

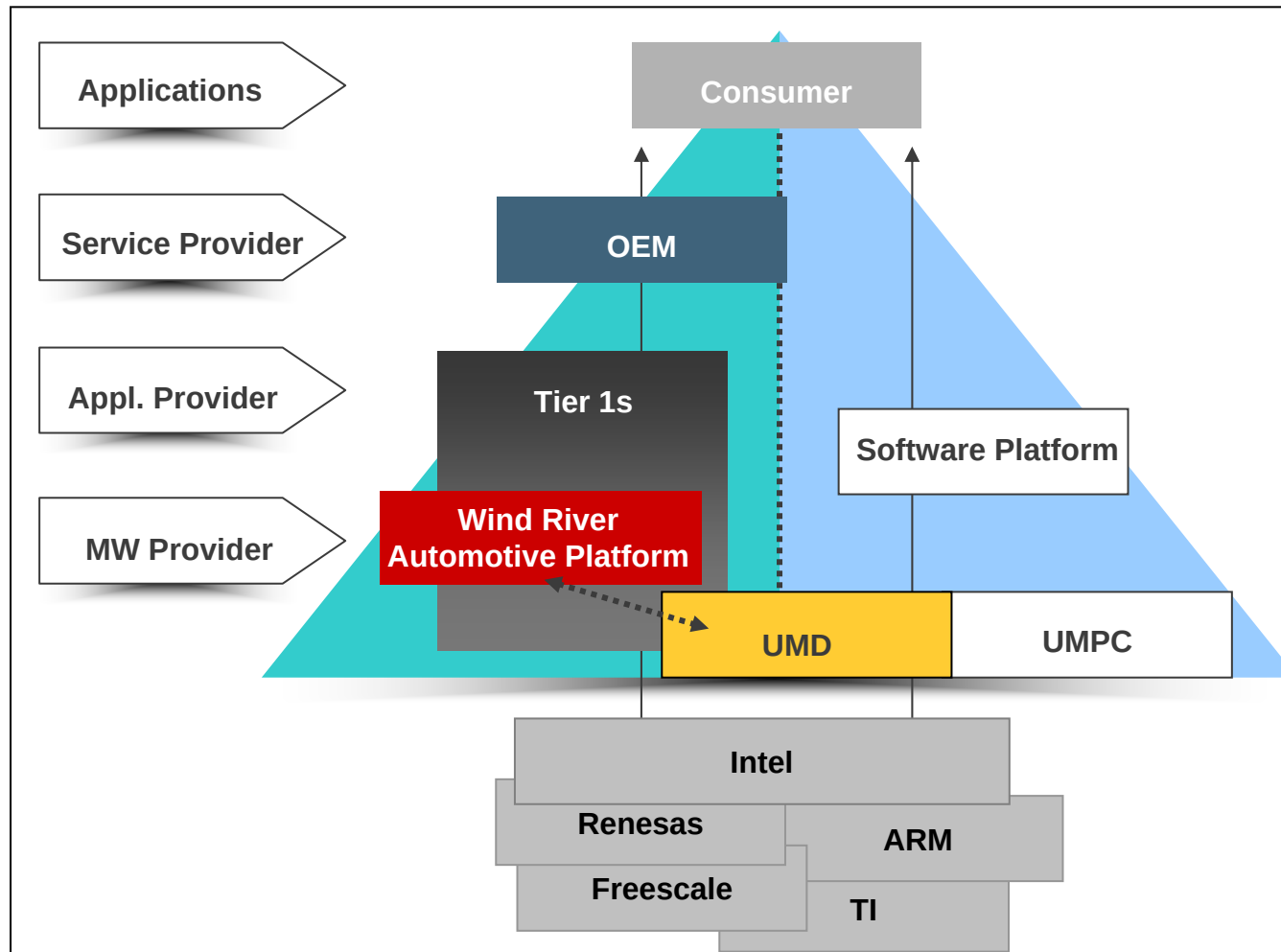
Wind River Automotive Strategy for in-vehicle infotainment design

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Challenge 2: Value Chain Dynamics

