

Market Drivers for Real-Time & Embedded Systems

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Content

- What is Embedded & Real-Time?
- Where do we get a perception of the Market?
- What are the Market Drivers?
- Are these Drivers taken serious?
- Is the need for SAFE systems going to change something?
- Conclusions.

What are Embedded & Real-Time Systems?

Confusion

- Embedded systems
- Real-time systems
- Fault tolerant systems
- Safe systems

Dedicated Systems

Embedded Systems

Computer system that is enclosed in another system and makes an essential part of it

Hardware and software, which forms a component of some larger system and which, are expected to function without human intervention

Real-Time Systems

Systems that respond in a predictable way to unpredictable external stimuli arrivals

Predictability

Fault-tolerant Systems

The ability of a system or component to continue normal operation despite the presence of hardware or software faults.

Safe systems

Systems who avoid physical or economic damage to persons or property.

Examples

	Embedded	Real-Time	Fault-tolerant	Safe
Fly by wire system	yes	yes	yes	yes
Cellular phone	?	yes	no	?
CarPC	yes	? (no)	no	no

Dedicated Systems

The functionality of the system is predefined by the available hardware & the loaded software. H&S reprogram ability may be used to a certain extent to change the functionality through the lifetime of the system. A dedicated system may have a combination of the following characteristics: being embedded, real-time, fault tolerant, safe.

Dedicated Systems Development Components

- ☞ Hardware (processors, bus architectures, ...)
- ☞ Software (OS, Protocol libraries, GUI, ...)
- ☞ Tools (Development, Debugging, CASE, ...)
- ☞ Brainware (Methodologies, Creativity, ...)



The Dedicated Systems MARKET

- Aerospace/defence
- Audio/video industry
- Building
- Communications
- Computers and their peripherals
- Consumer products
- Electronic funds, transfer systems
- Manufacturing
- Scientific and medical instrumentation
- Transportation/automotive

Where does get the market perception?



The logo for Dedicated Systems Experts, featuring a yellow key icon to the left of the text "Dedicated Systems" in a bold, sans-serif font, with "Experts" in a smaller font below it, all on a dark background.




Service Profiles

- Red-Team Development Verification & Validation
- System Architecture Design & Support
- Product Evaluation & Comparison
- Technology & Applications Watch Studies

Information Gathering & Distribution

- Magazine and Web sites
- Seminars, conferences
- Management and Support of Associations
- Proprietary audit reporting



A collage of four images representing information sources: a magazine page with a table, a "SPECIAL ISSUE" flyer for Dedicated Systems, a screenshot of a web page, and a screenshot of a presentation slide.

What are the Market Drivers?

Market Drivers

- Reduce time to market
 - COTS
 - Reduce development time by reuse
 - Rely on standards
- Competitive advantage
 - Cheaper
 - More performant
 - Fancy look
 - Product stability & robustness
 - Create a unique product

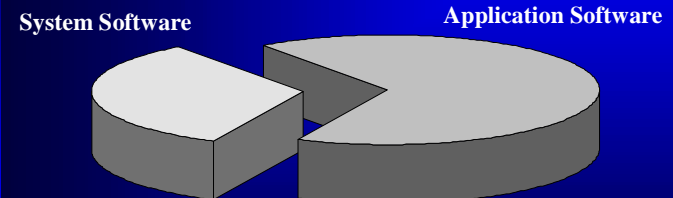
Anti Market Drivers

- Personnel problems
 - Engineers mentality: I don't need help
 - Conservatism
 - Lack of ICT personnel
 - Gap between management and engineers
- RT & Embedded Systems exponential complexity
 - Poor problem understanding
 - Product Complexity handling
 - Lack of (re) education
- Poor quality of COTS products
 - Bugs
 - Missing features
- Market protection: anti-standard mentality
- The canyon between HW - SW

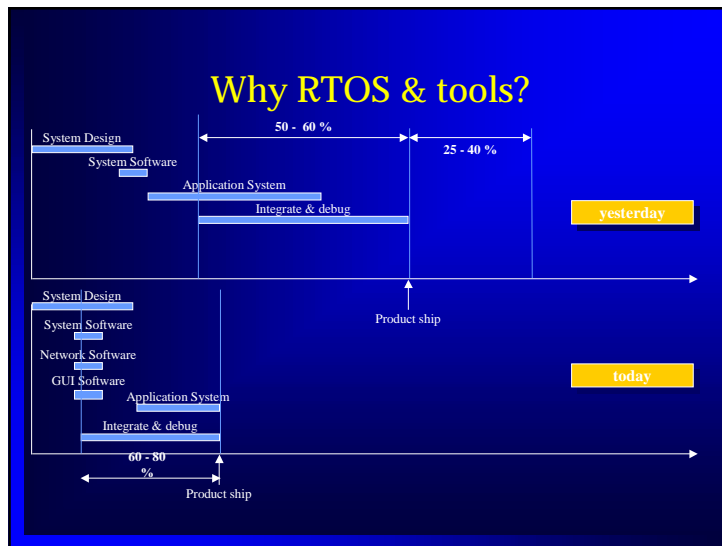
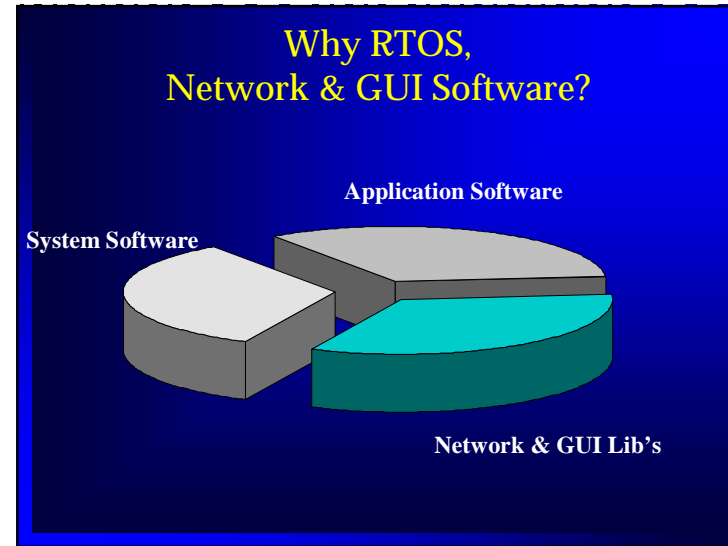
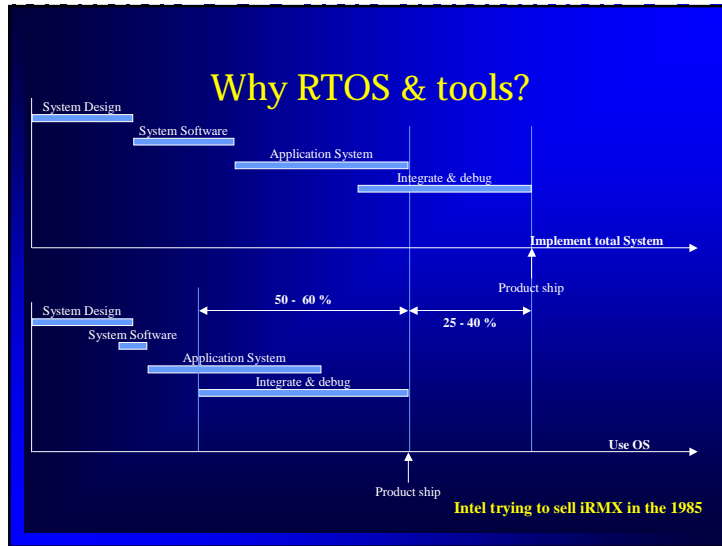
The ideal situation – designer's needs

