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The Structural Process Management Company™

The Fei Koala Architecture

& why we hope it is future proof

Contents

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Introduction to Fei

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History

- 1949: Philips Electron Optics sold first commercial TEM
- 1971: Fei (Field Electrons & Ions) is founded
- 1997: Fei and PEO merge

Operations in

- Hillsboro (Oregon) – Main Office
- Peabody (Massachusetts)
- Eindhoven (Netherlands)
- Brno (Czech Republic)

About 1600 employees worldwide, nasdaq FEIC ($26.51 on 28-1-2004)

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Fei Products

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Fei Products

- Transmission Electron Microscope (TEM)
- Scanning Electron Microscope (SEM)
- Focussed Ion Beam (FIB)
- Dual Beam (DB = SEM + FIB)

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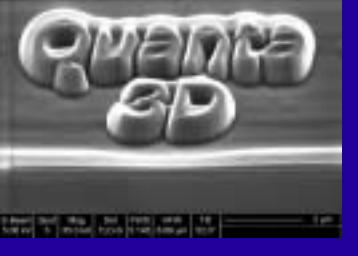
- Introduction to Fei 5 min
- Why ‘future proof architecture’? 5 min
- Architecture model 10 min
- Fei Koala Architecture 10 min
- Conclusions 5 min



What is architecture?

- Standardized interfaces between modules

Examples:

- Standardized dimensions (e.g. for plumbing pipes & joints or screws & bolts)
- Standardized pin-out & voltages for connectors (e.g. telephone and mains power)
- Standardized software interfaces (e.g. http, COM)

Why architecture?

- Share infrastructure
- Independent development of modules (by many people)
- Reuse of modules

→ Reduce cost

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Why not architecture?

- Expensive to design
- Limitations (things that cannot be done)
- Education of people
- Modules may be more expensive / complex because they must match the architecture

Why future proof?

- To avoid designing a new architecture
  - » Which costs a lot of time
  - » Which makes existing modules & tools obsolete
  - » Which makes existing education obsolete

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Why new architecture?

- Desire for better performance
- Obsolete parts, knowledge, tools
- Price reduction
- Get rid of top-heavy old architecture (due to add-ons over time)

Long-lived architectures

1795 France adopted the metric system (again in 1840)

1804 Steam locomotive (standardized tracks)

1876 Telephone

1882 Electricity (Edison's first power station)

1969 TCP/IP

Why long-lived?

- Prohibitively expensive to replace
- Good design (gradual improvements possible)

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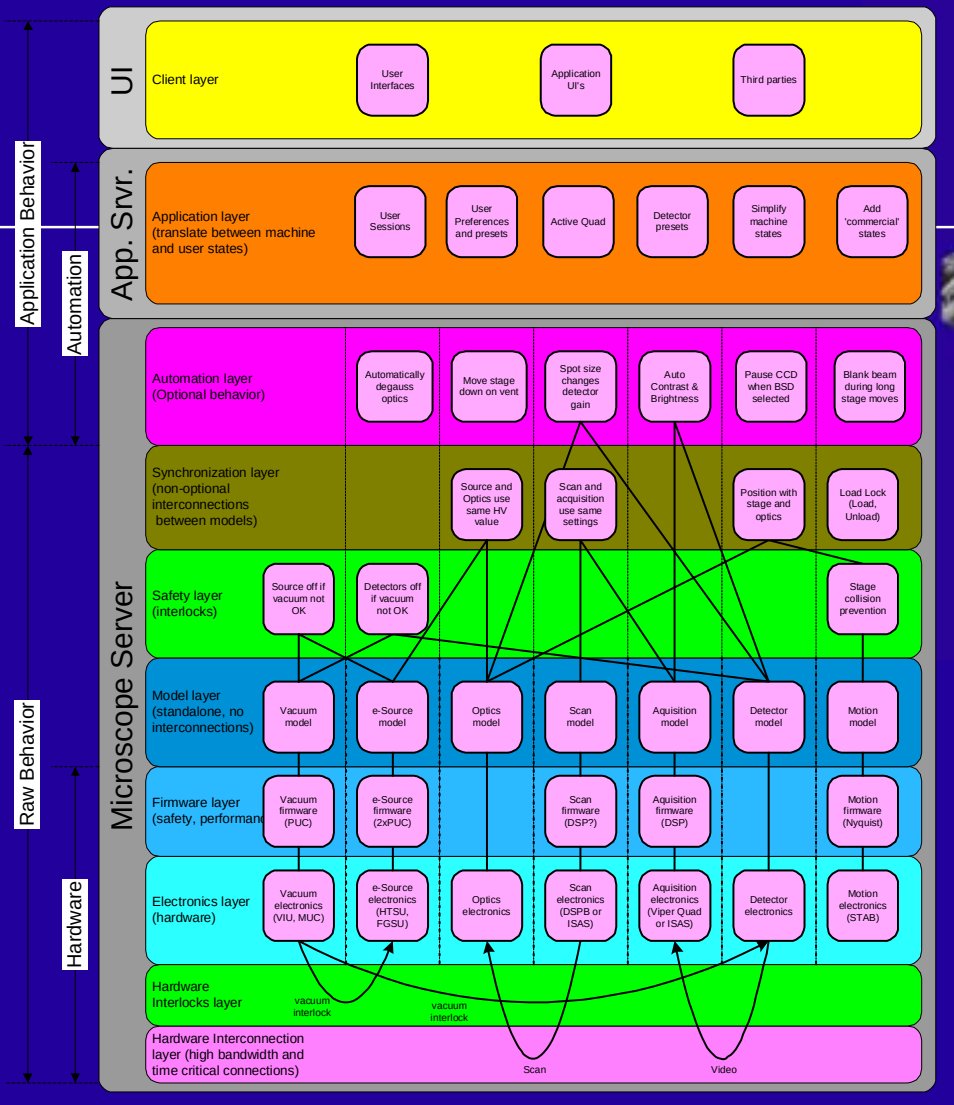
Layers