Exploding R&D costs with today's proprietary systems



Huge Platform Costs at Tier 1

- Stifle Innovation
- Create Lock-in
- Can't keep up with PND market
- Alternatively, risk exiting business

Challenges 3: Device Design

Built-In Use cases

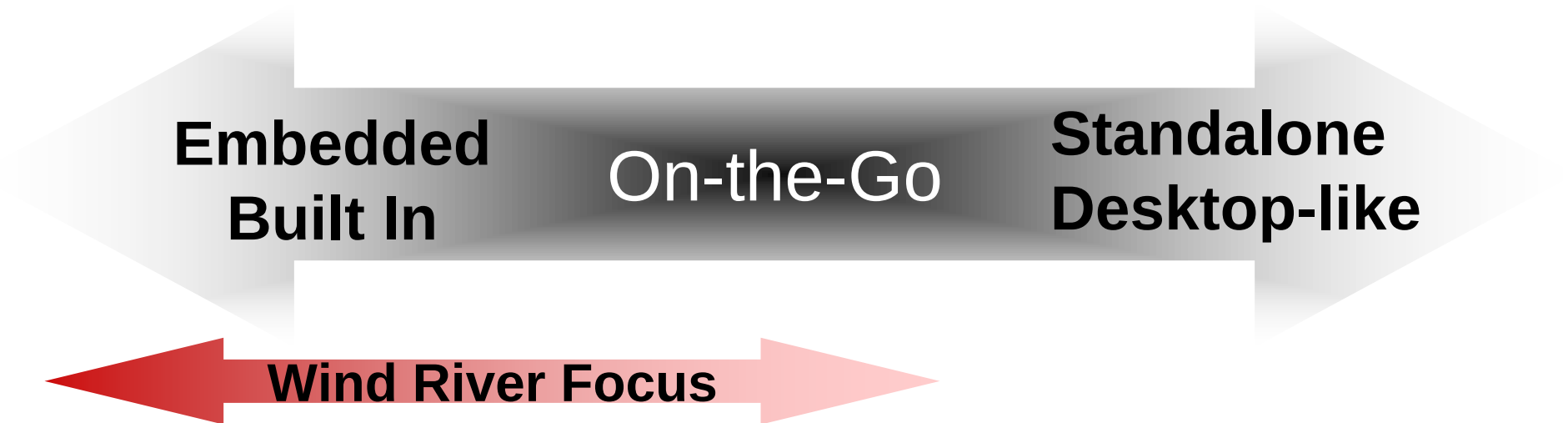
- **Scenario 1:**
 - User inserts ignition key, and within 10 seconds, media player songs are streaming out of the car's loudspeaker
- **Scenario 2:**
 - The user is listening to MP3 music while the navigation application is displaying 3D graphics. An incoming call generates need to fade the music out, call is answered.

Standalone / PND use cases

- **Scenario 3:**
 - User browses map using Google Earth®, selects a shop as his POI (Point of Interest) and one-click transfers it as a destination into the navigation application
- **Scenario 4:**
 - User cold-boots the PND system. After 2 minutes, the system is up and running. User logs in, starts the applications of choice.

Automotive Devices

- *Embedded, built in devices*
- *Dockable Devices*



Enabling a New Automotive Platform

Goal: Replaceable Automotive Infotainment Platform

- **True competition based on standardization**

- Tier 1s not reinventing the wheel
- Competition at each level in the stack
- Open architecture with evolvable interfaces



- **Interoperability based on defined interfaces and conformance**

- Standardization drives market size drives standards acceptance
- Conformance drives clear goal-posts drives quality and value
- Market size drives new business models/applications

- **Sharing the gain**

- Adoption by multiple players drives cost-sharing and quality (e.g. telecom)
- Benefits must be compelling for all members of the Ecosystem, including Tier-1

Platform Decision Criteria

Proprietary Platform

Benefits

- Footprint, performance
- Real time features
- IP reuse
- IP protection/control

Considerations

- Vendor-specific
- Production royalties/BOM impact
- Vendor lock-in
- It is *not* open source