- Concentrate on added value not on basic components
 - Use as much as possible existing reliable proven building blocks
- Reduce development effort and risk
 - Use a streamlined set of tools and methods to get a quality product into production as quickly as possible
 - Be capable of demonstrating or proof the quality of the product before its production
- Standards are covering all the possible interaction and interchanges between subsystems, components and buildig blocks.
- ..

Why should we use a RTOS & tools?



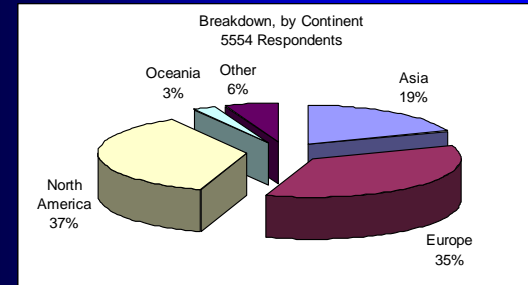
Intel trying to sell iRMX in the 1985



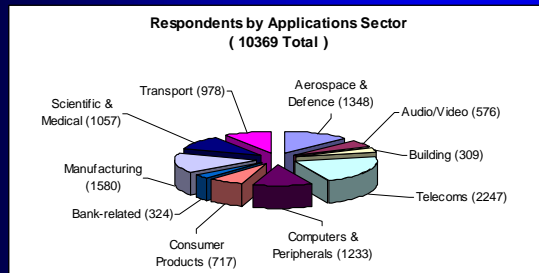
RTOS Market Report

- Data collection via our Website (> 50K visitors/month)
- Subscriber has free access to some papers, studies, buyers guide

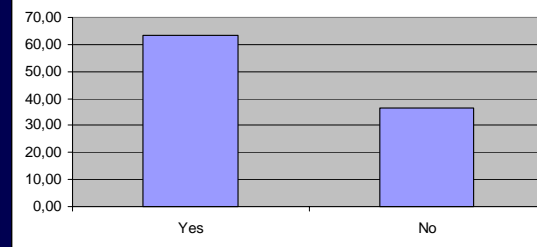
Samples - breakdown by continent

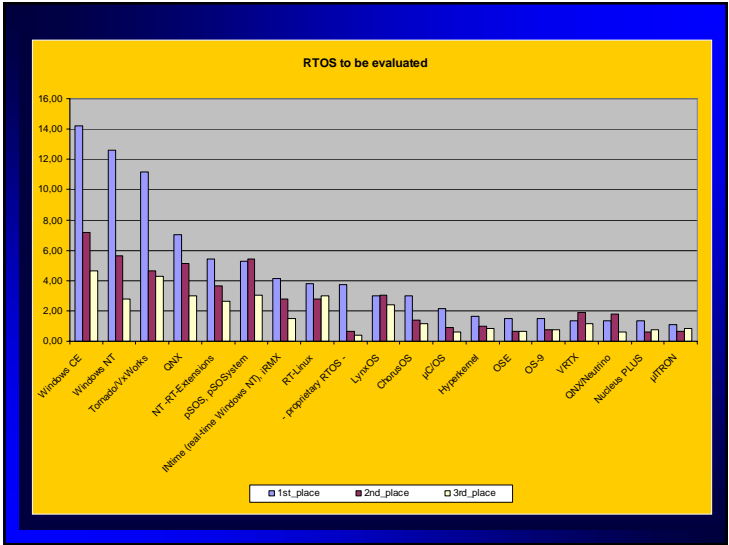
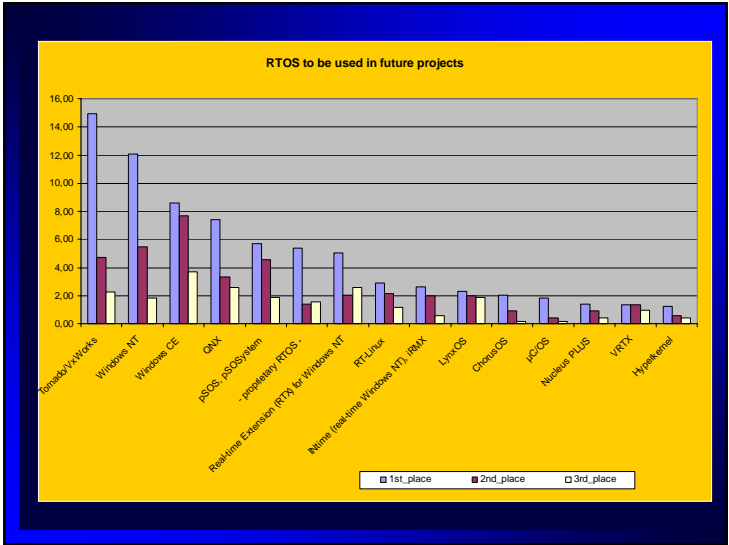
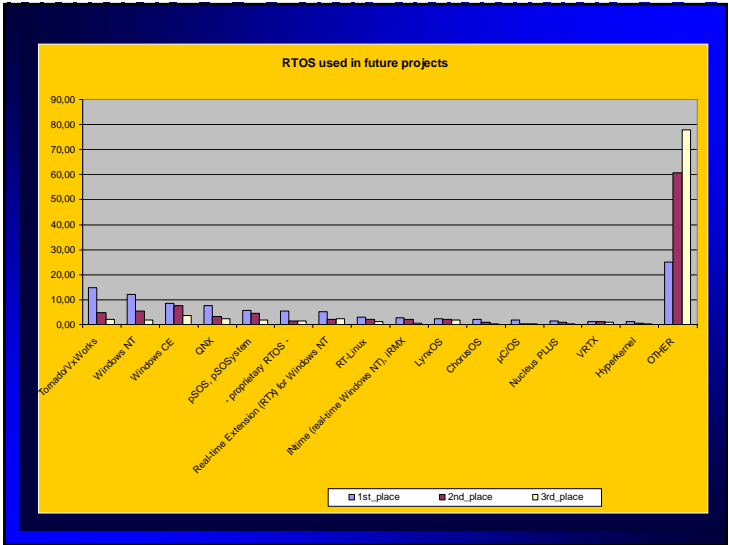
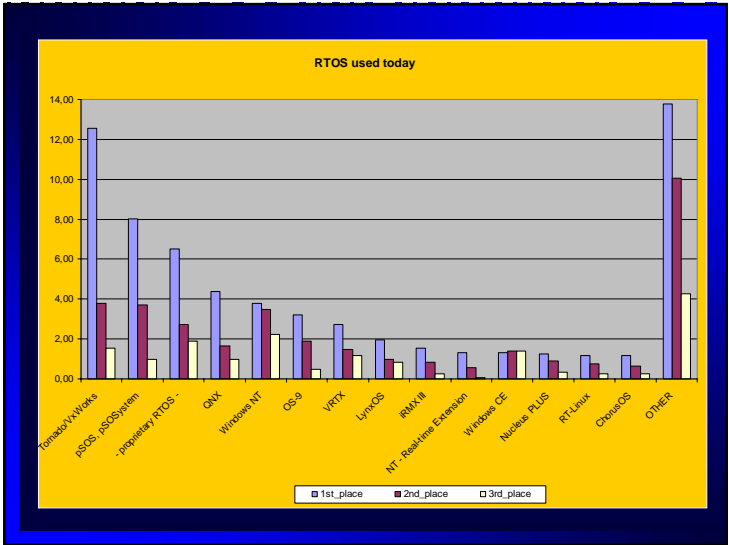


