Pains and Challenges in the Mobile Internet Evolution

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Outline

- Introduction: ACCESS Overview, Industry Overview, . . .
- Triple challenges of the mobile Internet evolution)
- Early Stage Challenges and Deliverables
- Late Stage Challenges and Emerging New Skill Requirements
- Lessons from Mobile Service Evolution
- Summary

ACCESS overview

- Founded in 1984 (Tokyo)
- 1,625 employees (2008/E)

NetFront™ Family

- Browser and network software components: 808 million licenses (by July 2009)
- One-seg browsers: 153 models, 48 million units in Japan (by 2009)

User Increase

Mobile Internet Users (premium service subscription)

Year	Premium Users (Mil)	Users (Mil)	Percentage (%)
2000	26.86	58.19	46.2
2002	59.53	73.77	80.7
2004	73.55	85.48	86.0
2006	82.59	94.94	87.0
2008	90.17	105.83	85.2

http://www.tca.or.jp/database/index.html

3G Penetration in Japan

Month	3G Users (Million)	Wireless Subscribers (Million)	Ratio (%)
2004.9	24.94	84.31	29.6
2005.9	39.23	89.13	44.0
2006.9	58.15	93.81	62.0
2007.9	79.83	99.33	80.4
2008.9	94.03	104.83	89.7

Data Service Flat Rate Users

Month	Flat rate users (Million)	Wireless subscribers (Million)	ratio (%)
2004.9	2.38	84.31	2.8
2005.9	9.27	89.13	10.4
2006.9	17.90	93.81	19.1
2007.9	31.03	99.33	31.2
2008.9	39.73	104.83	37.9

Andy Rubin vs. Tomy Kamada

	Andy Rubin(Age 46)	Tomy Kamada (Age 48)
Founder	Danger, Android	ACCESS
Taste	Digital Appliance	Digital Appliance
1980's	Apple	ACCESS
1990's	GeneralMagic	ACCESS
Late 90's	WebTV	NetFront(ACCESS)
Early 00's	Danger	Mobile Suites (ACCESS)
Middle 00's	Android	ALP (ACCESS)
Late 00's	Android(Google)	LiMo (ACCESS)

- WebTV(1997) and Danger(2008) were bought by Microsoft.

Personal Story

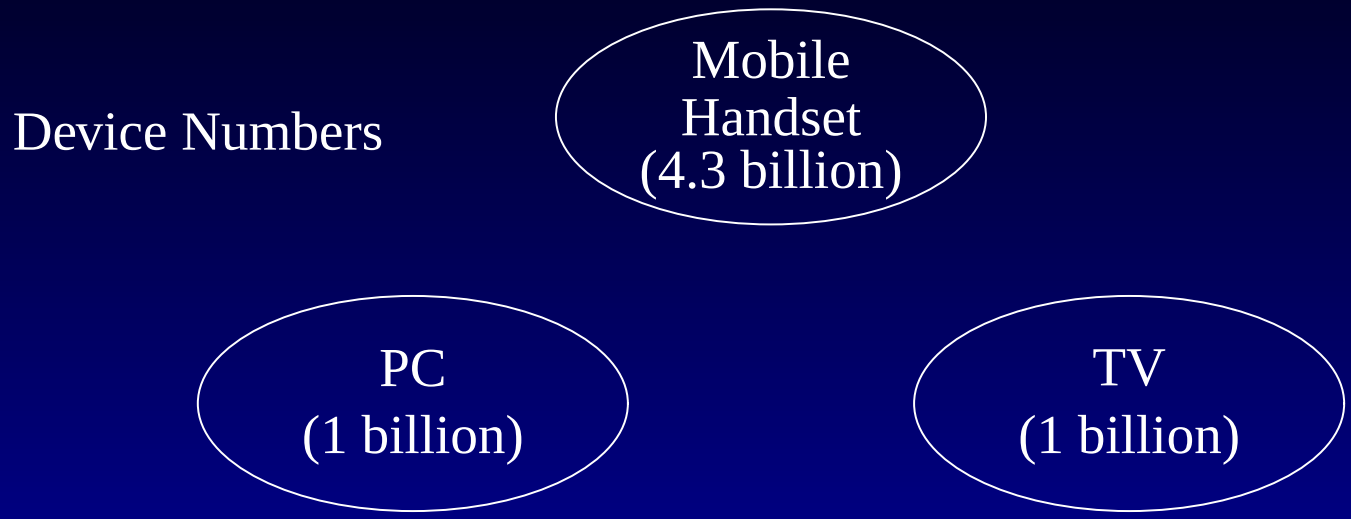
- In many cases, I talk first. Then, I try to summarize what I wanted to present in order to create something valuable.
- In most cases, the persons who invited me for a talk did not know what I had in my mind for the presentation.
- When I started my carrier in 1984, I told that I had no interest in communication layers lower than layer 7. I did not realize that I was put in an army of people with layer-2 and layer-3 specialization. I was a little bit too brave.
- Later, my boss told me that he thought the current researcher needed software engineering skills such as they needed circuit engineering skills in early 1970's.
- So, what skills do we need in an information technology industry in 2010's and 2020's?
- From my personal viewpoint, today's computer science education in most universities is totally out-dated.

Worldwide share 2005-2008

Vendor	2008		2007		2006		2005	
	Shipment (Mil)	Share (%)	Shipment (Mil)	Share (%)	Shipment (Mil)	Share (%)	Shipment (Mil)	Share (%)
Nokia	468.4	39.7	437.1	38.2	347.5	34.1	264.9	31.8
Samsung	196.7	16.7	161.1	14.1	118.0	11.6	102.8	12.3
LG Electronics	100.7	8.5	80.5	7.0	64.4	6.3	54.9	6.6
Motorola	100.1	8.5	159.0	13.9	217.4	21.3	146.0	17.5
Sony Ericsson	96.6	8.2	103.4	9.0	74.8	7.3	51.1	6.1
Misc.	218.5	18.5	202.9	17.7	197.8	19.4	213.1	25.6
Total	1180.9	100.0	1,144.1	100.0	1,019.9	100.0	832.8	100.0

Note: IDC Worldwide Quarterly Mobile Phone Tracker Excluding OEM sales

Media Potential



- Also, the mobile software engineering accommodates the fundamental engineering challenges of today
  - “Challenges of Change and Diversity”
  - Total engineering, including technical, platform, ecosystem, business model …

Triple Challenges

Player	Challenges
Vendor / Technology Provider	Technology Acceptance with Constraints
Carrier	Service and Platform Development
Content and Application Provider	Revenue Development and Competition

- Two Big Challenges in Different Stages
  - Launch eco-system: needs a risk taker
  - Post-launch eco-system: needs a stage-awareness and competence shift
- Combination of Technical and Business Model Challenges

Standardization

First Stage	Second Stage	Third Stage
Content-Awareness, Subset	Convergence	WebAPI, Component convergence, Source sharing
Compact HTML, Compact NetFront, SLIM library, Porting Layer	NetFront 3 Architecture, Component-based	BONDI, Widgets, NetFront DirectConnect, Foundation Engineering

Implementation

First Stage	Second Stage	Third Stage
Compact Implementation, Portability	Convergence, Extensibility, Modularity, Quality Control	Collaboration (Foundation engineering), Eco-system-awareness (Platform, Application store)

Business Development

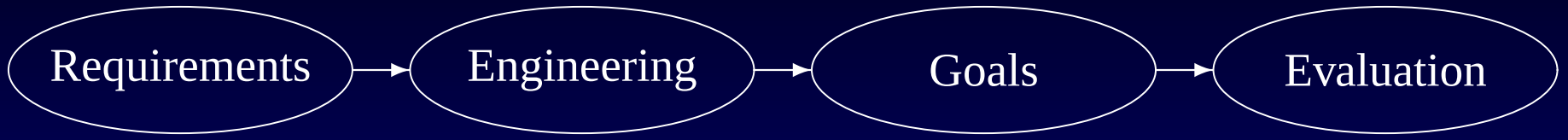
First Stage	Second Stage	Third Stage
Technology-initiative (WAP, W3C), Sponsored Development	General Agreement for Carriers and Vendors	Platform consortium (OHA, Symbian Foundation, LiMo Foundation), Application Platform, OSS-based Platform, Service Provider Penetration (Apple, Google)

Challenges in Evolution

- Diffusion makes landscape change

Player	Early	Late
Vendor / Technology Provider	Entry Risk/Opportunity	Commodity Risk
Carrier	Entry Risk	Competition Risk
Content and Application Provider	Entry Risk	Competition Risk and Landscape Change Risk

Engineering



(Given conditions)