Open Source Platform

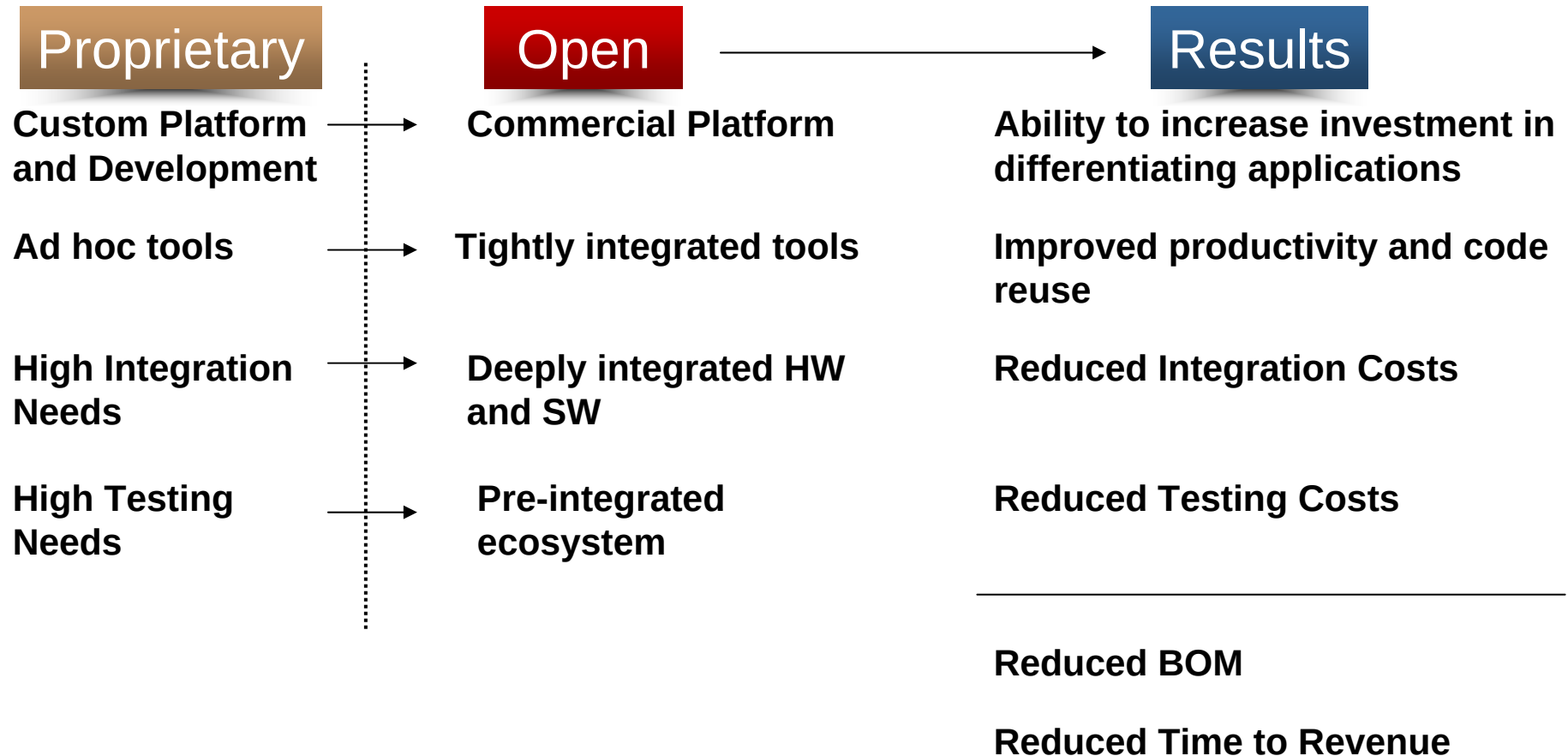
Benefits

- Multimedia, connectivity support
- Business model flexibility
- Open source apps available
- Broad external developer community

Considerations

- Over customization
- GPL issues
- Availability of in-house open source expertise
- It *is* open source

Why an Open Platform for Automotive



Wind River Solutions for Automotive Devices

Wind River Linux + VxWorks 6

In-Vehicle Devices

- Navigation/GPS
- Consumer Device Integration
- Emergency Call
- Rear Seat Entertainment
- Driver Information
- Toll Collection