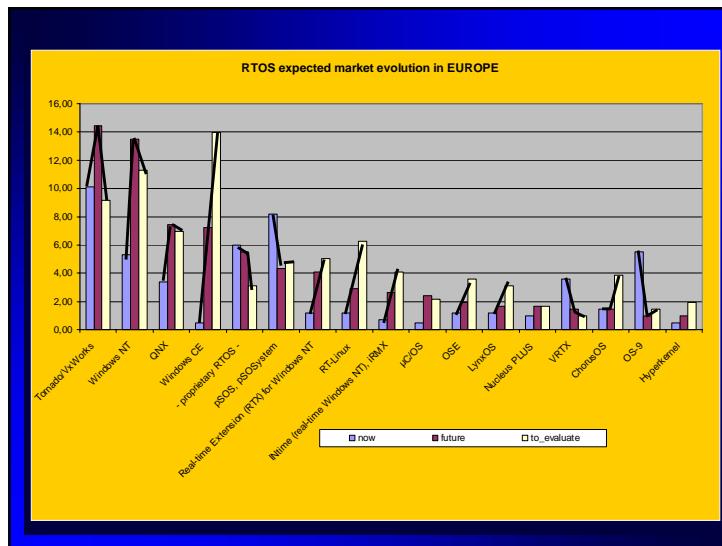
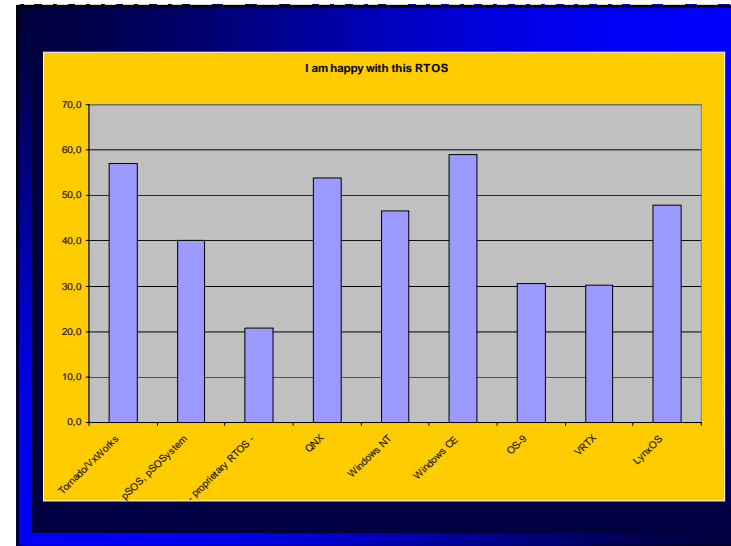
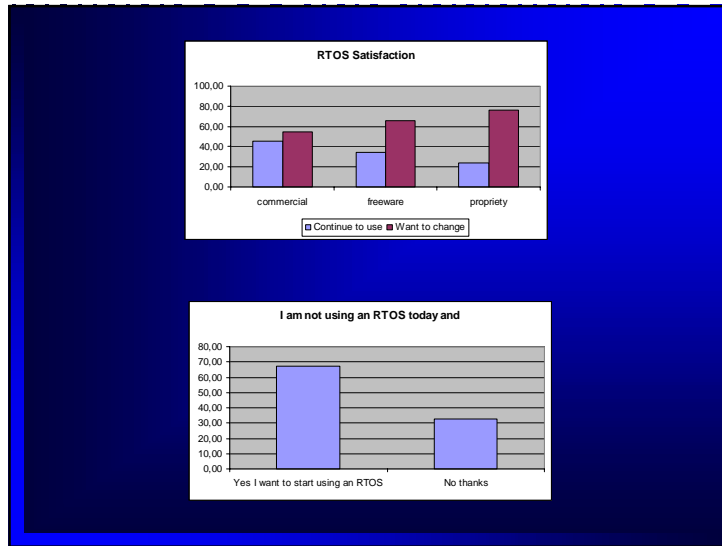
Samples - by sector



Use RTOS today







How fast is this changing?

- Today (03/2001): 8000+
- This study: 5554
- Sample timeframe: november 98 – april 2000
- Samples are about people using = projects numbers
- Samples are NOT about license numbers!!
- Name + company etc.. available

Samples by sector

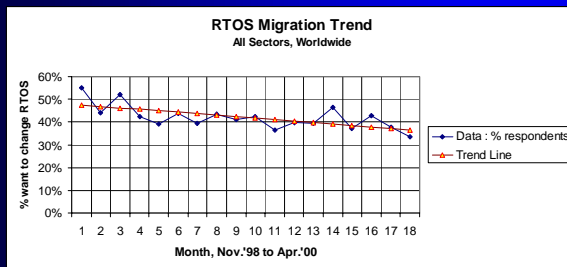
- 21.7 % Telecom
- 15.2 % Manufacturing
- 13.0 % Aerospace & Defence
- 11.9 % Computers & Peripherals
- 10.2 % Scientific & Medical

- 72.0 % Total for these sectors

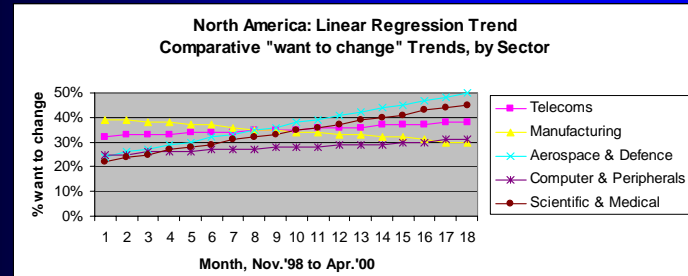
General Trends

- A lot of people are « unhappy » and want to change
 - Is this changing?
 - Is this different per sector?
 - Are there geographic differences?
 - Are there differences depending on what they use today?

