leiders geworden in mecha-optronica-ware (mechatronics met optica en (60+%) software oftewel high-end equipment).
- In de 4+1 ambities kunnen wij waarde & welvaart scheppende leiders voor 2020 creeren als we nu kiezen & focuseren.

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Content

- Introduction
 - The Ambient Ambition
- Hard- & Software
 - “Changing the rules of the game”
 - Learning curve
 - Product-Life Cycle
 - Price/Performance ratio
- Communication
- Services and Small devices
- Conclusions

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Learning Curve - Double Logarithm

Cost Unit (Log.)

Learning rate = DECREASE OF COSTS PER UNIT WHEN NUMBER OF UNITS DOUBLES

e.g. Number of products (1920-30 Assembled Aircrafts) (Airlines: passenger-miles)

(Log)

1 (10) 2 (100) 3 (1000) Cumulative nr of Units

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Learning Curve - CPU Example

Costs/MIPS

Legend

- Mainframes
- PC's

MIPS

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BRINGING CIVILIZATION TO ITS KNEES...

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The Computerless Computer Company (HBR 1991)

Value is created as software enables new/more usage of cheaper hardware

Initially software was scarce, so you asked a high price (and got rich)

HARDWARE IS COSTS	SOFTWARE IS SCARCE	Apple	Microsoft
HARDWARE IS CHEAP	SOFTWARE IS CHEAP	Microsoft	Microsoft
1975-1985: Hardware Decade	1985-1995: Software Decade	Replacing: typewriter by a text editor calculator by a spreadsheet	BIOS IBM, Compaq, Taiwan,

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Product Life Cycles – the Substitution Process

Examples of technologies:

- CPU's
- hard disks
- mainframe, micro, dust computers
- relay switch, digital switch, packet switches
- peer-to-peer communication (post, phone, Internet-2)
- access

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Life Cycle of Products/services

PLC (product life cycle) model of Boston Consultancy Group (1968)

STAR CASHCOW

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Learning Curve & Product Life-cycle

Market Size & Price

Cost price (following learning curve)

Market price

Profit area

STAR CASHCOW

Cum. Number of Units & Time

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Life Before and After the PLC Top

Time T1: market price is 700

- market leader (700-300) at 1000 units = 400.000 profit
- follower at (700-500) at 200 units makes 40.000 profit

Time T2: market price 300

- market leader at 8000 units, costs 200, that is +800.000
- follower at 500 units costing 400, that is -50.000: EXIT

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Where you make real money, cash-cow and life extenders

From here only the 3 largest, but probably in Hi-Tech only the largest company makes money

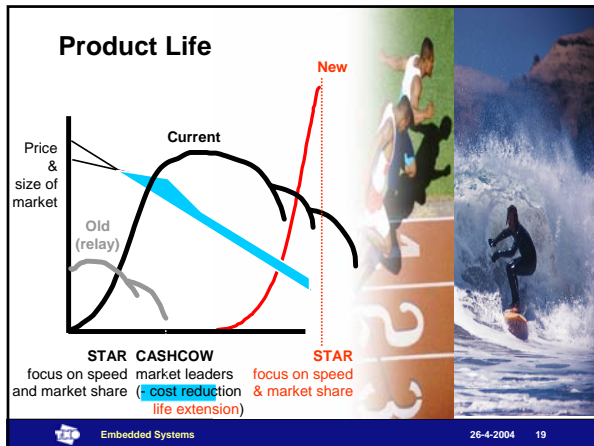
Price & size of market

TIME & sum of units

CASHCOW Life extenders

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Paradigm Shifts (or how the rules of the game change)

Price/performance in digital electronics improves by factor of 2x in 18 months

Hardware p/p 1000 x in 15 years (80-95)
Software ??