Theories
Methods
Process, Operation
Best Practices

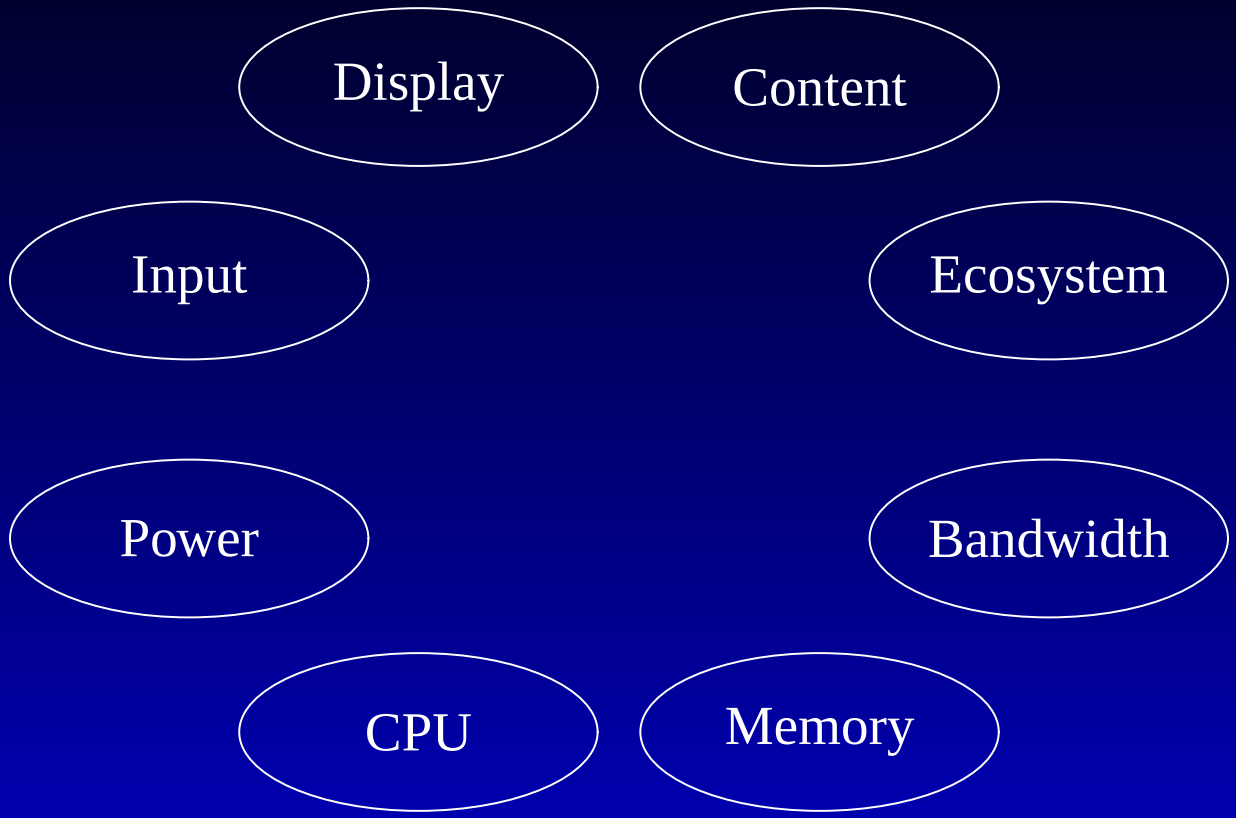
[Sources of Pains]

Constraints

Diversity

Evolution

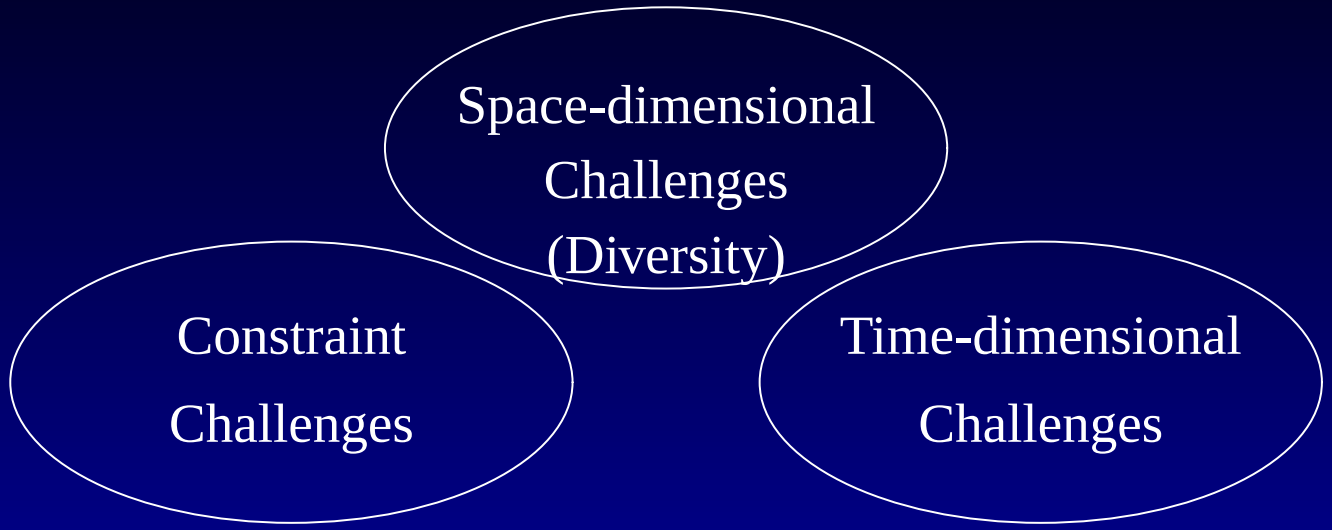
Constraint



Constraint(2)

- i-mode requirements: same size, same cost, same battery, same weight
- i-mode browser started from 300KByte ROM and 150KByte RAM
- Software compaction engineering: unique technical field in thug software industry
  - ACCESS, Aplix, . . . : many Japanese technology providers started at PC software in 1980's
  - Come-back after 10–15 years
- Some constraints persist: Mobile Linux virtual memory on Flash memory, application framework, . . .

Challenges for Technology Providers



Time-dimensional Challenges

Backward Compatibility	Forward-Looking Design

- Carrier-grade backward compatibility requirements
- Long lead time for market in embedded software engineering

Evolution


ECMAscript, DOM
SMIL, SVG, PDF
Java support
SSL support
JPEG
IrDA comm.
3D Polygon
Camera
Color support
Ringer tone
download
C-HTML
GIF
WAP2.0
+ Alpha
Mega Pixel Camera
Flash support
i-mode
Start
@Mail
(KDDI)
Global
i-mode
Video download
TV-Conference
3G
FOMA

Evolution(2)

- QUALCOMM snapdragon:
  - QSD8250: Toshiba TG01: 1GHz CPU-core (2009.2)
  - QDS8672: 1.5GHz dual CPU-core (to appear 2010)
  - Overlap with NetBook market (able to cover 12-inch display)

A Decade of Evolution

Screen Resolution

Year	1999	2006	2008
Screen Resolution (dot)	94x72	240x400	480x864
Model	501i	903iTV	905i
Color	Monochrome	color	color

A Decade of Evolution(2)

Data Speed

PDC	9.6Kbps–28.8Kbps
IMT-2000(3G)	–144Kbps(H) –384Kbps(L) –2Mbps(S)
HSDPA*	2–3Mbps(ave) 14Mbps(max)

Note: S: stayed, L: low speed, H: high speed

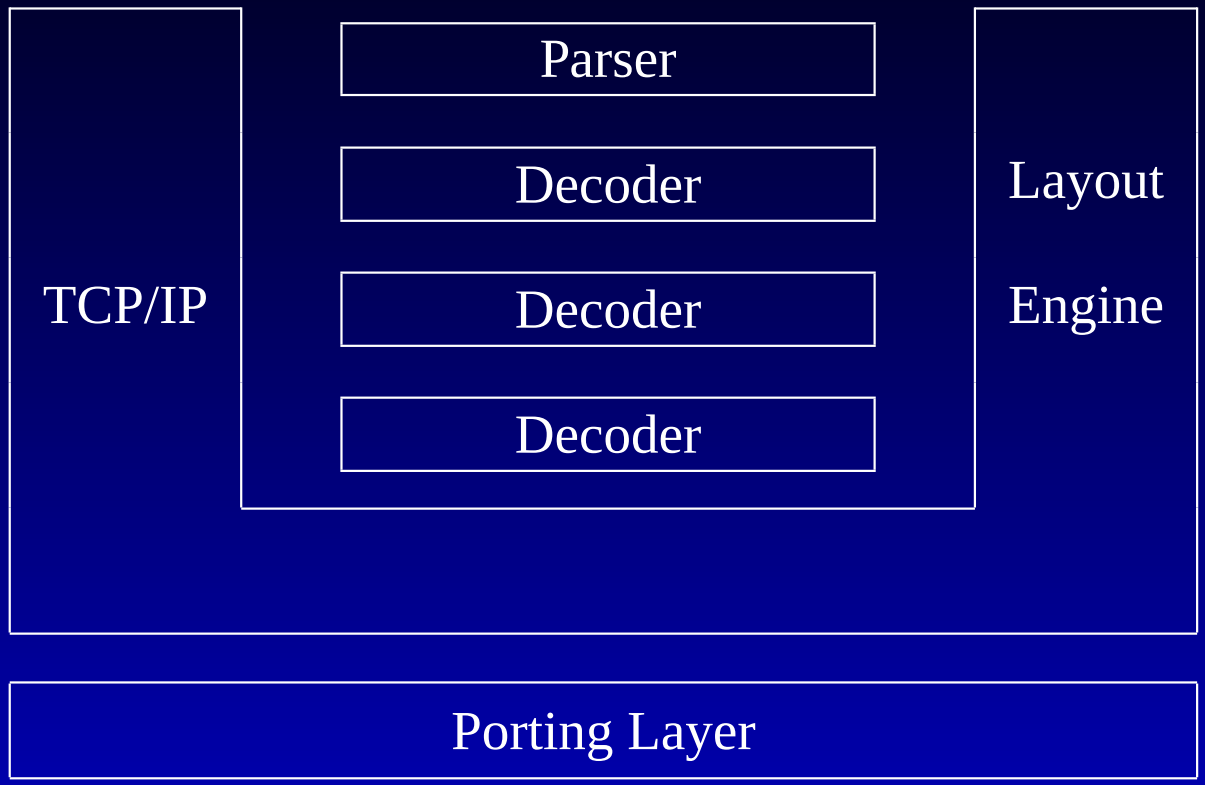
HSDPA: High Speed Downlink Packet Access