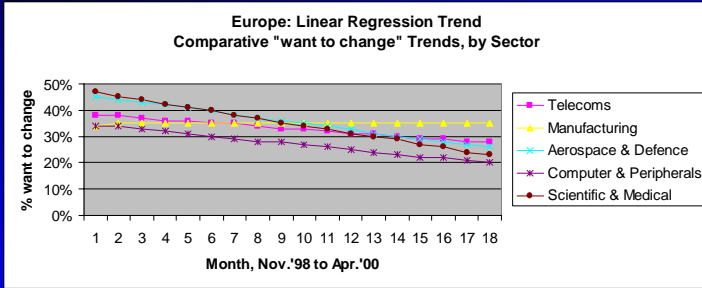
RTOS migration (want to change?)



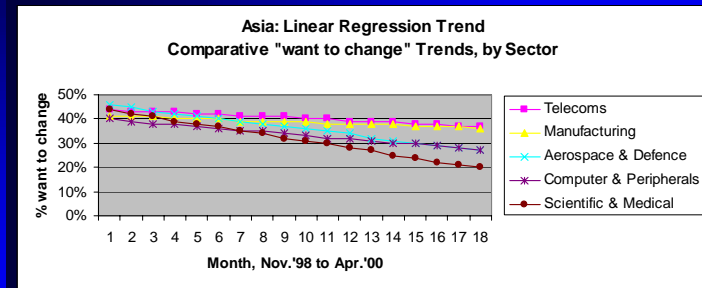
NA – WTC



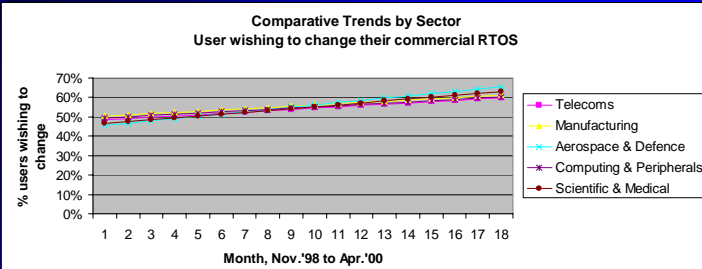
Europe – WTC



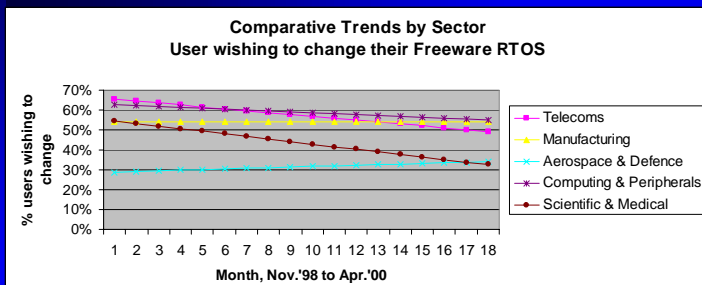
Asia – WTC

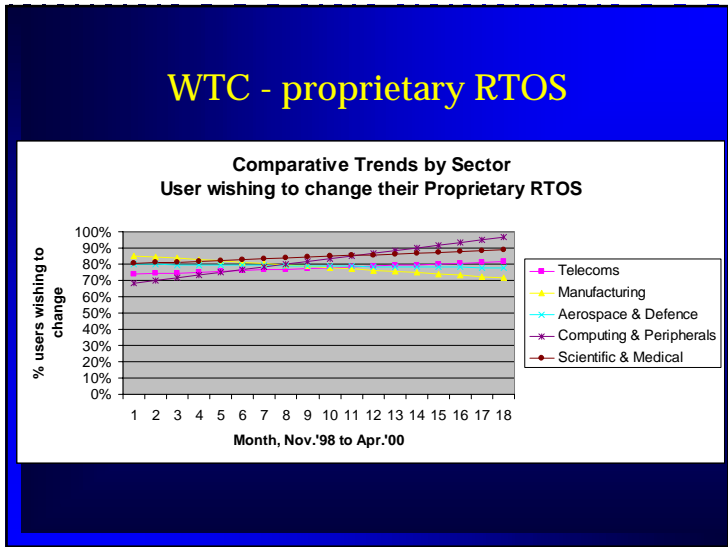


WTC - commercial RTOS



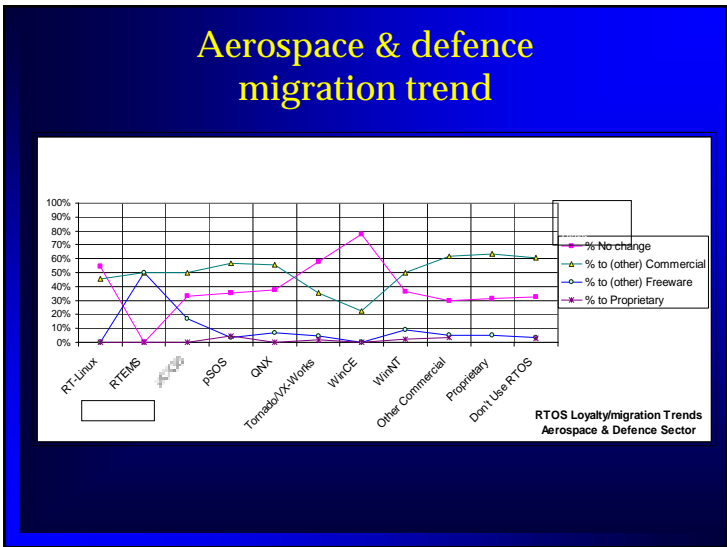
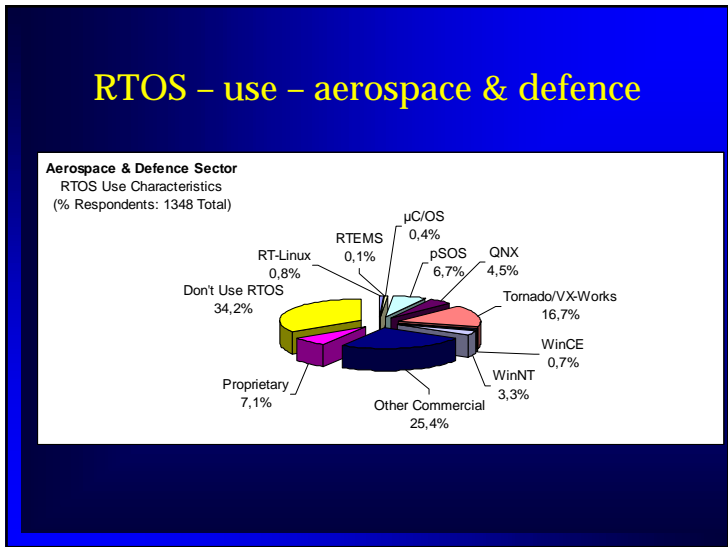
WTC – freeware RTOS



