



15.905 Technology Strategy

Red Hat and the Linux Revolution

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Agenda for today, Wednesday 2 May 2007

- ~12:45 • Admin issues
- ~12:50 • Red Hat and the Linux Revolution
- ~14:00 • Architecture, modularity and value capture



Microsoft's take on Linux

- *OSS poses a direct, short-term revenue and platform **threat** to Microsoft, particularly in server space*
- *the intrinsic parallelism and free idea exchange in OSS has **benefits that are not replicable** with our current licensing model and therefore present a **long term developer mindshare threat**.*
- *... **commercial quality** can be achieved / exceeded by OSS projects*
- *OSS is long-term credible threat **FUD tactics can not... combat it**.*
- ***Linux outperforms many other UNIXes***
- *Linux can win as long as services / protocols are commodities.*
- ***OSS projects have been able to gain a foothold in many server applications because of the wide utility of highly commoditized, simple protocols. By extending these protocols and developing new protocols, we can deny OSS projects entry into the market.***
- *OSS evangelization scales with the size of the Internet much faster than our own evangelization efforts appear to scale*



Modularity is becoming more prevalent, increasing value creation, challenging value capture

- Falling costs of co-ordination make modularity easier
- Modularity, where it can be employed effectively, can accelerate value creation
 - once dominant design established, hence stable architecture and modular interfaces
 - and ultimate performance is not critical
 - autonomous or modular innovations, in this context
- Very challenging for value capture
 - loss of control for leaders
 - rapid, diverse innovation
 - revenues and value widely dispersed



Modularity

noun

1. the use of individually distinct functional units, as in assembling an electronic or mechanical system¹
2. designed with standardized units or dimensions, as for easy assembly and repair or flexible arrangement and use²

1: Random House Unabridged Dictionary, © Random House, Inc. 2006

2: American Heritage® Dictionary, © 2000 Houghton Mifflin



Modularity → decoupling

- *“When a product or process is ‘modularized,’ the elements of its design are split up and assigned to modules according to a formal architecture or plan.”*
- *“From an engineering perspective, a modularization generally has three purposes:
 - to make complexity manageable
 - to enable parallel work
 - to accommodate future uncertainty”*

Modularity in the Design of Complex Engineering Systems,
Carliss Y. Baldwin and Kim B. Clark, HBS Working Paper, January 2004