PDC: Personal Digital Cellular

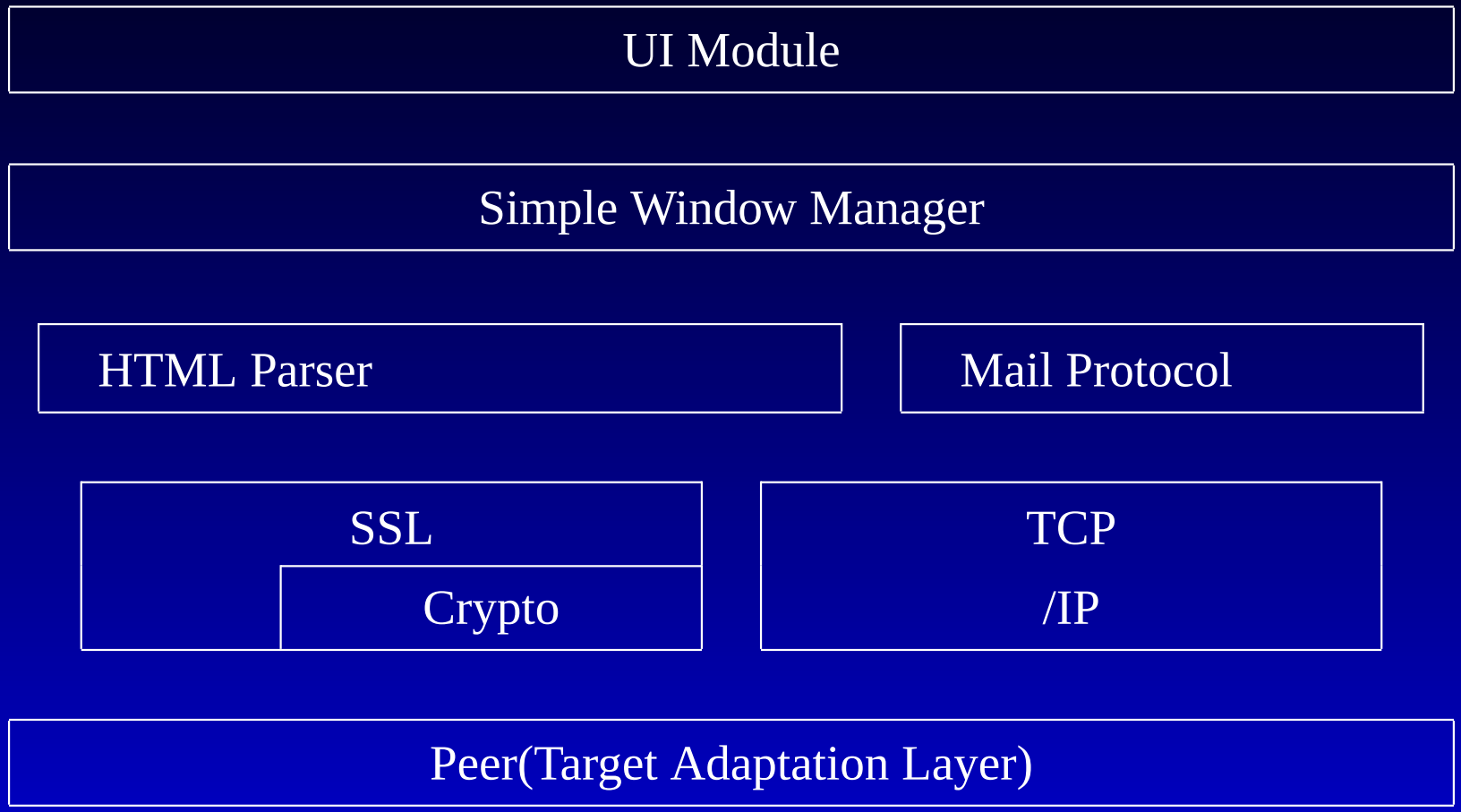
(Japanese local 2G standard)