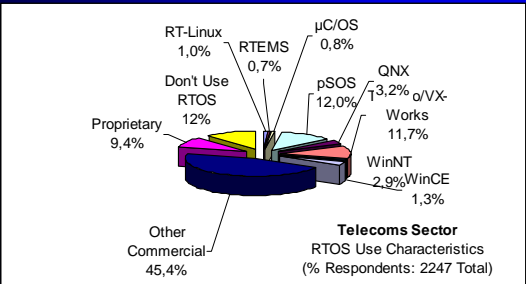


Migration Trends (Per sector)

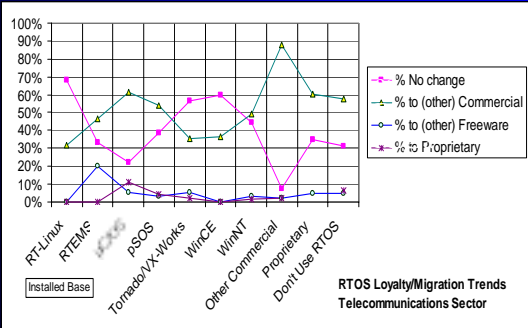
- Who is using what?
- Who migrates to what?



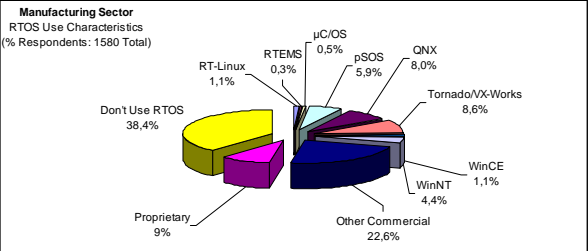
RTOS use - TCOM



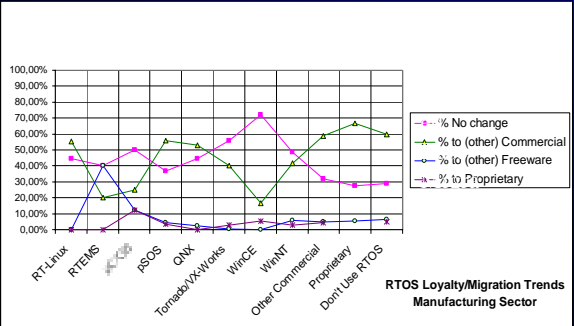
TCOM – installed base migration trend



Manufacturing – RTOS use



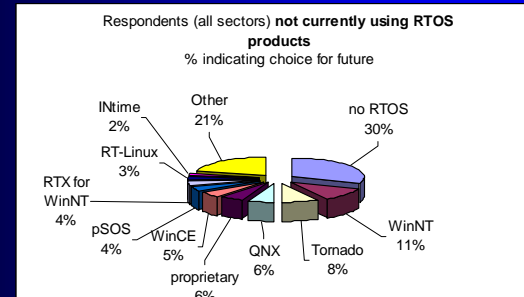
Manu – migration trend



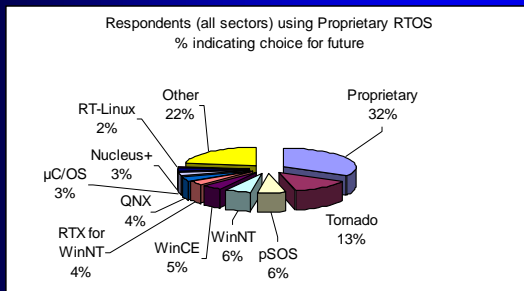
Future Market

- Moving from one RTOS to another
- WRS + MS will share the market in the future
- RTLinux is NOT (yet?) important market player

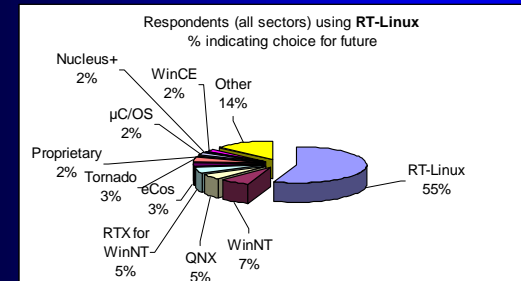
Non RTOS users moving to...



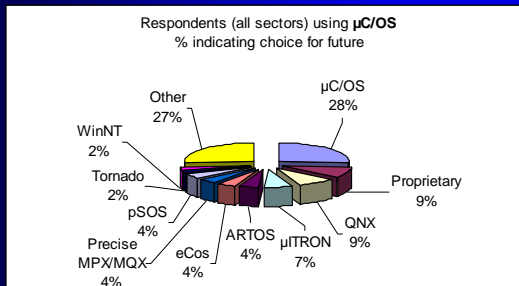
Prop RTOS users moving to...



RTLinux users moving to...



uC/OS users moving to



Future Market share WRS + MS: 38%

Currently use:	Evaluate 1st choice =>	Tornado	pSOS	WinCE	WinNT	other RTOS
Tornado	552	143	27	57	47	278
pSOS	412	55	102	59	25	171
WinCE	68	4	2	28	3	31
WinNT	182	7	2	25	65	83
other	4340	364	206	374	519	2877
checksum	5554				2114	5554
total "medium term market share" Windriver+Microsoft:						38.06%

RTOS Conclusions (1)

- Market is, and continuous to be very diluted.
- Wind River & Microsoft will share almost 40% of the market in the future.
- QNX is steady in this battlefield
- LINUX will increase slightly its market share but the product has technically still to proof a lot
- Outsiders like OSE as European products will become more important in the future.