Product Architecture

Integral

Modular

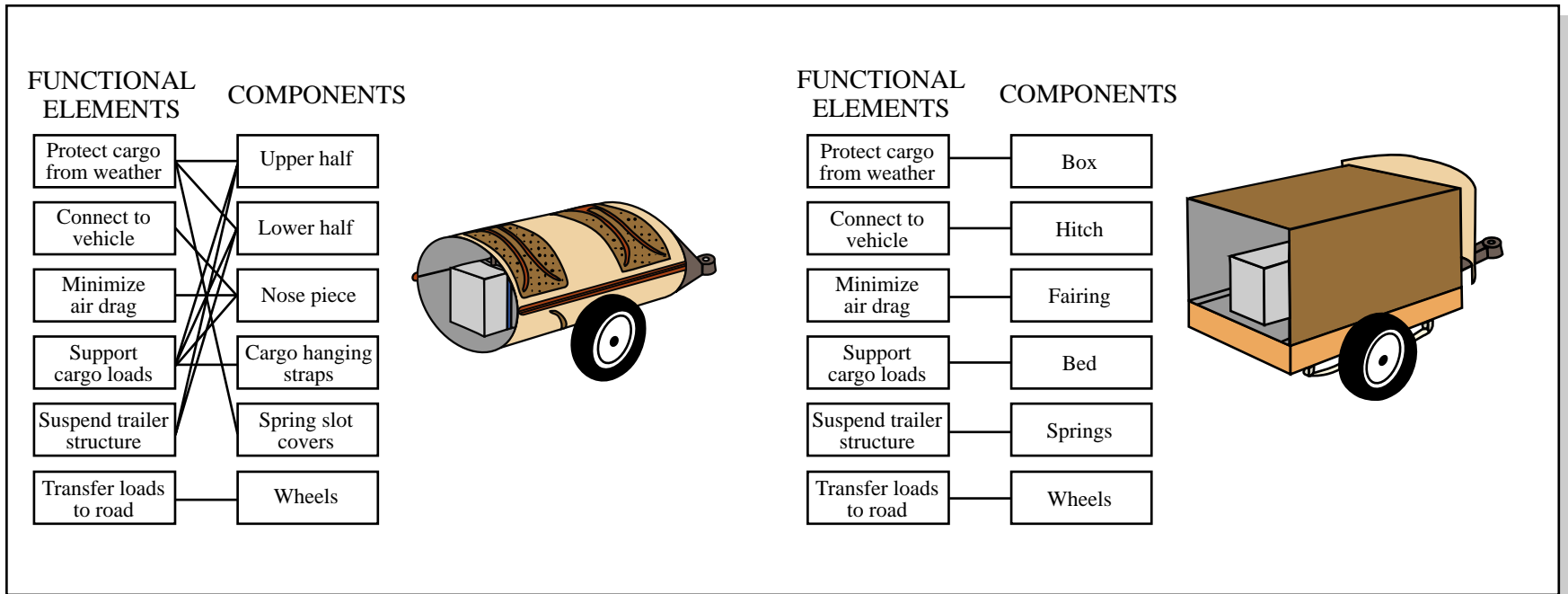


Image by MIT OCW.





Interfaces

Modular

- Customer understands and can specify key parameters
- Can be measured and tested reliably and unambiguously
- Understand how variation affects system performance
- Market can function effectively
- Codified knowledge
- Difficult to protect

Interdependent/ Systemic/Integral

- Associated with optimizing design for ultimate performance
- Unstructured technical dialogue
- Necessary information for market does not exist
- Management and integration most efficient coordinating mechanisms



IBM System/360

- First modular computer, conceived as a family of computers
 - different sizes suitable for different applications
 - same instruction set
 - standard interfaces for peripherals
- Design rules and decentralized development
 - Central Processor Control Office defines rules
 - each team full control over hidden elements
- Wildly successful, drove other players out of the market
- BUT undermined IBM's dominance in the long run - through emergence of plug-compatible modules



Nippon Denso can make 288 products from just 8 modules

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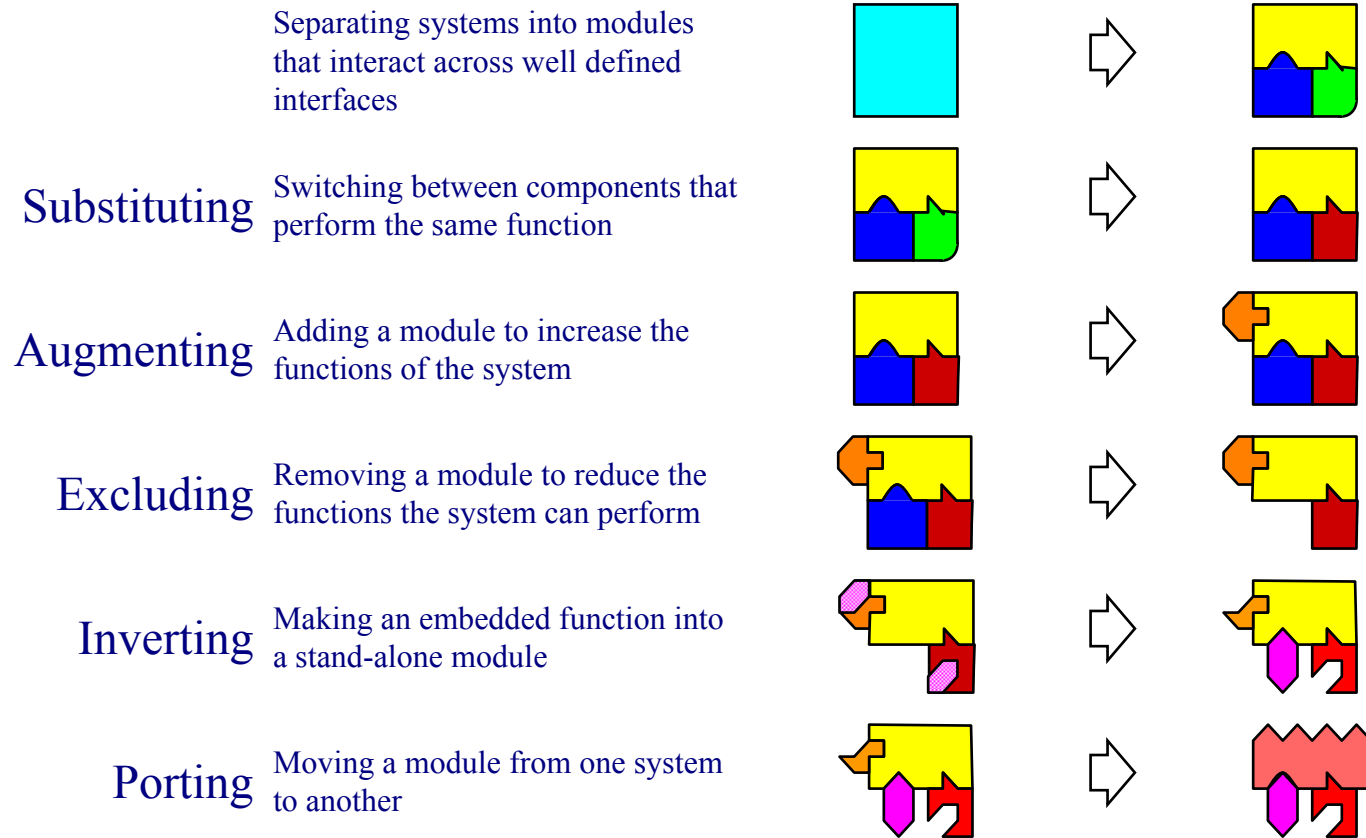