FOMA started in 2001, HSDPA started in 2006

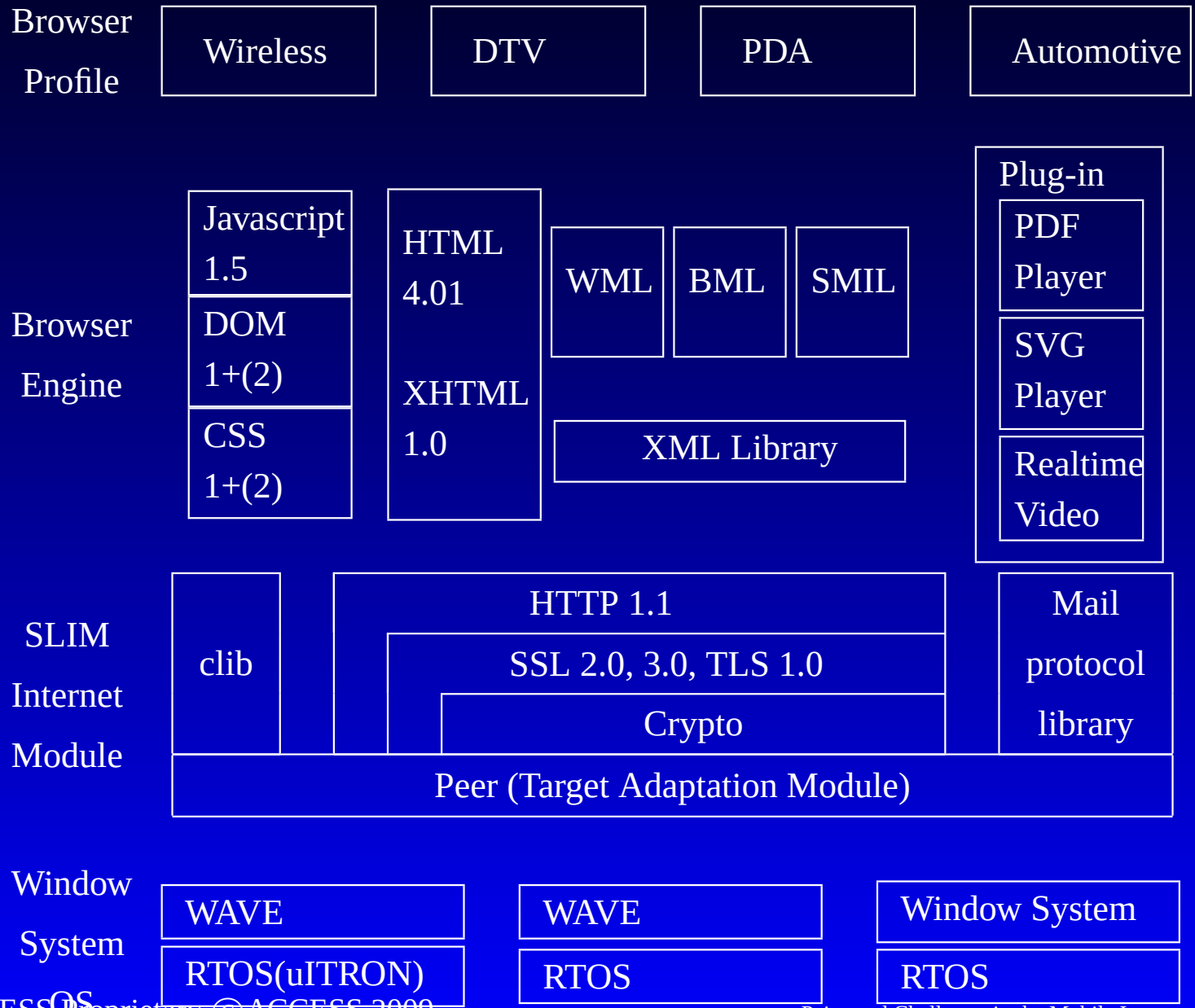
NetFront™ 1.0 Architecture



NetFront™ 2.0 Architecture



NetFront™ 3.0 Architecture



Early Software Challenges

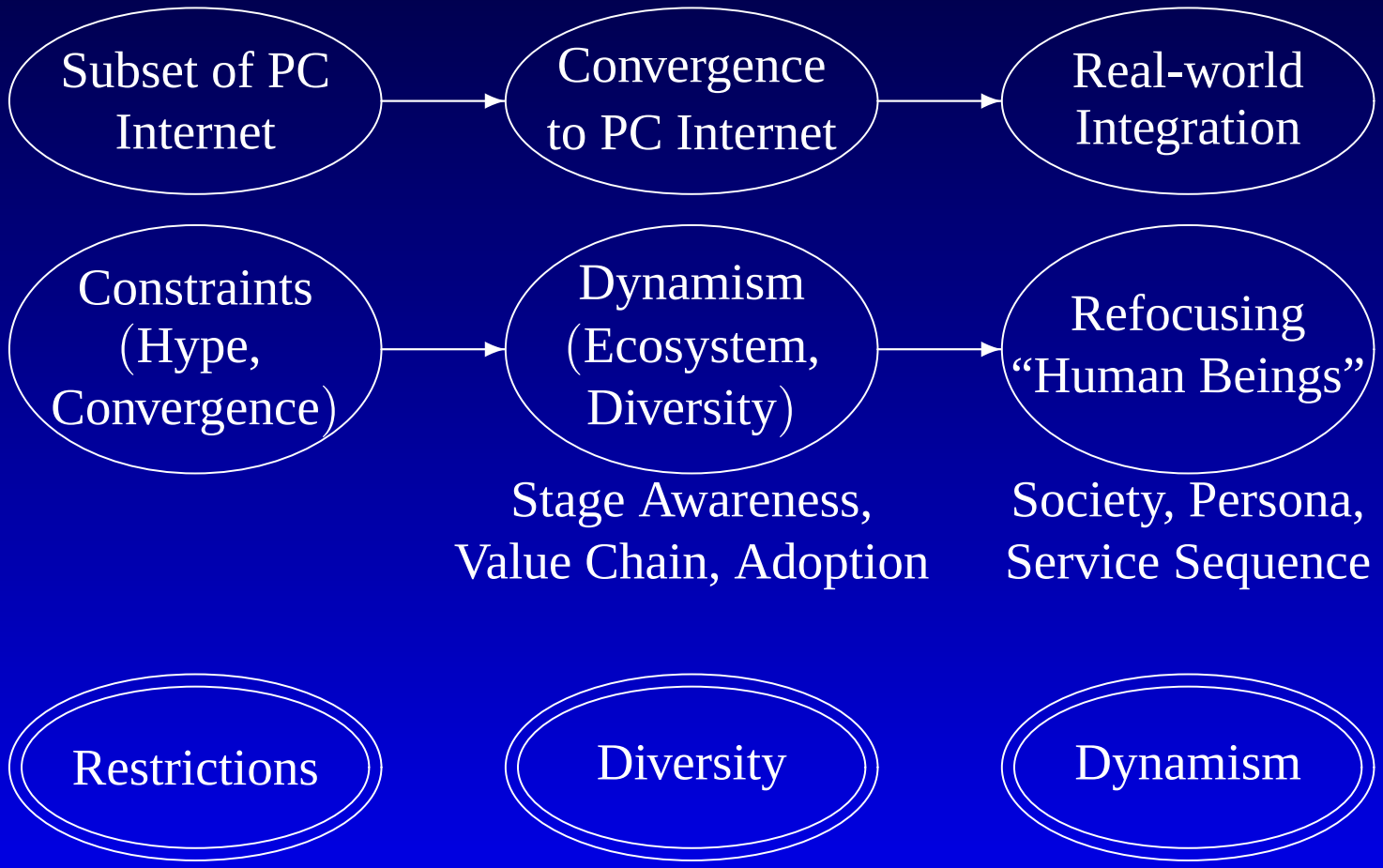
- Memory Constraint
  - Limited ROM and RAM, Fixed at Factory Shipment
  - No magic for Making software Small
    - Making it from scratch
    - Sega Dreamcast case (Windows CE)
  - Skill collection since 1994
    - Memory-aware coding and library
    - Application-life time aware coding
    - Error handling: Error-robust
    - Progressive processing with Error handling
- Portability: Chipset, No Window system, Diversity in API compatibility
  - Portability-oriented architecture
  - Device-independent code and customization: Three-layer Structure (Core, Major Profile, Device Profile)

Early Software Challenges(2)

- Constraint Engineering
  - Company from 80's and 90's PC programming
  - ACCESS, Aplix, HI, Acrodea, . . .
- Early days of Embedded Network Software
  - DOCOMO demanded 4 No's (a) weight increase, (b) size increase, (c) battery life decrease, (d) cost increase
  - ACCESS needed total reengineering for Compact NetFront
    - Sacrifice modularity to cope with 1:10:100 memory capacity gap
    - Inherit NetFront Library, Porting Layer, Total Memory Reengineering
      - Memory management: Applications cannot depend on OS on memory management
    - Robust code: content error tolerance due to network constraints (narrow, but charged)

Lessons

- The biggest lessons may be “dynamism” and “never-ending challenges”.

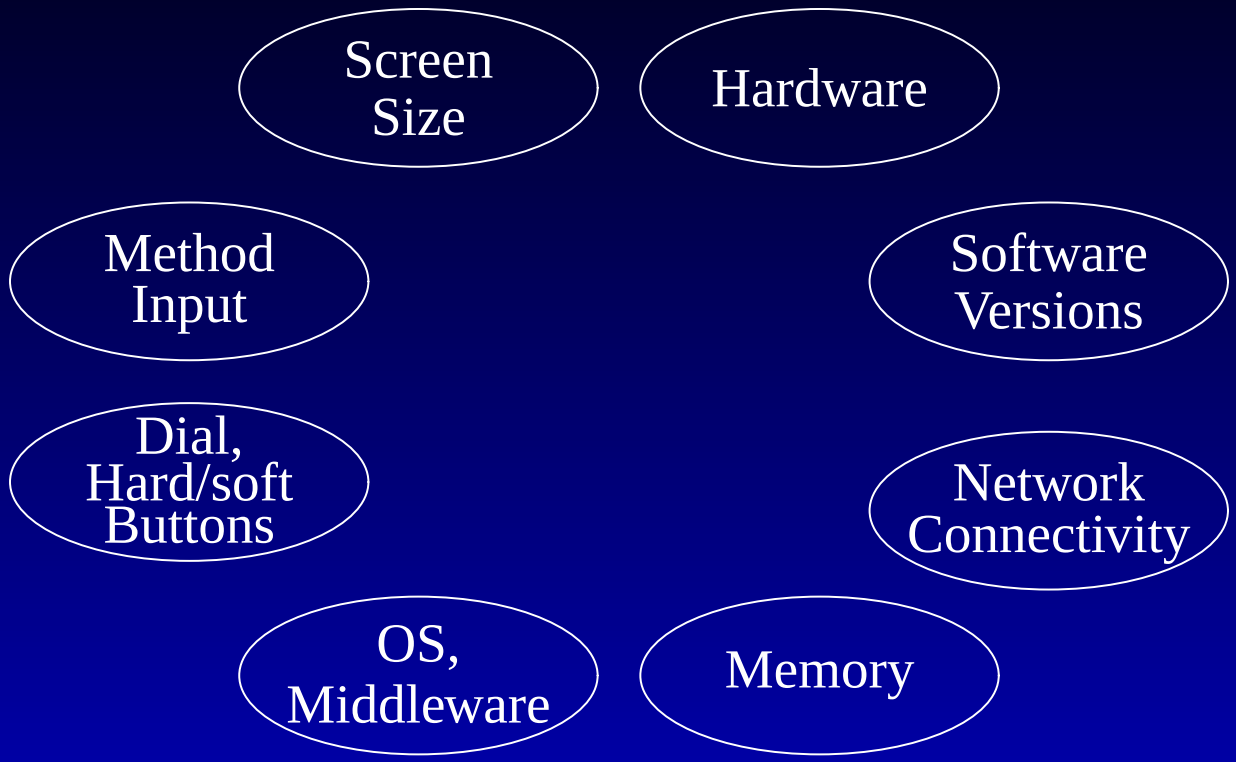


Diversity

Time Dimensional Diversity	Space Dimensional Diversity

- Internet Giants struggled with diversity
  - Java: “Write once and Run anywhere” did not work in mobile clients
  - One of the reasons why Google coined Android

Diversity(2)



- Differentiation
  - Vendor competition for market share
  - Carrier competition for ARPU (Average Revenue Per User)
- Vendors' past assets
- Different users, different use scenes, different markets(cost)

Two Big Waves

Apple
iPhone
AppStore

Google
Android
Android Market

player	Apple	Google
strategy	Device convergence from iPod	Seamless Google application use experience
business model	Strategic alliance with carriers, Taste engineering	No revenue from Android
eco-system	Application store, breaking the legacy ties with applications and handset vendors (carriers)	Free open middleware, Android market, high-level application running environment, challenges to vendors and carriers as the mega-service provider