VxWorks 6

Under The Hood Devices

- Powertrain
- Brake System
- Crash Sensor/Airbags
- Stability/Chassis Control
- Window/Door System

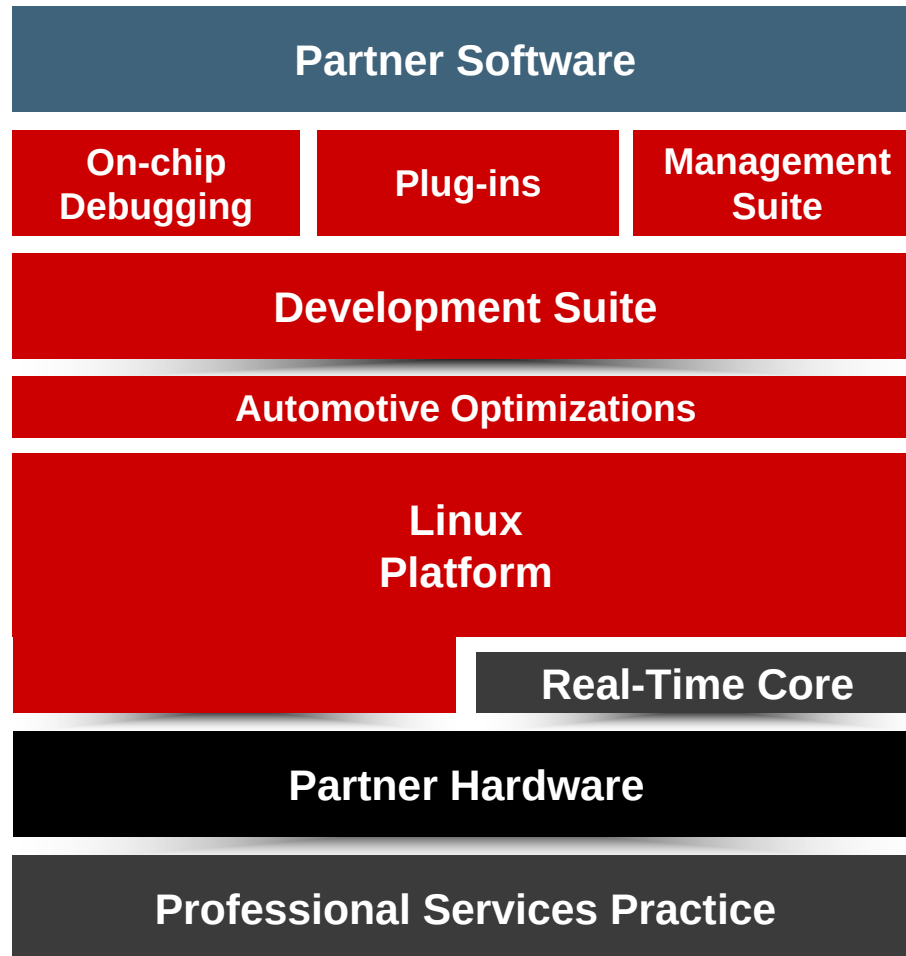


Workbench / On-Chip Debugging / Compilers / Device Mgmt

Wind River In-Vehicle Device Strategy

- **Based on Wind River PCD-LE 2.0**
 - Linux kernel, build system and relevant packages
 - Open flexible architecture, with defined API's (spec, OSS packages)
- **Customized platform targeting Automotive Requirements**
 - Multimedia & HMI support
 - Connectivity – Network, Consumer, Automotive
 - Enabler for Automotive applications
 - Driver assist – Navigation, Safety, Telematics
 - Entertainment / Lifestyle / Location Based Services
- **Performance enhanced, optimized BSPs**
 - Automotive Power Management
 - Automotive Peripheral support
 - Support for automotive specific reference boards
- **Extensive ISV ecosystem for pre-integrated applications**
- **Test and Validation Services**

Linux Solution for In-Vehicle Devices



- Stable, validated commercial Linux Platform
- Integrated tools
- Support for automotive requirements
- Virtualization or real time abstraction for some applications
- Device management
- Integrated with leading automotive chips and hardware
- Deep automotive and embedded Linux expertise