RTOS Conclusions (2)

- Microsoft NT is serious competition, even if this product has NO RT features!
- CE 3.x is now serious competition for VXWorks, QNX, pSOS in not too simple highly connective applications
- Microsoft is stronger than ever: CE 4.0 announced
- WRS mergers are hard to digest
 - where is the AE product?
 - HP changed overnight from WRS to Greenhills for a tools issue!!
 - Start focussing more on services than on the product
- Availability of Internet technology/connectivity determines today the popularity of a product

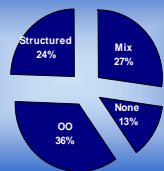
Conclusion (3)

- What a waste of energy:
an enormous quantity of products are in the market –
no one is really good -

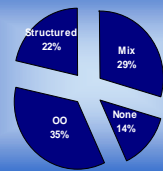
Tools Market Report

- Subscriber got free magazine
- Sample numbers are low: < 200
- Very long questionnaire

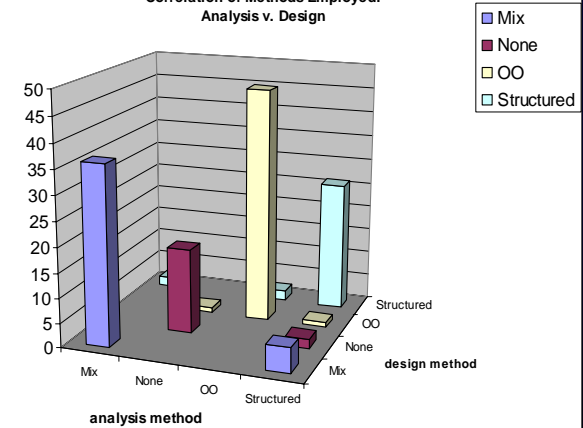
Analysis Method

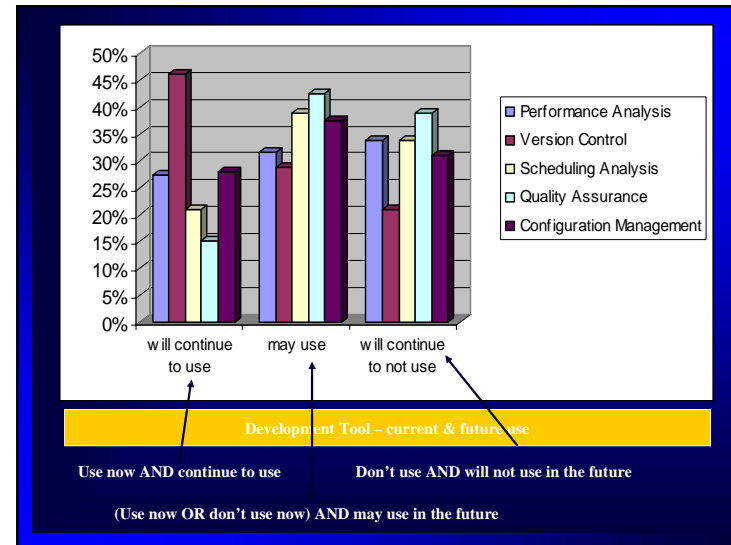
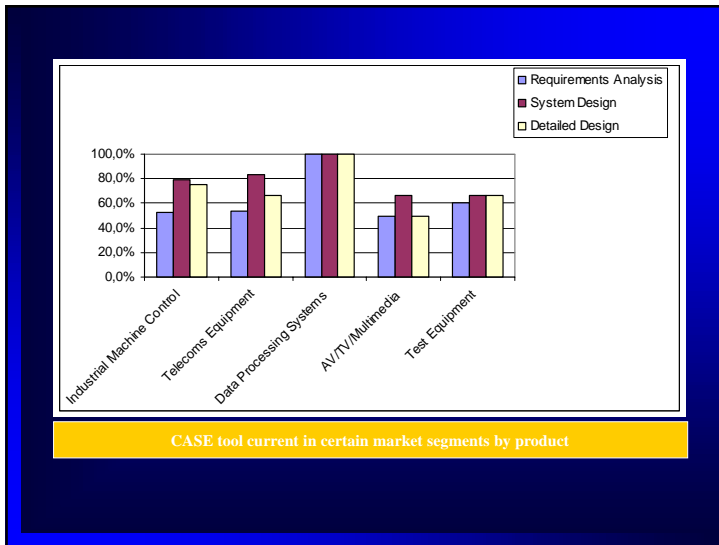
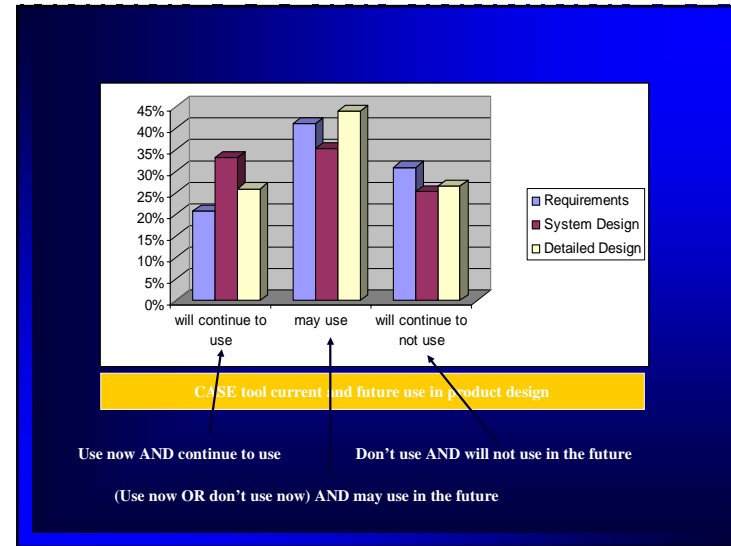
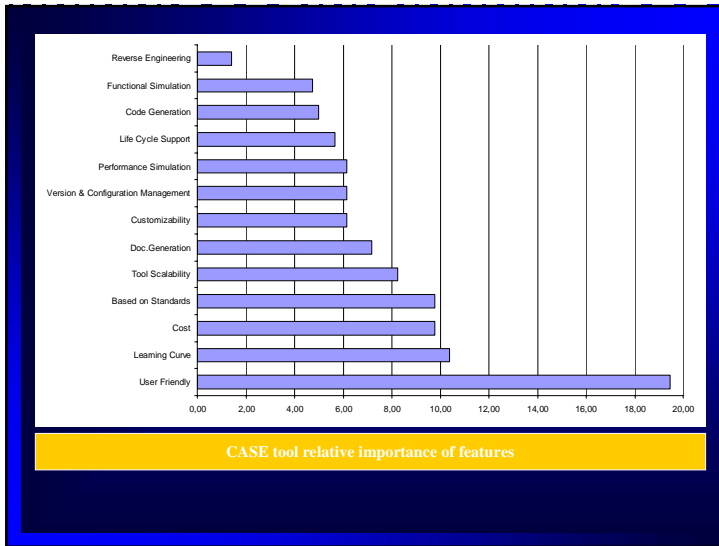