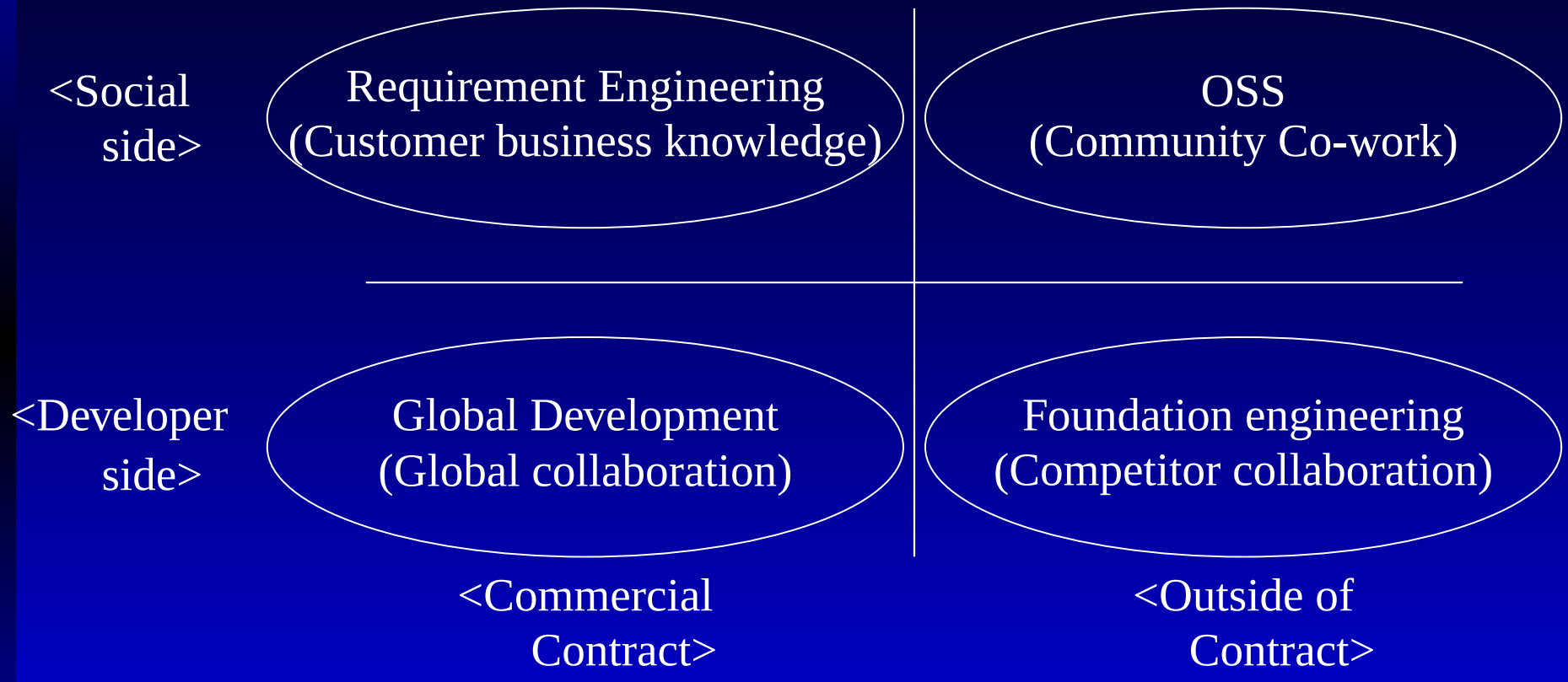
Application Store

Store	Company	Description
App Store	Apple	With iPhone 3G, App Store was launched in July 2008. It provides applications for iPhone and iPod Touch. Total download number reached 1.5 billion with 65 thousand applications (as of July 2009).
Android Market	Google	Download of free applications was launched in October 2008. Charged application download started since February 2009.
BlackBerry App World	RIM	Launched in April 2009. More than 1000 applications for consumers and business users are provided.
Ovi Store	Nokia	It was launched in May 2009. It is available for more than 50 Nokia models.
Samsung Mobile Applications	Samsung	Test download started in February 2009 in UK with 1100 applications.
LG Application Store	LG	It was launched in July 2009 for Asian users with 1400 applications.
Windows Marketplace for Mobile	Microsoft	It is planned to launch in the 2nd half of 2009 for Windows Mobile 6.5 devices.

App Store

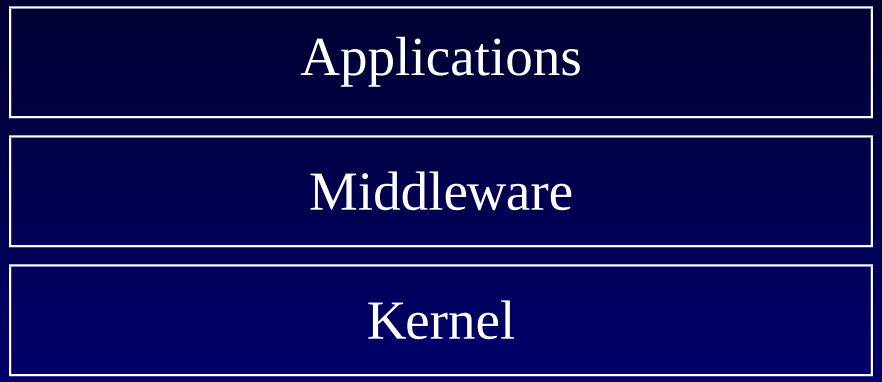
- 148app observation (July 2009) http://148apps.biz/app-store-metrics/
  - Downloadable applications at US 58,088 (excluding 4,206 undownloadable applications)
  - Games 10,584, Non-Game applications 47,504
  - Number of Active Publisher at US 15,242
  - Average application price 2.59$; game 1.40$, non-game 2.85$
  - Free applications 13,093(22.54%); game 2,888, non-game 10,205
- Dejavu of early i-mode . . .

Cross-boundary Software Engineering



- Cross-boundary leveraging factor: drastic information/communication cost decrease

Foundation Engineering



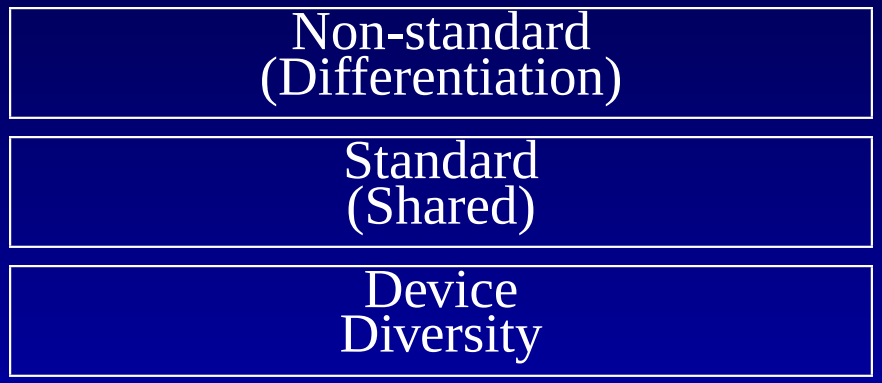
- Large-scale software
  - Kernel: 7.7 Million lines of code (Android)
  - Middleware: 4-8 Million lines
  - Applications: 5- Million lines
- 50–80 % of Middleware is OSS
- OSS ratio is increasing
- Maintenance cost is crucial

Foundation Engineering(2)

LiMo Foundation	Jan 2007	Carrier-Vendor Collaborative Middleware development, Combination of OSS and Commercial-grade middleware
Open Handset Alliance	November 2007	Google Android based Open source, Seamless Mobile Application Execution Environment with Dalvik
Symbian Foundation	June 2008	Symbian asset contributed by Nokia, Maintenance cost reduction with a large installation-based software

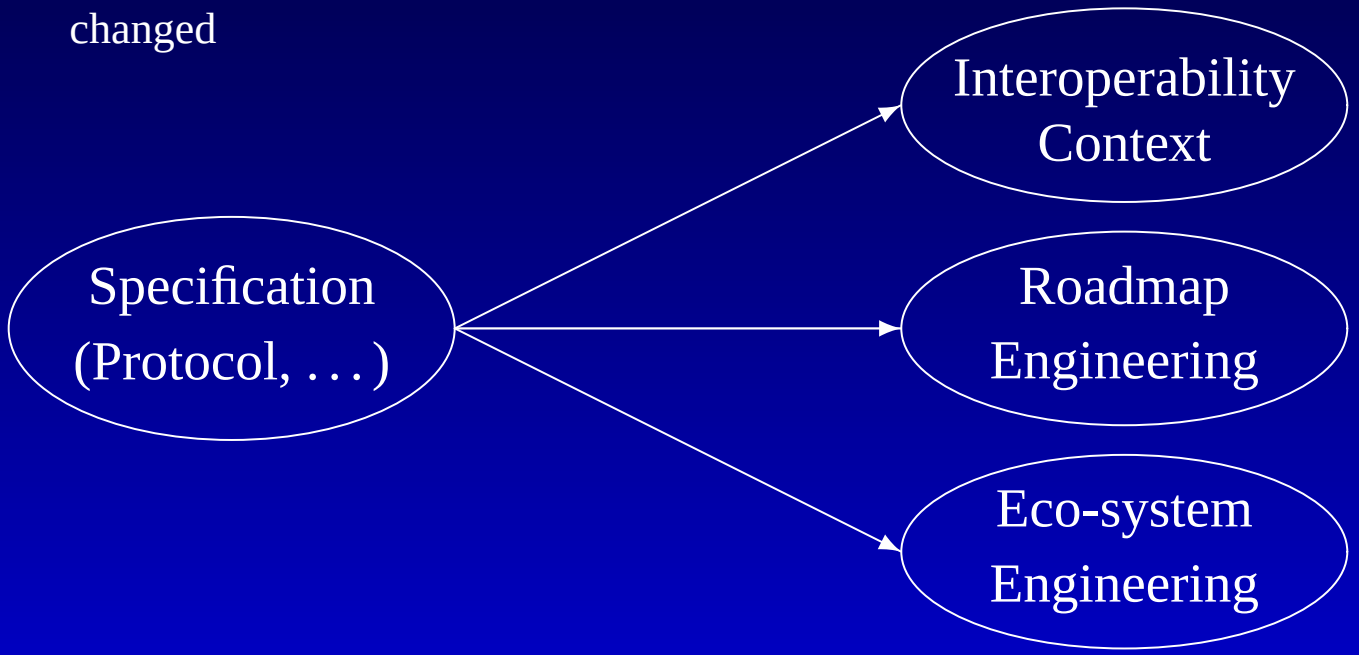
Framework Engineering

- Standardization Engineering
- Foundation-based Software Engineering
- Wisdom management how the world resource should be used



Standardization Engineering

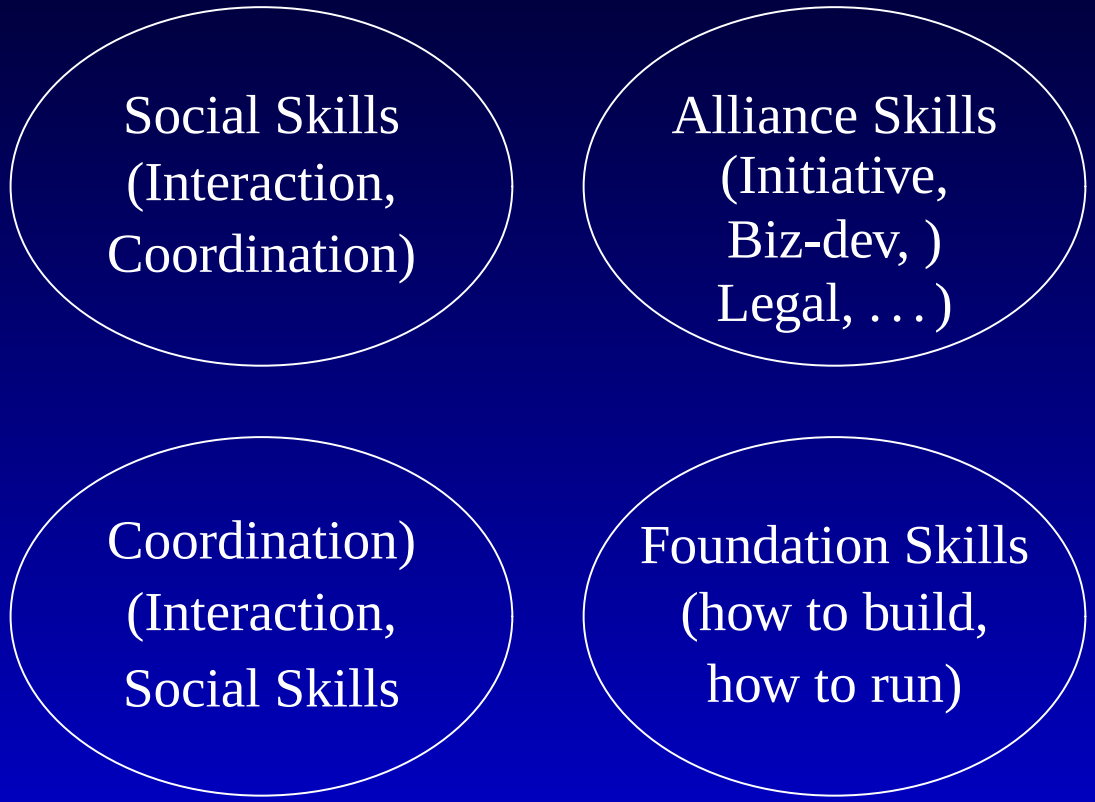
- Stage-dependent
  - When no one can make it, it is crucial to define something (protocol, language, encoding, . . .)
  - When it is well known (or feasible) how to make it, the landscape is completely changed