Braun family of coffee makers

Image removed due to copyright restrictions.



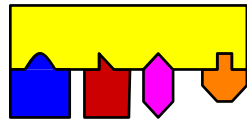
There are six modular operators that together enable a very wide range of system designs



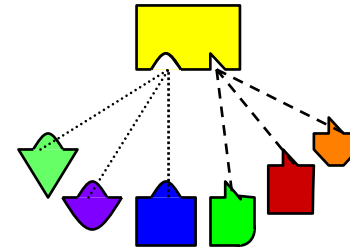


The resulting systems can exhibit several different types of modularity

Slot



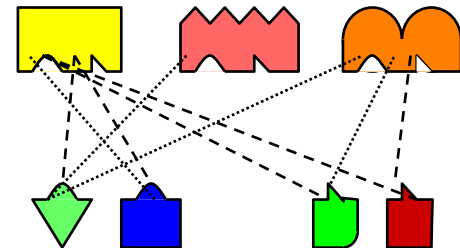
Component Swapping



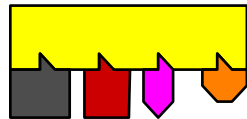
Direct



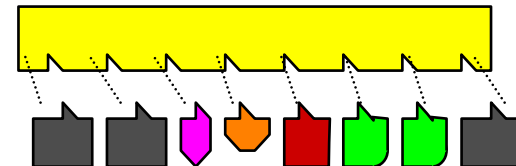
Component Sharing



Bus



Bus



**Modular
platforms can
be a very
effective
vehicle for
diverse offers**

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Strategic options

Architect

- For system innovations, may require broad scope of activities at the outset
- Create design rules, define visible information
- Convince people this architecture will prevail
- As modularity established, lead the evolution of the business ecosystem

Module player

- Conform to the architecture, interfaces and test protocols established by others
- Master the hidden information involved
- Rely on superior execution



Key to value capture is *focus on locus of value*

- “... *the virtuous virtuals have carefully nurtured and guarded the internal capabilities that provide the essential underpinnings of competitive advantage... they invest considerable resources to maintain and extend their core competences [because without them] their strategic position in the network would be short-lived*”

Henry Chesbrough and David Teece, “Organizing for Innovation: When is Virtual Virtuous?”, Harvard Business Review, August 2002, pages

- “*Attractive profitability seems to flow ... to the point at which unsatisfied demand for functionality, and therefore technological interdependency exists.*”

Clayton Christensen and others, “Disruption, disintegration and the dissipation of differentiability”, Industrial and Corporate Change, 2002, pages 955-993





Locus

noun

1. a center or focus of great activity or intense concentration¹
2. a center or source, as of activities or power²

1: American Heritage® Dictionary, © 2000 Houghton Mifflin
2: Random House Unabridged Dictionary, © Random House, Inc. 2006



Amdahl's Law: "...make the common case fast..."

- Amdahl's Law is concerned with the speedup achievable
 - from an improvement to a computation
 - affects a proportion P of that computation
 - where the improvement has a speedup of S

"God grant me the serenity to accept the things I cannot change (much); courage to change the things I can (a lot); and wisdom to know the difference."