Wind River Linux for Automotive

Userland	microperl	Ipsec-tools	mtd	usbutils	busybox	boa	freetype	Others...
Automotive Connectivity	MOST	CAN	Others...					
CE Connectivity	USB	Bluetooth	usbutils	libusb	hotplug	SD Card	Others...	
IP Connectivity	TCP	UDP	IPv4	IPv6	MIPv6	FTP	OpenSSL	DHCP
	SCTP	TFTP	PPPoE	Ping	DNS	OpenSSH	NTP	Others...
Application Libraries	glib	glibc 2.3.6	uClibc	Open SSL	zlib	cairo	Readline	expat
	SQLite	Others...						
Utility Libraries	ProcPS	popt	hotplug	iproute2	ALSA lib	DirectFB	libusb	Others...
File Systems	YAFFS2	FAT32	PRAMFS	ext2	ext3	XFS	ReiserFS	JFFS2
	udev	CRAMFS	NFS					
Kernel	Linux Kernel 2.6.21 (Wind River PCD-LE w/optional Linux Tiny Patch)							
Hardware Drivers	MOST	CAN	USB	Bluetooth	NAND Driver	NOR Driver	UART Driver	LCD Driver
	Video Driver	Power Mgt. Driver	Sound Driver	Touchscreen Driver	I2C Driver	UART Driver		
	Framebuffer Driver	SD/MMC Driver	Ethernet Driver	Camera Driver	OneNAND	WiFi		

Workbench

- Project System
- Build System
- Profiles
- Editor
- Patch Manager
- Source Code Analyzer
- WR Debugger
- QEMU Debug
- Virtual I/O
- Kernel Config.
- User Space Cfg
- Host Shell
- System Viewer
- ProfileScope
- MemScope
- StethoScope
- CoverageScope

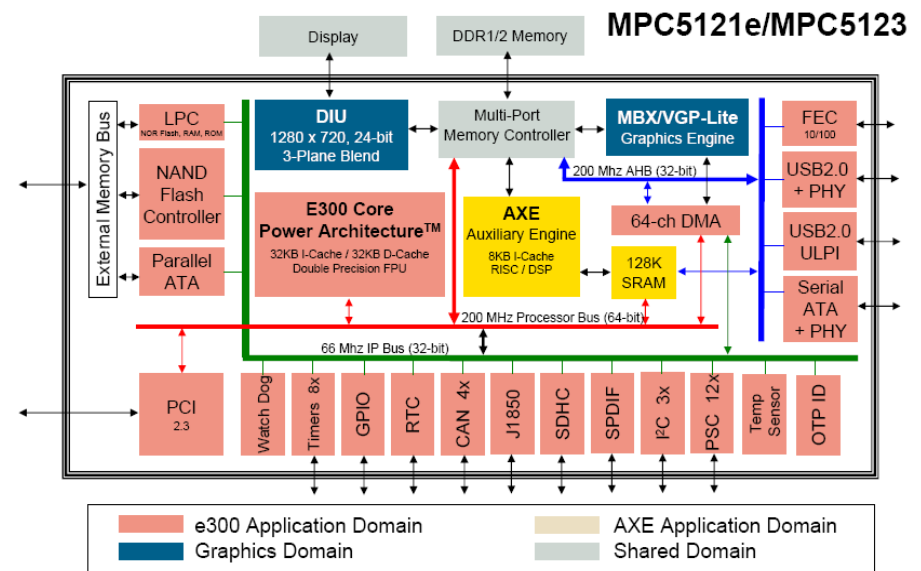
Host Tools

- QEMU
- gcc 4.1
- gdb
- kgdb
- kgdboE
- Prelink
- Squashfs
- Other...