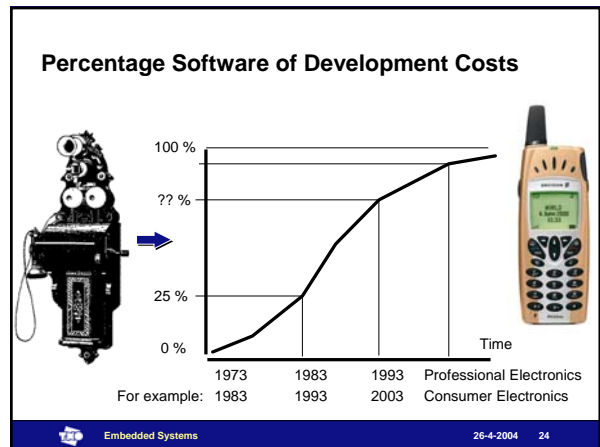
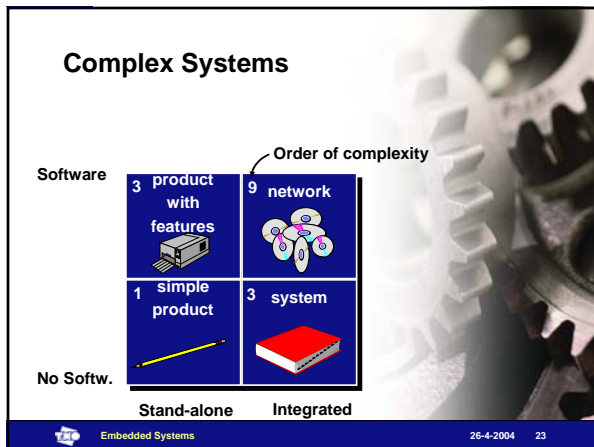
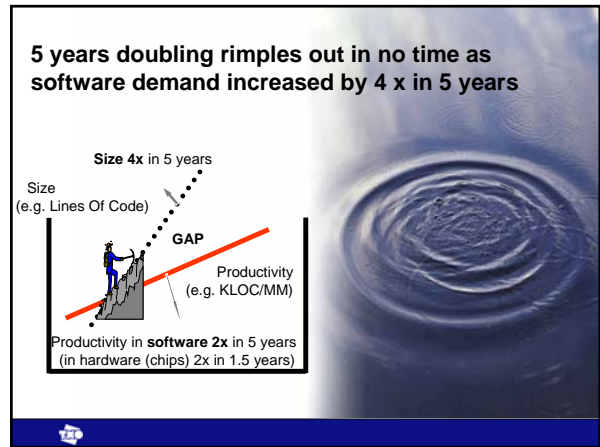
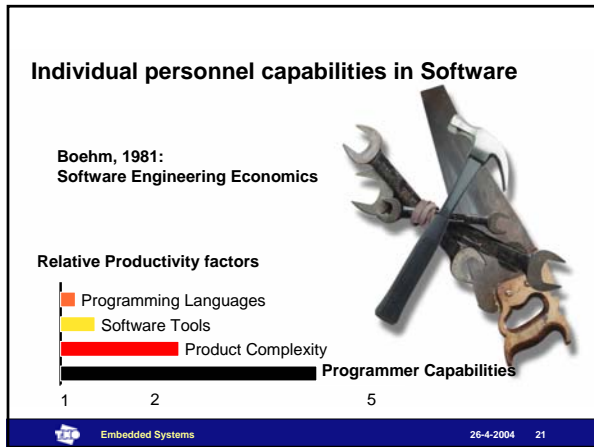
HARDWARE IS COSTS

SOFTWARE IS SCARCE

1970-1980:
Hardware Decade
E.g IBM

1980-1990:
Software Decade
e.g.: Microsoft

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HARDWARE IS COSTS

SOFTWARE IS SCARCE

HARDWARE IS CHEAP

DEATH OF DISTANCE

SOFTWARE IS CHEAP

PROCESSING IS FREE

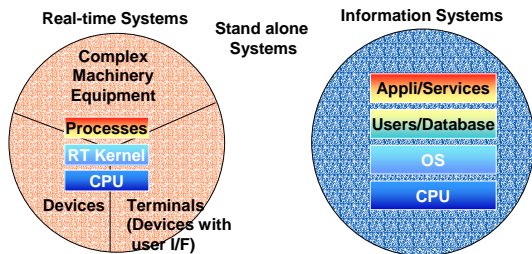
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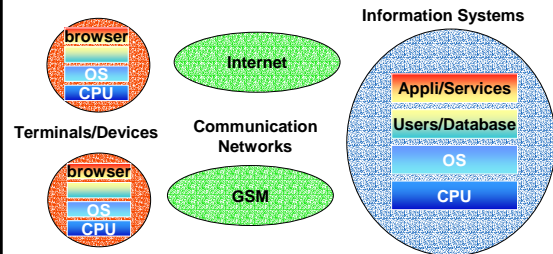
1990-2000:
Network Decade
e.g. PTT's/Cisco