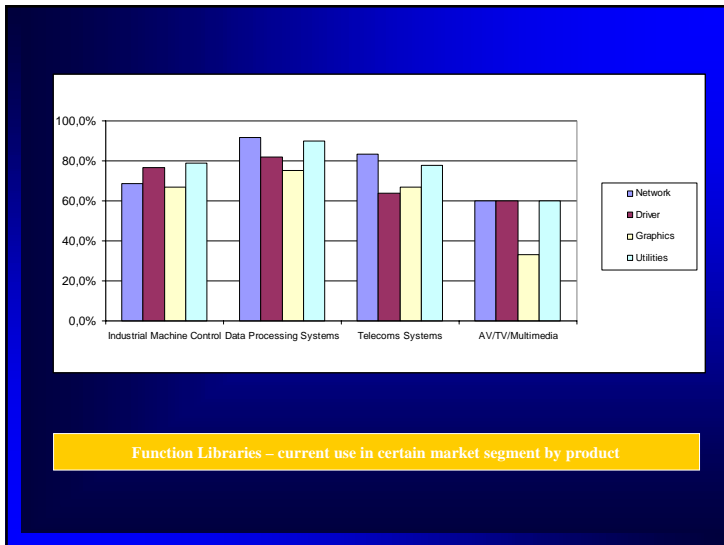
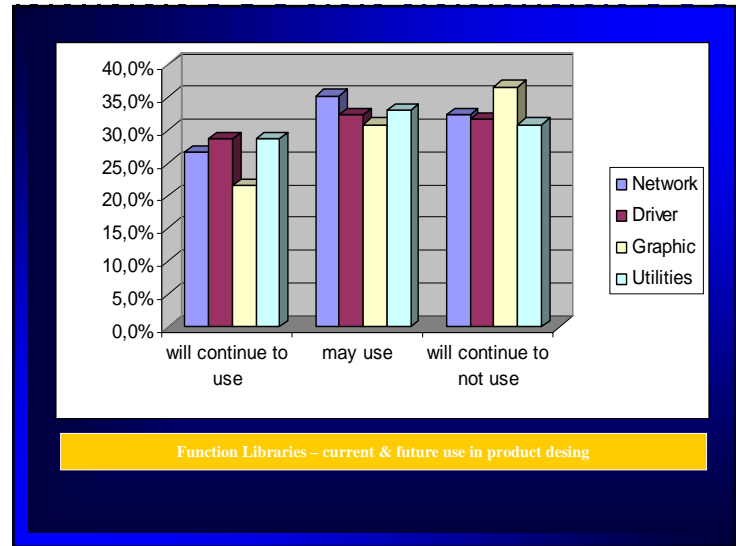
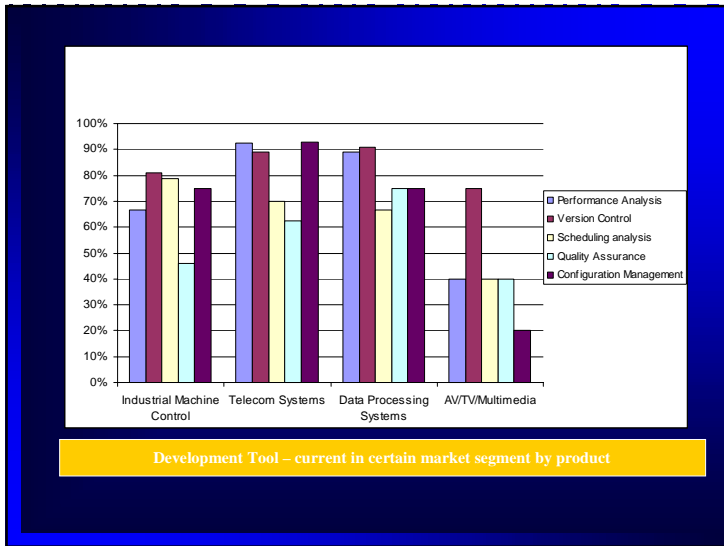
Design Method



Correlation of Methods Employed:
Analysis v. Design







A fool with a tool is still a fool!

Are we fools???

Confusion 1: Tools – to do what & how?

- Upper CASE
 - Analysis (WHAT?) ↔ Design (HOW?)
 - Structured ↔ Object Oriented
 - Standard ↔ Proprietary
 - Formal or not
 - Testing specifications generation
 - Simulation tools
 - Quality assurance aids
- Lower CASE
 - Programming aids
 - Debugging, testing tools
 - Schedulability designers and simulators
 - ICE, profilers, ..

Confusion 2: A tool will solve my problem.

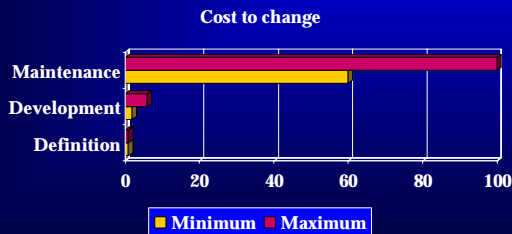
But: what is the problem???

Only a good analysis phase can solve this!

**Structured analysis has the best modeling
for this.**

Confusion 3: Programming is the only productive effort.

- Cost for a change increases from analysis to implementation. You better do the first steps right, which is not programming!



Confusion 3: Programming is the only productive effort.

- Our experience shows that programming is only 10 to 20% of the job.
- Requirements analysis also takes 10%
- The biggest effort goes in
 - Architectural design
 - Detailed design
 - Testing, Debugging and qualifying

Missing low level tools....

- Debugging tools ← → microprocessor support
 - SoC is a dramatic turn if it comes to debugging
- Multitasking
- System activity visualisation/monitoring tools
- Testing tools

Immature upper level tools

- How many CASE tools are more than just a drawing tool?
- Where is the repository and the multi-designer support?
- Where are the requirement analysis tools?

Endless « religious » discussions....

- Structured analysis – design
against
- Object analysis – design
- UML 1.0, 2.0, 3.0, 4.0.....

There is no such thing as
the BEST tool.

There is
the BEST ANALYSIS & DESIGN,
which is made easier by using tools.

This is NOT going to change soon!

- Missing IT personnel
- Wrong IT personnel
 - Too much programmers
 - Not enough architects
- Engineers mentality change is necessary:
they CANNOT do everything themselves
they DO NOT have all the skills needed for all steps
- Education is missing especially in the dedicated systems arena

Application Designer's side

This is NOT going to change soon!