Grouping of system behavior into logical layers. An actual implementation will have less layers than shown here, combining several layers into one. Interconnections within a single layer are forbidden: if two modules need to share data this must be done in a higher layer, and at least at the level of the Safety layer (for software) or in one of the two lowest layers (for electronics). On the left you can see a coarse behavior split between *Raw* (hardware specific) and *Application* (market specific) behavior, and how the xT Nova functionality it is split over the Microscope Server, Application Server and UI (there is still too much functionality in the Microscope Server). Note that only a few of the actual modules and interconnections are shown.

Pybe Faber 28-1-2004

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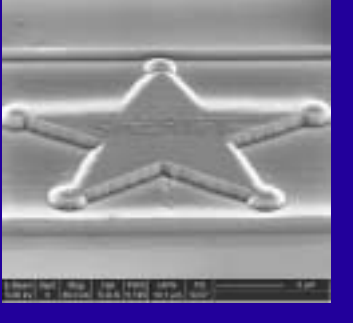

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Fei Architecture History

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- ±1985 xL: first mouse-controlled SEM, P80 electronics
- ±1995 xP: 32 bit (mainly xL electronics)
- 1998 Tecnai: first mouse-controlled TEM, COM, P80 electronics
- 2001 Quanta: new electronics, CAN bus, modularized server software, digital video
- 2003 Nova&Quanta3D: application server, top-down software interconnections

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Hardware interfaces

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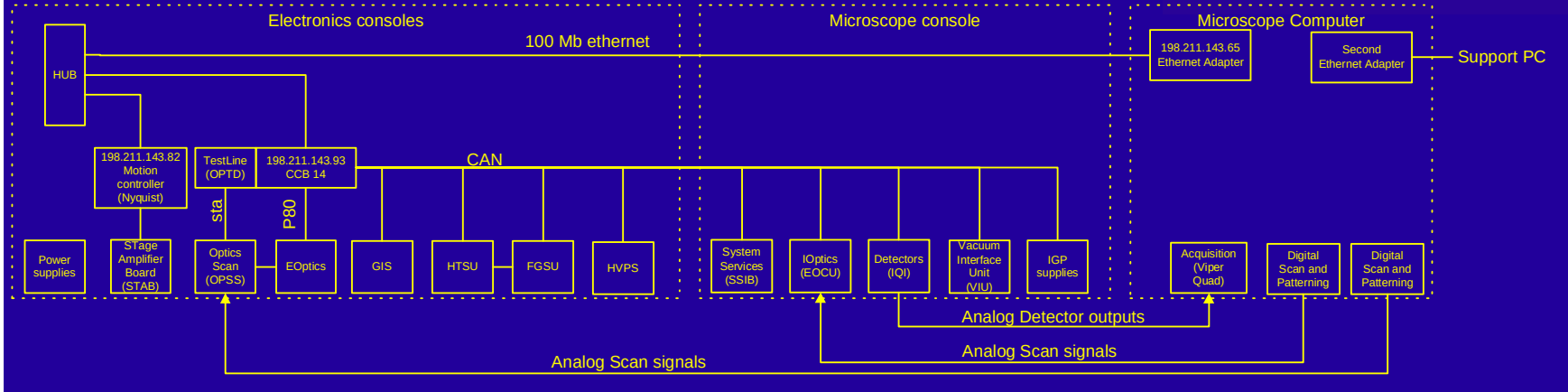

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Software interfaces

- (D)COM interface between instrument server, application server and UI.
- Object Model: structured way to organize the interface, target is to have a single OM for all Fei products (will take a few years still…).
- Visio tool to graphically display connections between ‘bricks’ (software modules) – see next slide.