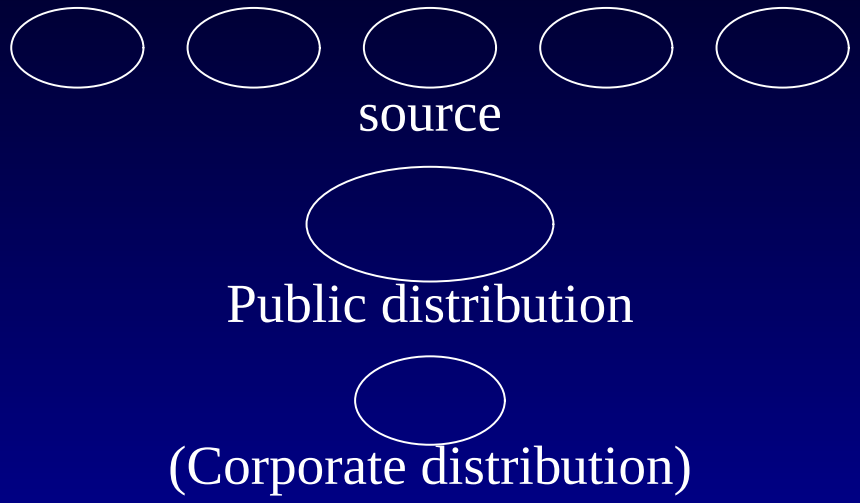
- Time-dimensional and space-dimensional engineering

Standardization Engineering(2)

- Also applicable to foundation-based software engineering



OSS Engineering

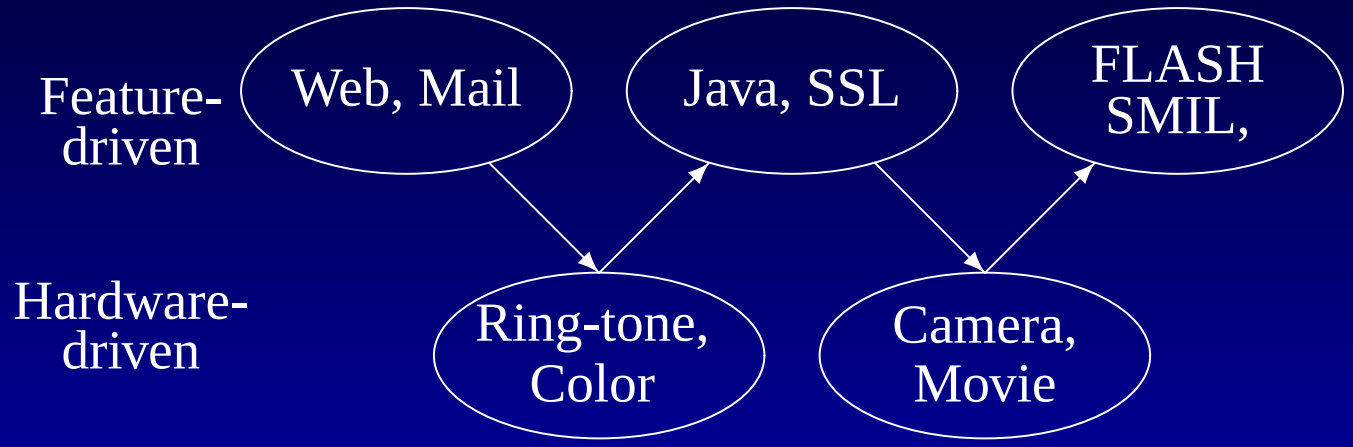


- The maintenance cost for commercialized OSS is underestimated in the industry.
  - Combination of different license, convention, roadmap code.
  - Upstream contribution and interactions with communities.
  - Evaluation
  - Dependency resolution
  - Roadmap synchronization

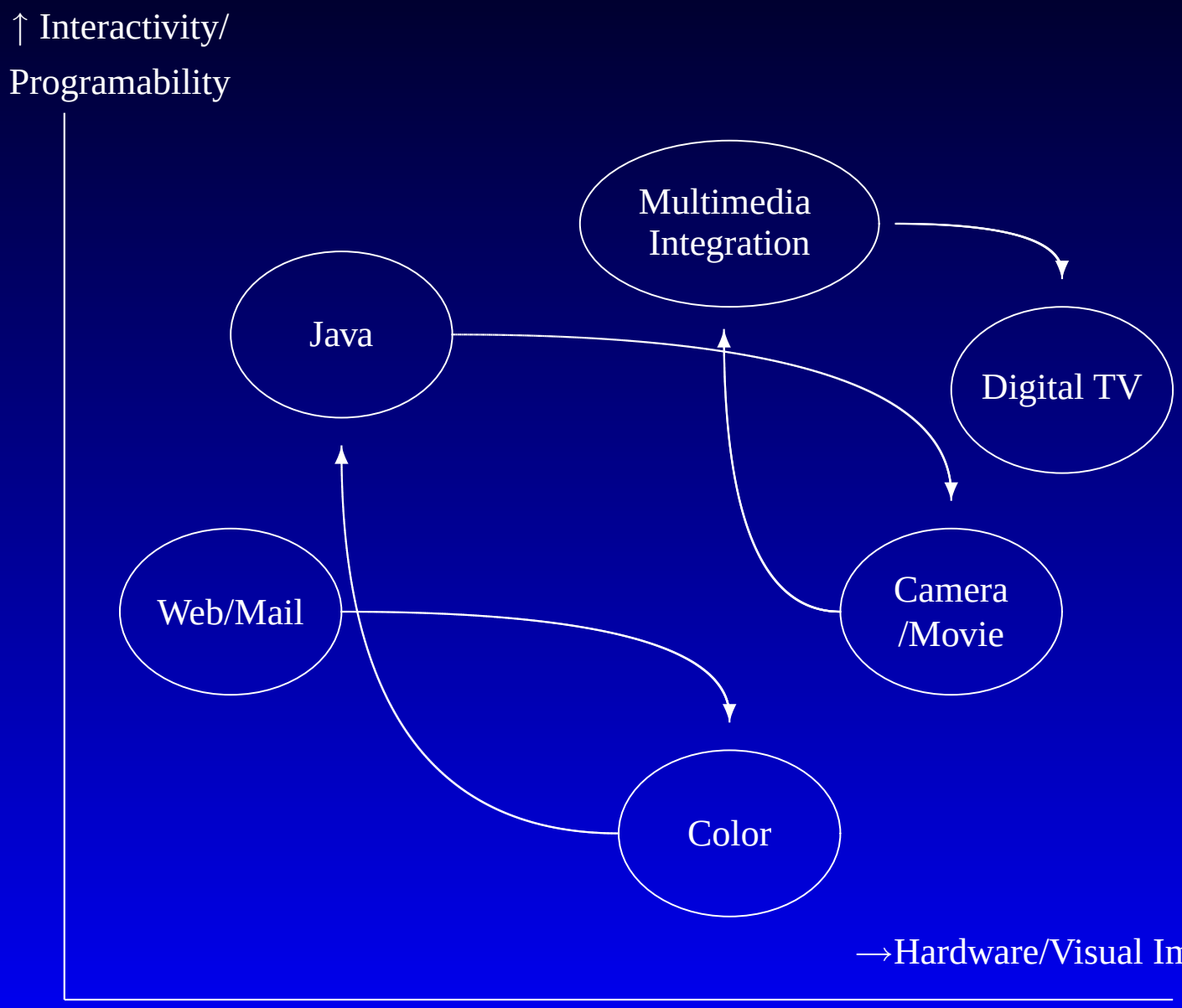
Mobile Battle lines

- As the number of service menu increases, the impact of each service decreases.
- User's capacity to choose services is limited.
- Increased services lead to increased development cost.