- Missing IT personnel
- Non qualified IT personnel
- No real contact between research centres and manufacturers
- Research centres are too loosely coupled from reality

SF product manufacturer's side

**A fool with a tool is
even a bigger fool!**

**Is the need for SAFE systems
going to change something?**

Safety = reducing risk

Risk =
probability of damage
x
effect of damage

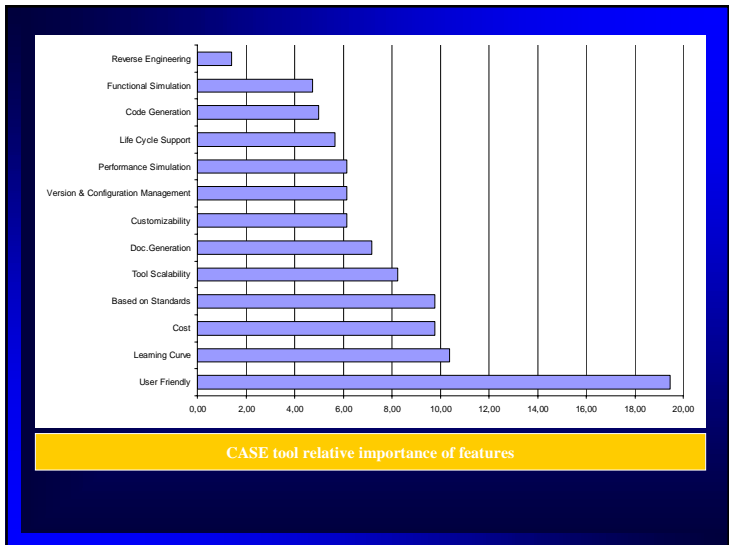
NEW: Software is also responsible for the damage

Requirements

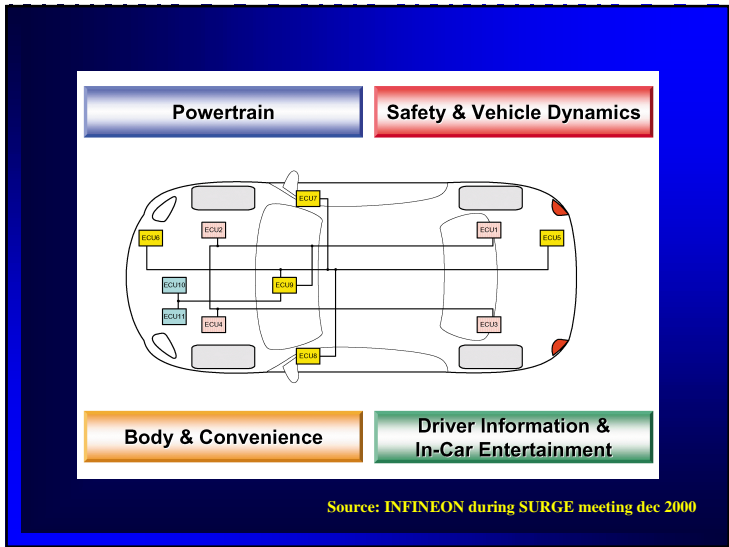
- safety must be designed in from the beginning
- testing can signal the presence of errors – but not their absence
- quality assurance techniques are necessary

Solutions

- Use of tools from the very beginning of requirement analysis up to qualification of the product
- BUT: where to buy these tools?????



Case Study: Tomorrow's CAR

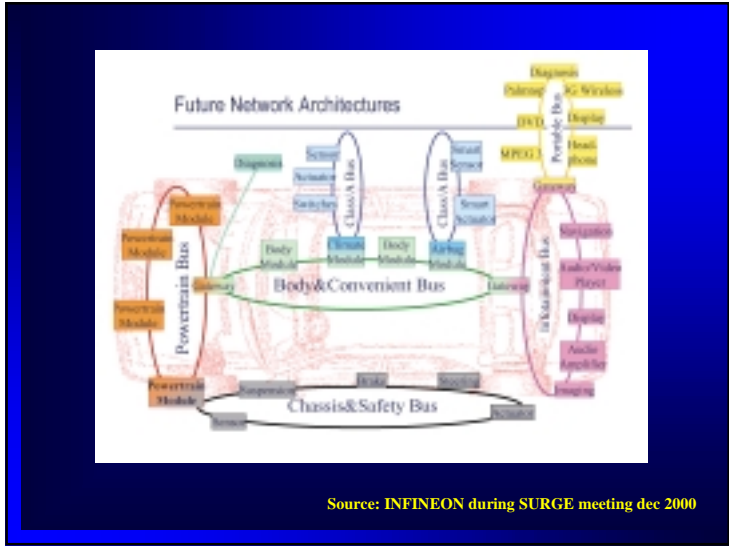


Source: INFINEON during SURGE meeting dec 2000

Exponential increase of new Functions

Body standard functions Alarm, central locking, Morning up lock Doors lock control Dashboard, displays Window lifts, sun roof Wipers Auto lights, interior lights Air conditioning Data storage Gateway Diagnosis	Body enhanced functions Low current central key, Keyless start-up Electrical power management Tire under pressure detectors Faults storing and reporting Enhanced air conditioning Hand free vehicle Parking help, ACC Enhanced diagnosis Tele-diagnosis Fast remote loading
Telematic Functions Localisation Communication Send/receive of short messages Emergency call Data server for Tele-diagnosis Security (firewall or other)	Multimedia Braille/s server Route guidance, directory, news Telematic services, Traffic information Passengers communication Functions Information from "auto" and "Telematic" Voice recognition, text to speech, web, email Peripherals: CD, DMR, DV13, VGA display and TV

Source: INFINEON during SURGE meeting dec 2000



Source: INFINEON during SURGE meeting dec 2000

If you are looking for

- ONE bus
 - ONE RTOS
 - ONE tool
- to solve that problem

FORGET IT!!

ONE rule: divide and conquer!

Conclusion

Market Drivers

- Reduce time to market
 - COTS
 - Reduce development time
 - Rely on standards
- Competitive advantage
 - Cheaper
 - More performant
 - Fancy look
 - Product stability & robustness

Anti Market Drivers

- Personnel problems
 - Engineers mentality: I don't need help
 - Conservatism
 - Lack of ICT personnel
- (Re) Education in RT & Embedded Systems
 - Poor problem understanding
 - Complexity of the problem
 - Lack of (re) education
- Poor quality of COTS products
 - Bugs
 - Missing features
- Market protection: anti-standard mentality
- The canyon between HW - SW

What we need:

- An excellent requirement analysis
- A super architectural design: reduce complexity via subsystem design

The problem:

- Convince both product managers and engineers
- Convince tool vendors
- Convince building block vendors

☹ Suggestion ☹

For time being label all Dedicated Systems with



Action Points

- **Education** of designers
- **Education** of vendors
- **Education** of teachers



Quality of Service
in order to produce
your Quality Products

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