Partner Hardware

Wind River Linux for Automotive

- **Automotive Connectivity**
 - MOST, CAN
 - Board Support
- **Consumer Electronics (CE) Connectivity**
 - Bluetooth
 - USB
 - SD Card
- **Internet Connectivity**
 - WiFi
 - WiMax*
- **Multimedia**
 - Display
 - Capture*
 - Multiple display*
- **HMI Tools and Interfaces**
 - Graphics
 - Speech-in
 - Speech-out
- **Platform and Remote Management**
- **Power State Management**



Key Packages Enable In-Vehicle Solutions

Reduced Footprint

- Fine grained file and package composition
- Size reduction tools using profiling
- Size-optimized kernel and packages
- Small footprint packages (uclibc, busybox, etc.)

Power Management & Fast Boot

- Dynamic Power Management
- Frequency & Voltage Scaling
- Fast startup from a clamp-off state
- Hardware-optimized fast startup

Performance

- Real-Time Solutions (conditional and guaranteed)
- High resolution timers
- Fast user-space mutexes

Multimedia Support

- Direct FB
- GTK+
- Helix
- Small footprint X
- ALSA

Platform Ecosystem

Design Tools Partners

- IBM Rational
- I-Logix/Telelogic
- The MathWorks

Software Partners

Speech Recognition

- Nuance
- Conversay
- IBM ViaVoice
- Fonix
- Asahi Kasei

Browser

- ProSyst (OSGi)
- Espial
- PsiNaptic (Jini)

Native Browser/Email

- Access
- Opera

GPS

- Trimble

Input Devices

- Immersion

GUI

- Altia
- ALT Software
- Elektrobit (3SOFT)
- Tilcon
- Trolltech

Design/Modeling Tools

Tools

Speech
Recog-
nition

Browser
Access

GPS

Input

GUI

JVM

File
Systems

Connectivity

Database

GUI

Multimedia
Framework

Linux

Hardware/Semiconductors

Freescale, Intel, Renesas, ST Micro, TI

Middleware Partners

JVM

- Microdot
- Apogee/IBM
- Aicas Gmbh
- Skelmir
- Aonix

File Systems

- Datalight

Bluetooth

- Parrot
- Open Interface
- StoneStreetOne

CE Connectivity

- VividLogic (1394)

Auto Connectivity

- SMSC (MOST)
- Vector (CAN)

Database

- Hitachi
- Solid
- Encirq
- Gracenote (Media)
- AMG (Media)