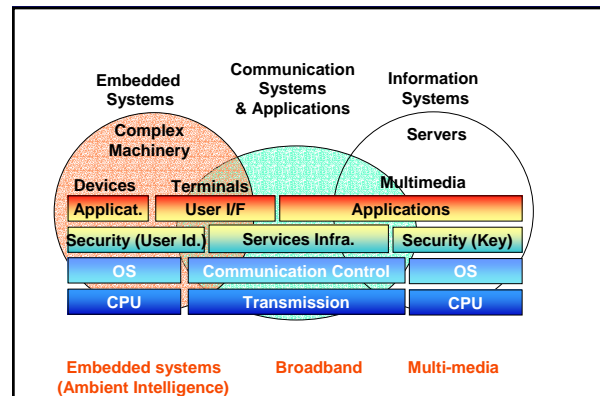
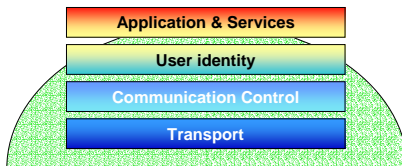
ICT architectures –the main frame of 1980 Real-time architectures - embedded systems



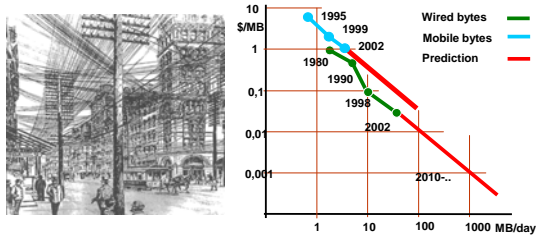
ICT architectures – PC and mobile world of 2000



Generic Communication layers



"Dollar a Day" Learning curve for Communication Networks



Since Graham Bell \$30 per month subscription 100 years long

Vision on Evolution of Multi-Services Networks

Phase 4: simplify:

ABC (Always Best Connected)

Probably 99%+ of all packets are generated in Ethernet framing
To make it 1000 x cheaper: don't change the packet (cost), but switch it to its destination (add value)

Phase 3: higher bandwidths and multi-services



Phase 2: today



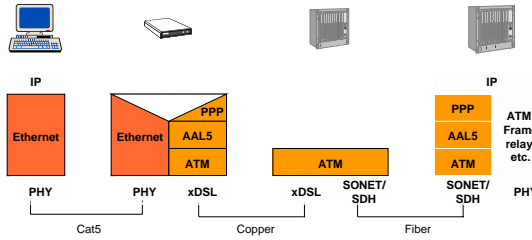
more bandwidth, more app's

Phase 1: Narrowb SDH

black phone service only

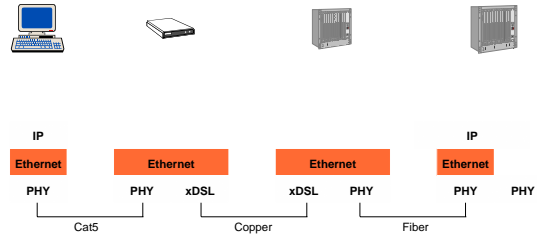
Forget ADSL, Ethernet is less expensive and simple

- A switched Ethernet network avoids costly protocol translations

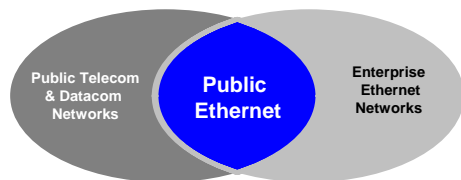


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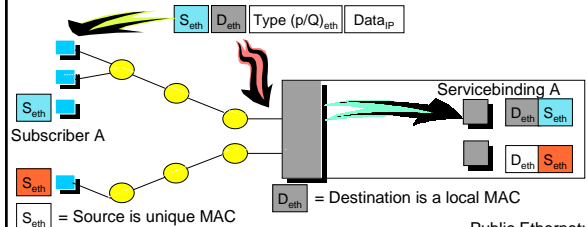
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Public Ethernet- the vision statement