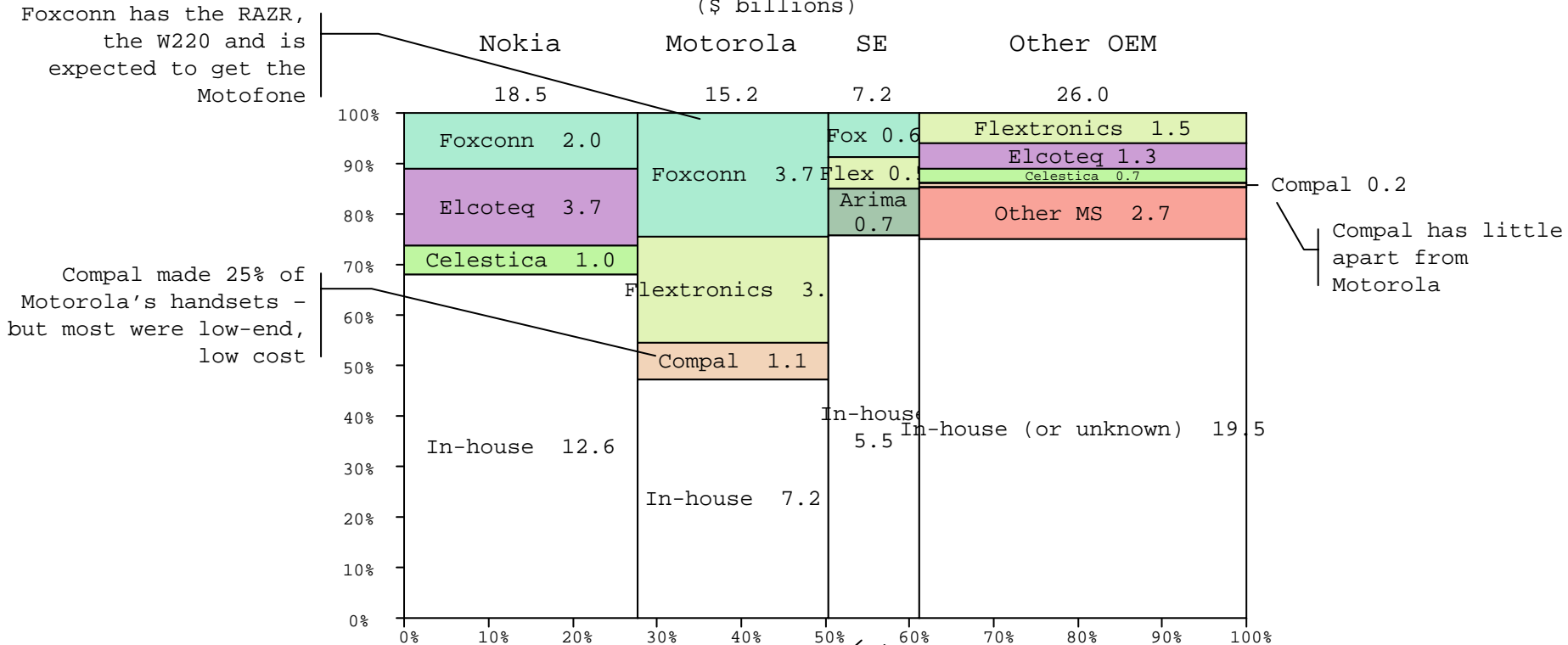
- Reinhold Niebuhr





The top three players now outsource at least 25% of their volume, and some more than 50%

Handset COGS, global, 2005
(\$ billions)