Bricks

Drawing Control Panel

Node Template 2
Connector Template 1
Positioning Algorithm 3
Data Source 1

filename.exe

Entity

Source File: c:\TecnaiSimpleMap.txt
Position File: C:\tools\visio\Solo3n.txt

Dim All Connections | Remove All Connections
Save Position Nodes | Restore Position Nodes
Refresh Nodes | Refresh All | Clear Diagam

(duration ~1 minute!)

Node Template :
1 = "explorer style"
2 = Square blob style

Connector Template :
1 = Straight line

Positioning Algorithm :
1 = Explorer small icon style
2 = Levels based on Tecnai dependancy file
3 = brick prefix

Nodes can be moved and the diagram will be updated. Right click on nodes to highlight and dim individual nodes.

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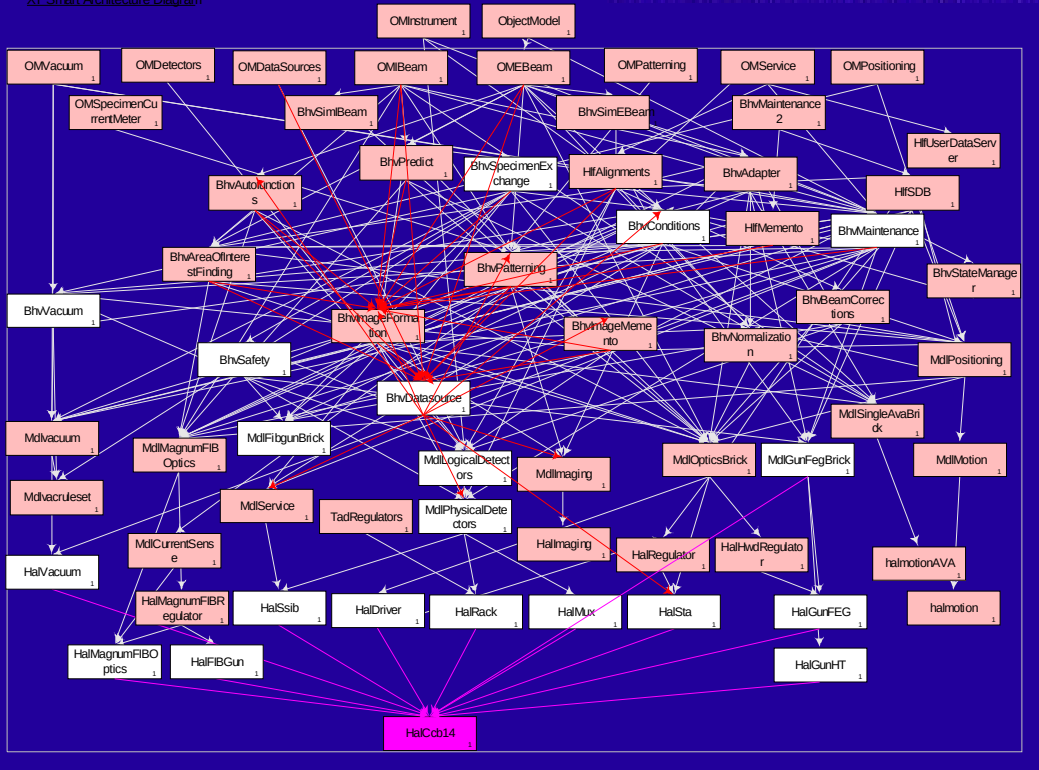
XT Smart Architecture Diagram



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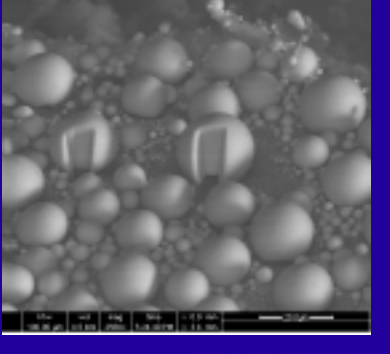

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Hardware Trends

- Bare PC, only standard network connections (ethernet, possibly also USB2, firewire or CAN).
- Standalone modules with standardized power and network connections (ethernet or CAN).
- Second ('support') PC for 3rd party applications, post-processing, data storage (keeping the server PC load predictable).

Software Trends

- More modular software, in a more hierarchical structure, distributed over more than one PC.
- As a result: focus on standardized software interfaces, with ability of ‘remoting’ (network connections).
- Databases for result storage (data from Fei systems, but also from 3rd party equipment).
- Tighter integration of 3rd party equipment, needed to automate complex tasks (focus on ‘solutions’ rather than ‘tools’).
- Moving to C# / .NET for application software (highest level).

Lessons from Fei's past

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- Complex parts are long-lived: the knowledge to design them is gone.
- High-risk parts are long-lived: a new design may introduce big problems.
- Embedded software is hardest to maintain.
- A new architecture MUST be linked to a product.
- Lean design: only standardize what is needed
- Don't add bells & whistles, provide 'convenience' as stand-alone tools, not as part of the architecture