Public Ethernet: Scalability of Ethernet LAN



Public Ethernet: serving more than 1M+ subscribers with hundreds of services

47 bit MAC for service bindings >> 4B (32 bit) IPv4 address space



Value creation in product-service

- Create 40 services with each user 7+/-2 at 1\$/day
- Give hardware away, move value to service
- Make hardware very small, no labor costs & minimal material, compete against Chinese

1970-1980: Hardware is costly

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2000-2020: Give Away, Open Source, Alw. Best Connect., Appli. & Services

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Mobile Telephony is not wireless the success is “mobility service”

Fixed Network

Fixed Subscribers:
“Is Bill there?”

Mobile Network

Mobile Subscribers
“Can you talk?”

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ERICSSON

Bluetooth

- Contact with car
- Doors Locked
- Trunk Locked
- Heating on
- Alarm on
- Parking time
- Car status

RX 1

Early morning. Turning on the heat in the car from my bedroom window via Bluetooth.

Learning curve for Operators

Provide an explosion of services for continuous lower € cost per subscriber-service binding

Triple Play (Voice, Video, Internet) (Teleph. TV, Internet)

Always Best Connected (Triple Play plus mobility & presence and ambient intelligence after 2010)

Not passenger or airmiles, but passenger-miles

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Microsystem technologie

Ambient Intelligence (Slimme omgeving)

10 x smaller, 10 smarter

(wireless interface to elsewhere, too small for a connector and/or power for computational processing)

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Polymer Electronics

The slide illustrates three types of polymer electronics:

- Field-effect transistor:** A cross-sectional diagram showing a source, drain, gate, and insulator layer.
- Light-emitting diode:** A diagram showing a metal top contact and a transparent electrode.
- Photovoltaic cell:** A diagram showing a metal top contact and a transparent electrode.

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Polymer Light Emitting Diodes

The slide shows three types of polymer light emitting diodes:

- Segmented:** A photograph of a digital display showing the number 87.
- Backlight:** A photograph of a laptop screen with a polymer light emitting diode backlight.
- Matrix:** A photograph of a polymer light emitting diode matrix display.

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Long-wave Economic Cycle: 5th Kondratieff

4-years waves, 8-10 years, 20 year & 50 (long) waves

- 1-wave: French + 1st Industrial Revolution (Railroad)
- 2-wave: Marx + Steel Industry (Steam)
- 3-wave: Capitalism + Electricity (1892-1948)
- 4-wave: Consumption + Oil (1948-1990)

5-wave: triggered by “computer as communicator”

The graph shows four waves: 0-19 year, 20-64 year, and 65+ years. The 5th wave is projected to start around 2050.

value creation by handling information cheaper and faster (from mainframe, micro-computer to ambient devices)

Kondratieff:

- a combination of technology & society
- during upswing a lot changes rapidly, after 15-20 years it gets quiet again, as our year 2020 society grows elder

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Conclusion:

In the high-tech RijnLand Delta (Delta=Delft/Eindhoven/Leuven/Twente/Aachen)

We can, no must, win the battle for 4G Ambient Market
 We have the knowlegde, industrial players, the customers of care for elderly people

but

where is the 21-st Frits Philips, Antony Fokker, the Philips, ASML, Oce, or IBM, Microsoft, Nokia of the year 2020

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Summary

The bar chart shows the evolution of technology and services over time:

- 70-80:** Hardw.
- 80-90:** Hardw., Softw.
- 90-2000:** Hardw., Softw., Comm.
- 2000-2020:** Hardw., Softw., Comm., Appli. & Services, Death of distance, Open Source, Give Away.

Other trends shown:

- TNO Technische Menskunde:** TV, Triple Play, subs-service.
- TNO Telecom.:** MB/day, Mobi, Fixnet.
- TNO FEL:** MB/day.
- TNO TPD:** MB/day.
- TNO Industrie:** MB/day.

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