Foxconn has the RAZR, the W220 and is expected to get the Motofone

Compal made 25% of Motorola's handsets - but most were low-end, low cost

Compal has little apart from Motorola

Nokia only outsources low end and CDMA

Sony Ericsson mostly outsources low end

Sony Ericsson has added Compal in 2006

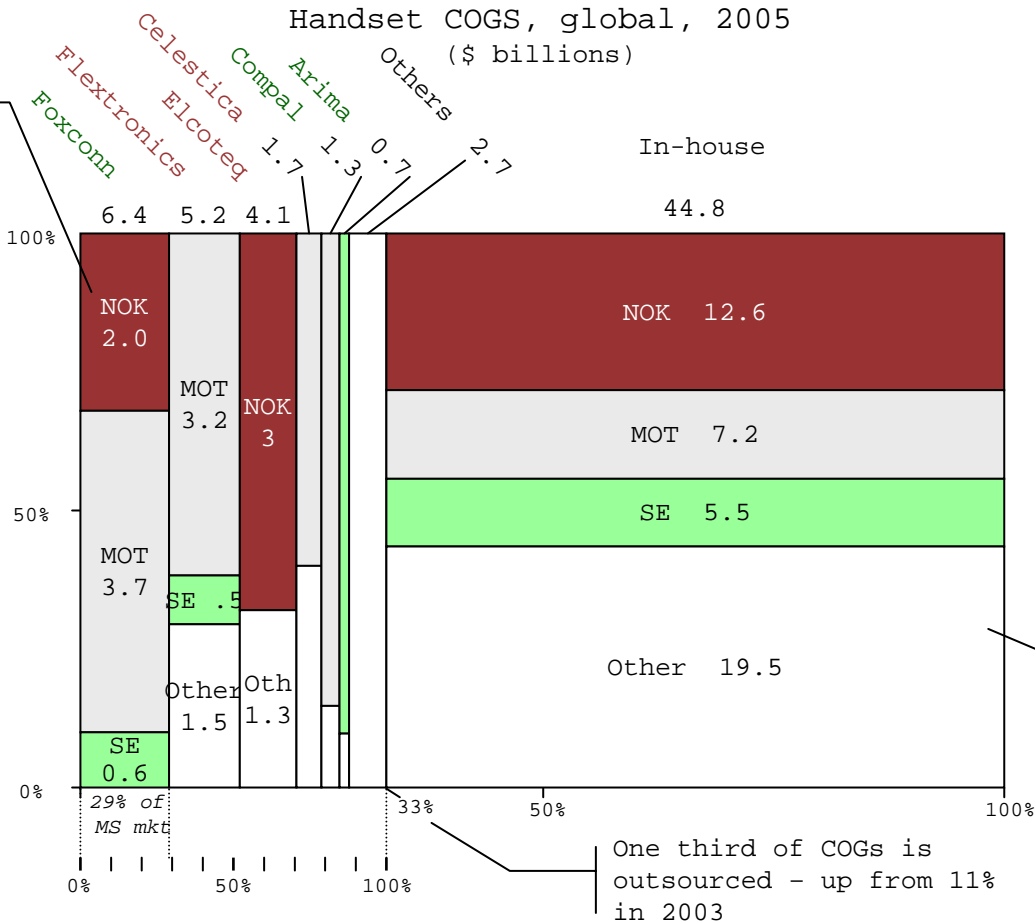


In '05, top tier vendors outsourced a third of CoGS; Foxconn is now #3 manufacturer

Handset COGS, global, 2005 (\$ billions)

Foxconn's revenue is expected to top \$11 billion in 2006, and it is now the world's #3 mobile phone development and manufacturing business

- Taiwan based
 - Foxconn
 - Compal
 - Arima
- US/Europe based
 - Flextronics
 - Elcoteq
 - Celestica



Sources: SinoPac; Nomura; ABN Amro; KGI; Yuanta; Ericsson company reports; 2003 COGS based on Citigroup, Nov 2004

Samsung and LG do not outsource much





Despite the importance of collaboration, there are still large differences: Nokia keeps clear leadership

Nokia 1110

Motorola C138

Feature set and cost comparison:

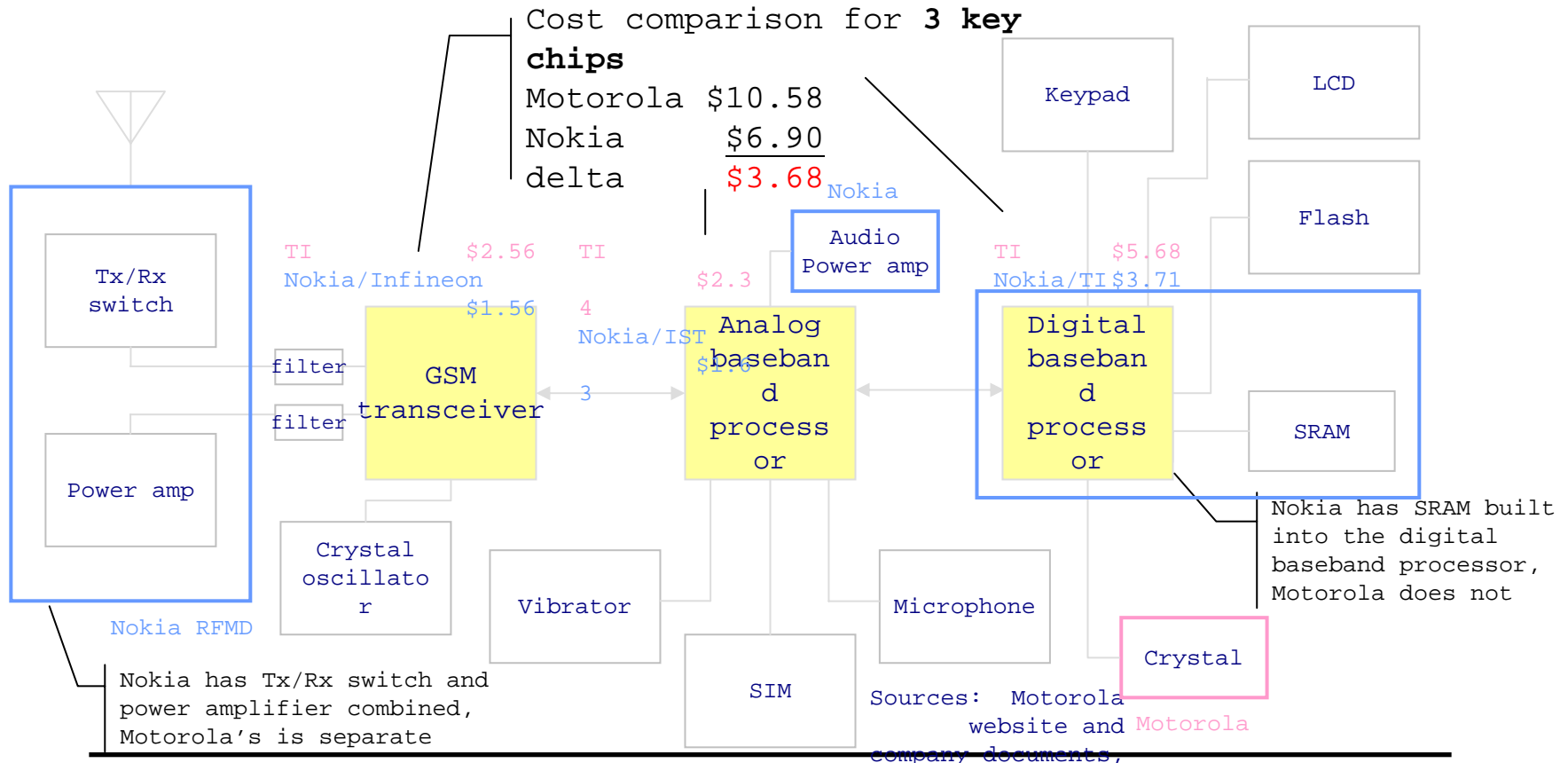
Standby time	Up to 380 hours	Up to 300 hours
Talk time	Up to 5 hours GSM dual band	Up to 7.5 hours
Technology	(900/1800 and 850/1900 versions)	GSM dual band (900/1800)
Weight	80g	81g
Volume	78cc	94cc
Dimension	104 x 44 x 17 mm	100 x 45 x 21 mm
Display	96 x 68 mono Removable covers, MP3	96 x 65 mono
Other features	grade, multiple language, speaker	Headset jack
Messaging	SMS, EMS, (picture messaging)	SMS, EMS
Personalization	Games, polyphonic ring, speaking alarm, stop watch,	Games, ringtones, alarm clock,
Call management	200 entry phonebook	calculator, stop watch SIM only
Manufacturing cost	\$29.45	\$34.91
Retail price	\$60 to \$75	Around \$50

- Nokia 1110 phone beats the Motorola C138 on most key measures that matter to customers:
 - ✓ 27% more standby time
 - ✓ removable covers
 - ✓ speakerphone
 - ✓ polyphonic ringtones
 - ✓ 200 entry phonebook
 - ✓ 17% smaller and 20% thinner
 - ✗ 33% less talk time



Nokia has 15% cost advantage from investing in research to lower the costs of three key chips

Architecture teardown and cost comparison: Nokia 1110 and Motorola C138





Summary

- Modularity when and if:
 - performance not critical
 - dominant design established
- Accelerates value creation, makes value capture tough
- *Focus on locus* of value
 - bottleneck, constrains overall system performance
 - build inimitable capabilities and core competences