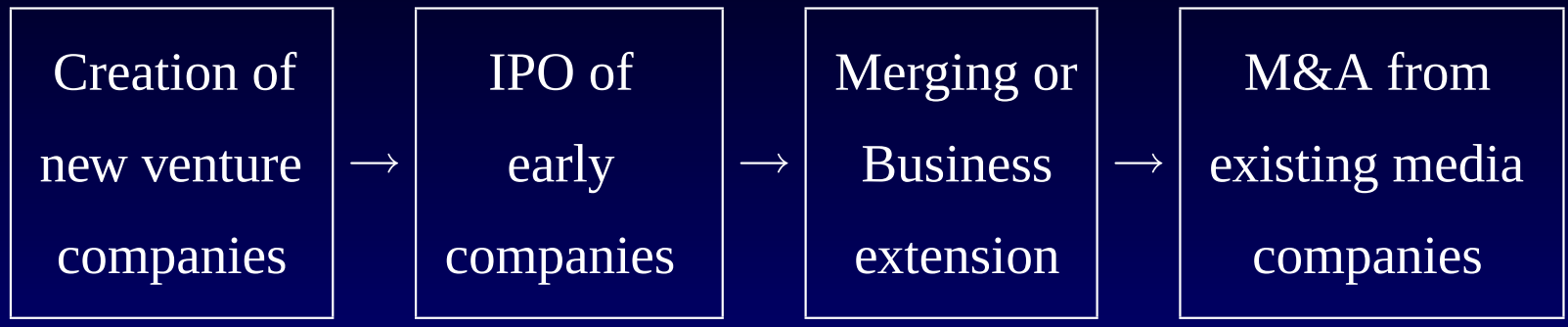
Turn-taking Model



Spiral Model

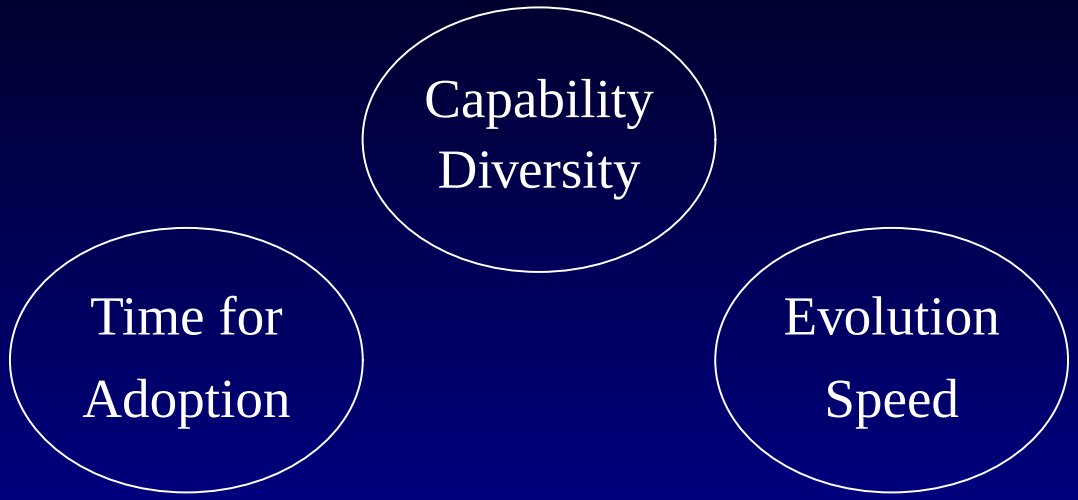


Lost Entrepreneur Dreams



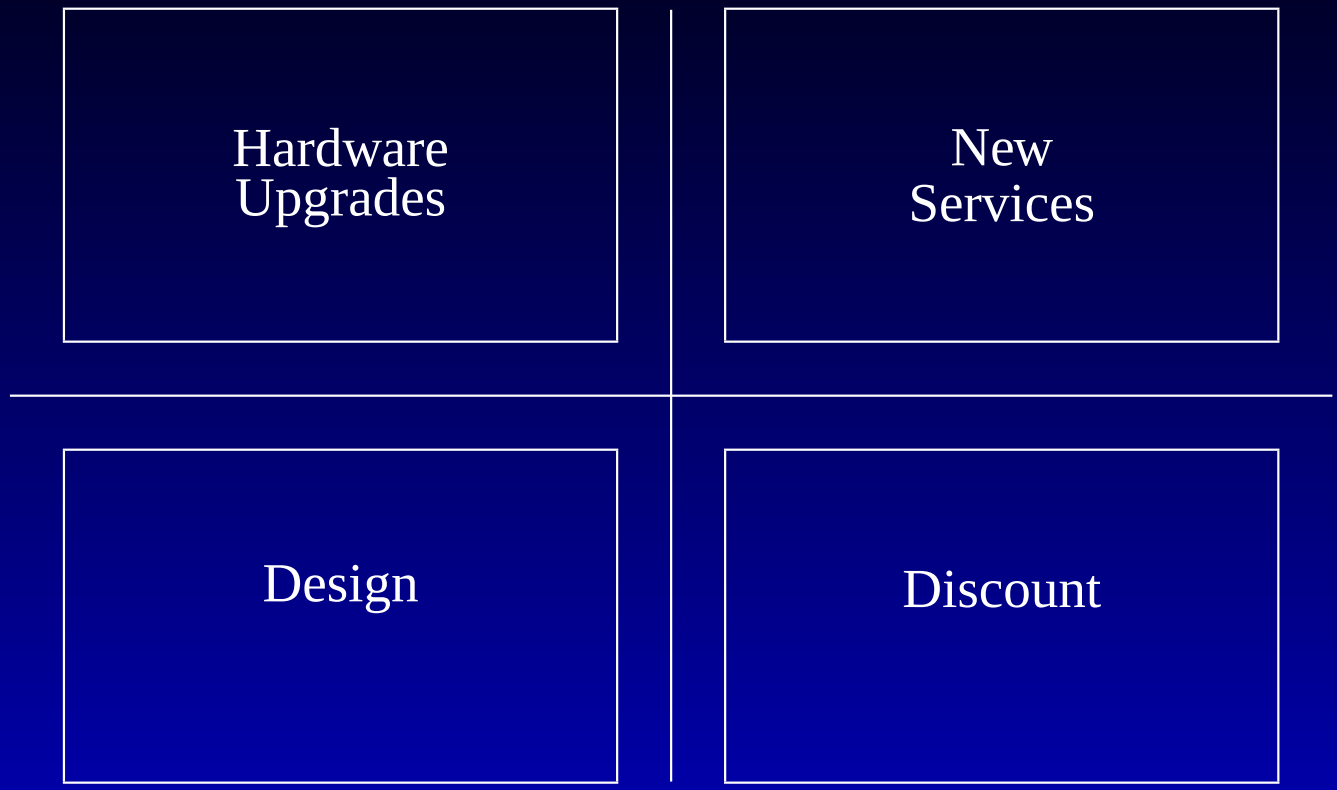
- Failure over Death Chasm
  - Increased Competition
  - Increased Diversity of Capabilities

Challenges for Content Providers



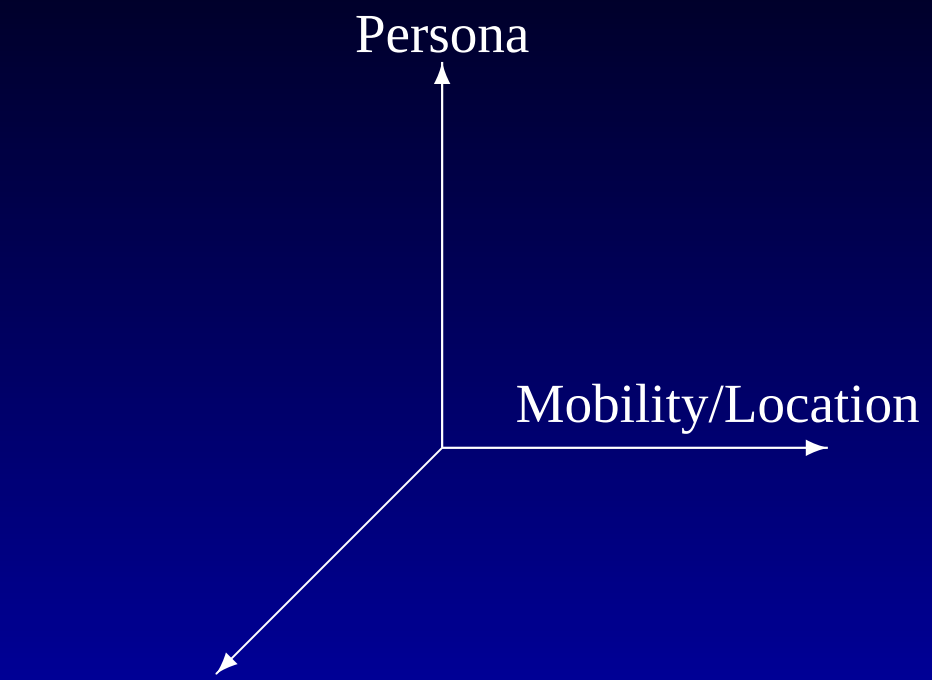
- Content market dynamism (with technology dynamism) continues to provide challenges.
- Having killed many start-up companies over a decade.
- Too many technology components (difficult for end users to swallow).