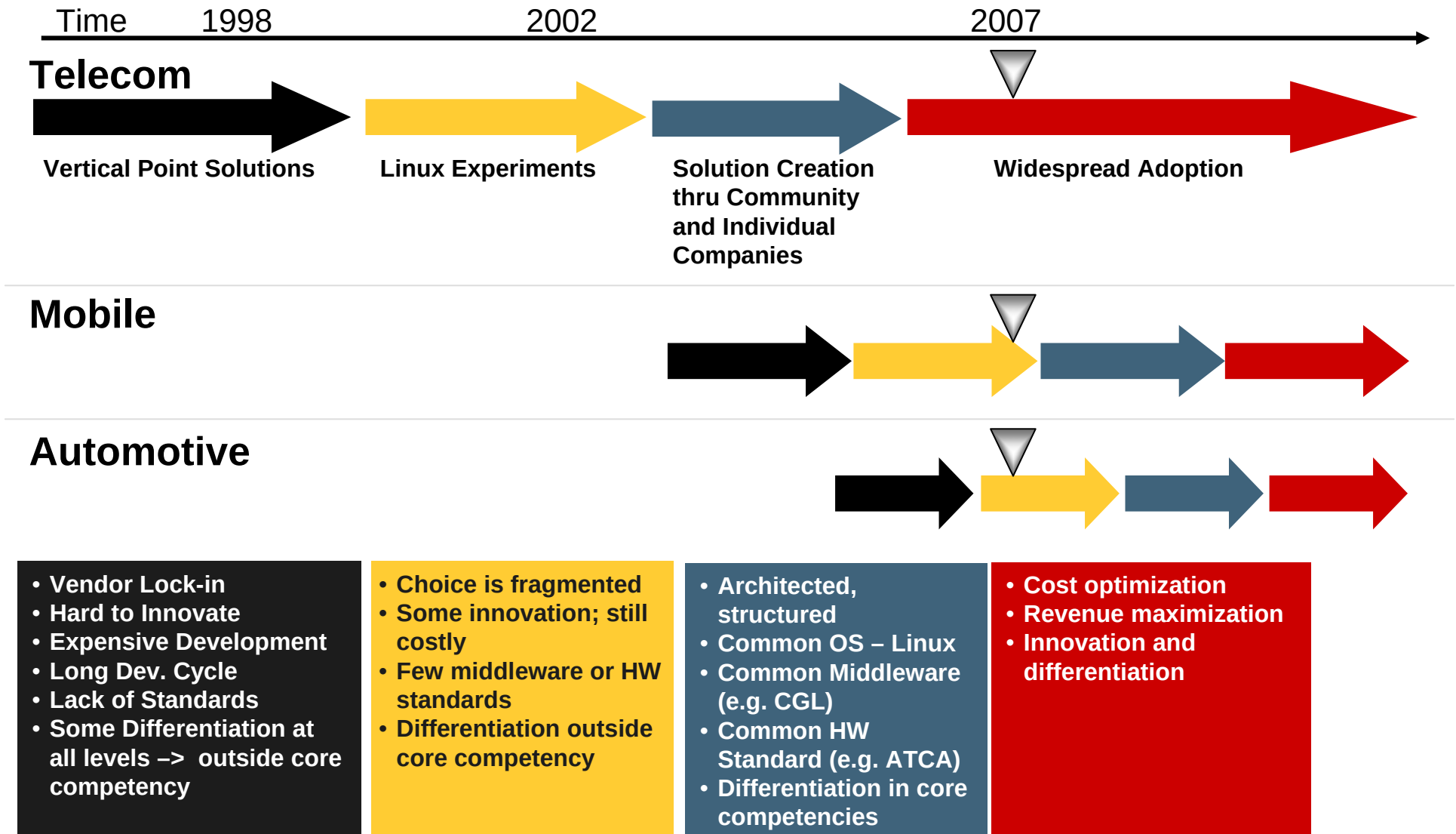
Navigation

- NAVTEQ
- Destinator
- 3DVU (mapping graphics)

Multimedia

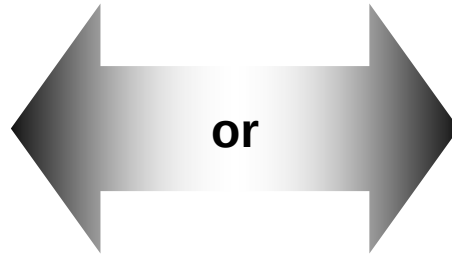
- UEI (Simple Devices)
- Mizi Research

Lessons Learned in other markets



Which Open Source Direction for Auto?

Telecom



Mobile



- Architected, structured
- Common OS standard – Linux
- Common MW standard – CGL
- Common HW standard – ATCA
- Differentiation only at highest level of application

- Constrained chaos
- Many kernel variants
- Few MW standards
- HW variations abound
- Differentiation attempted at all levels of device

Wind River: Leading the Linux ecosystem

- **Leadership in Standards & Open Source Initiatives**
 - Linux Foundation
 - Eclipse top level embedded project leadership
 - Carrier Grade Linux Initiative
 - Mobile Handset consortia, e.g. LiMo
 - Linux / Automotive design wins worldwide
- **Significant Value Add above generic Kernel**
 - Deep integration with key Intel and automotive silicon
 - Eclipse-based Workbench tool suite common across both Linux and VxWorks
 - Transparent, optimizing, build system
 - Hardware debugging tools integrated with Workbench and Linux
 - Worldwide Support delivered locally
 - Broad Automotive expertise coupled with deep Linux knowledge
- **Established ecosystem of Automotive ISV and hardware partners**
 - Optimizations and enablement are our focus

Summary

- **Convergence of CE Applications, Connectivity and Automotive create serious challenges**
 - Linux and Windows viewed as only long-term choices
- **Standards-based open platforms drive TTM, TCO, and differentiation**
- **Linux is broadly adopted across adjacent segments**
 - Offers a rich ecosystem for applications, tools and support
 - Other industries have hardened Linux to their requirements
- **Wind River is investing heavily in automotive Linux**
 - Automotive will follow the other markets

WIND RIVER