Stage Awareness

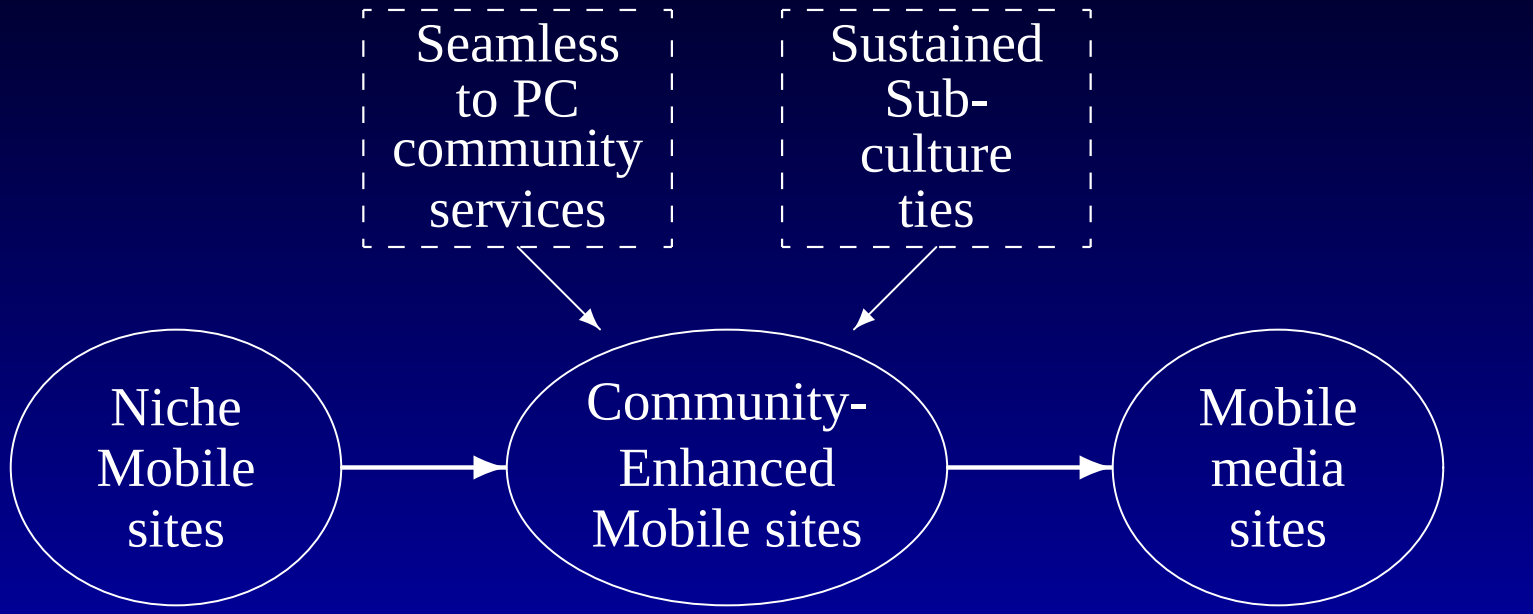


- Technology vs. Marketing dimension
- New Hardware vs. New/Old Hardware dimension

Three Dimensions



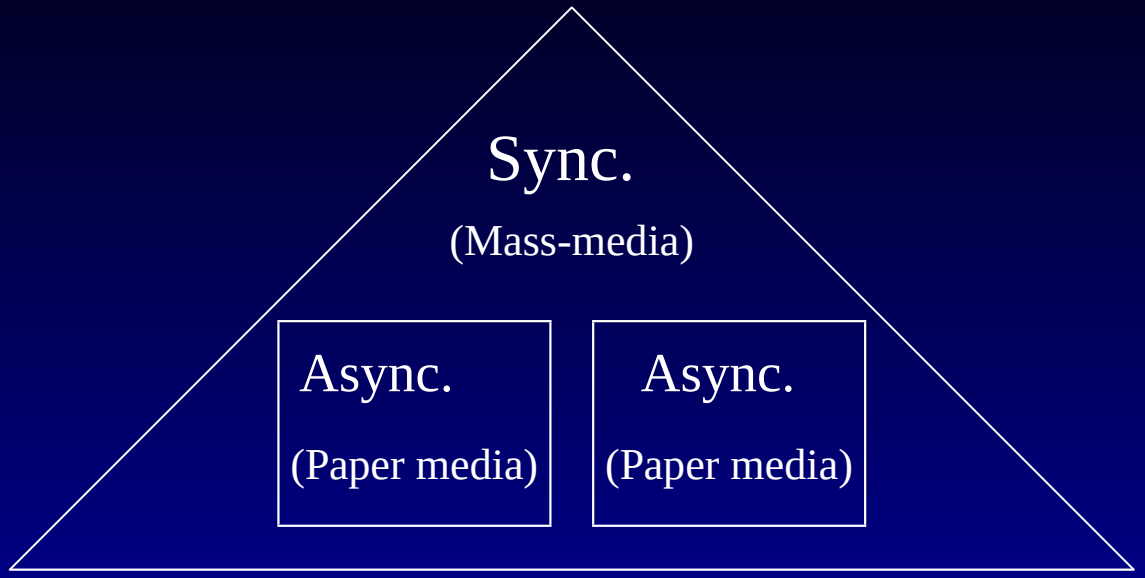
Portal Evolution Model



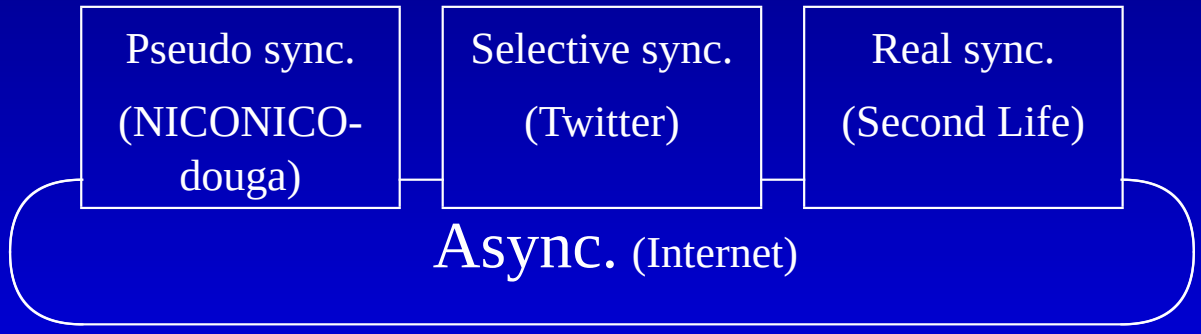
Community media
New video media
Community-combined game media

Other Service Topics

Bigger Picture of Media Evolution



(a) Early-modern/Mass-media

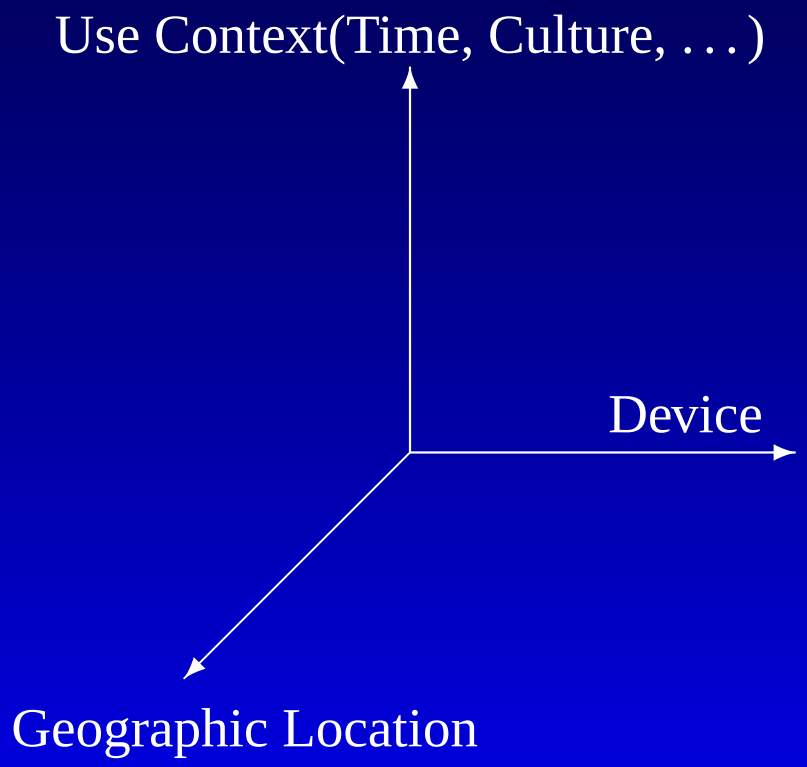


(b) Modern/Internet

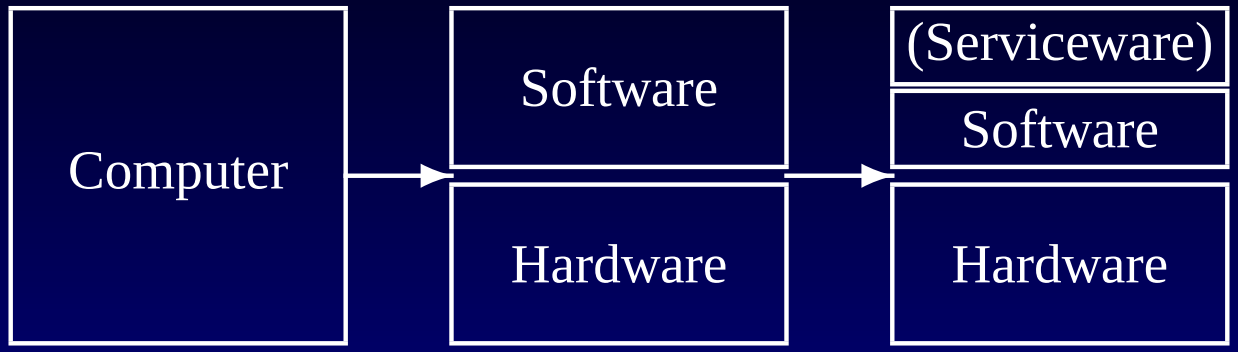
Note: From Satoshi HAMANA "Information Environment Research Note"

Mobile Engineering

- Total Reengineering the World, with Width and Depth
- Challenges to Understand Human Beings



Shifts in Computer Engineering



Conclusions

- Mobile Software Engineering has the three-hold challenges: constraints, diversity, and evolution with a complicated eco-system in the mobile industry.
- Time dimensional factor affects a wide range of engineering in technology and content.
- Recent landscape changes (large-scale software, OSS, cost-reduction pressure) put more complicated engineering in taking shape: Foundation engineering.
- Cross-boundary software engineering prevails and the engineering skills are shifted toward foundation skill to work with competitors and communities.
- Mobile service engineering also provides some lessons like spiral development, mobile-specific portal evolution, . . . with challenges due to the triple-hold challenges.
- New engineering require new skills, education, academic fields.