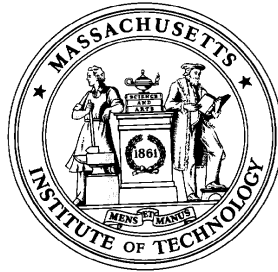


"Opportunities When Value Networks Collide: Telematics at the Intersection of Automotive and Telecommunications"



Professor Charles Fine
Massachusetts Institute of Technology
Sloan School of Management
Cambridge, Massachusetts 02142

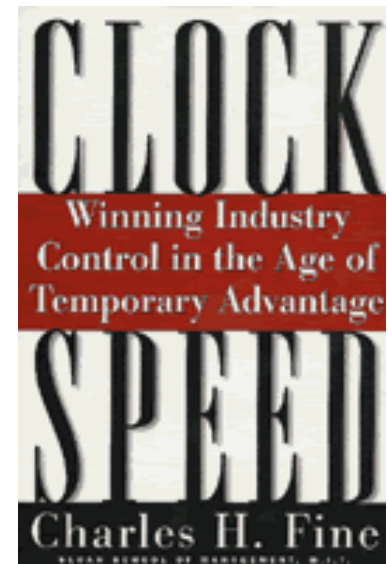
September 2003

charley@mit.edu

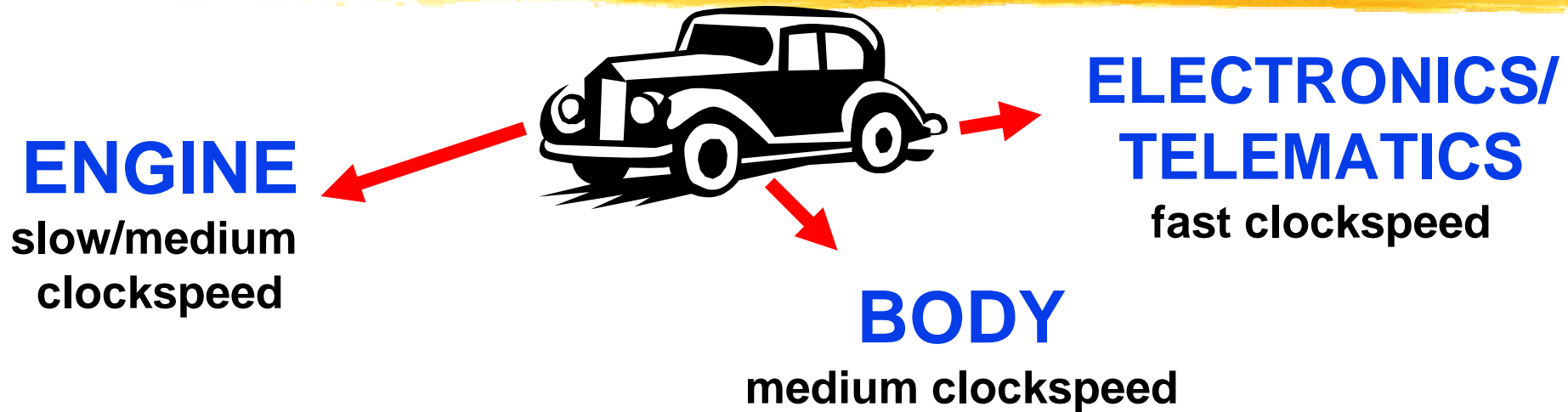
<http://cfp.mit.edu/people.html>

Tel: 1-617-253-3632, Fax: 1-617-258-7579

Excerpts from



Automobile CLOCKSPEED IS A MIX OF ENGINE, BODY, & ELECTRONICS/TELEMATICS



ISSUE: MOST AUTO FIRMS GREW UP IN AN AGE OF *ENGINE AND BODY CLOCKSPEEDS*; TODAY THEY NEED TO GO AT *ELECTRONICS/TELEMATICS CLOCKSPEEDS*.

FURTHER: AUTOMOTIVE VALUE CHAINS EVOLVE SLOWLY RELATIVE TO *ELECTRONICS/TELEMATICS VCs*.

One View (the consumer's) of the Communications Value Chain

Form (Size, Weight, Ergonomics)

O/S (Windows, Linux, Palm)

HW system (OEM, ODM, CEM)

Bundled Apps (phone, MP3, IM, etc.)

Network (CDMA, WiFi, Sonet, IP, Cable)

Equipment (Lucent, Ericsson, Cisco)

Channel (KaZaA, AOL/TW, MTV)

Artist (Madonna, NBA, Spielberg, SAP, Self)

Openness (EFF, RIAA/DMCA, TCPA)

Appliance

(Phone, Camera, Laptop, PDA, auto, Missile, MP3 Player)

Access

(Wireless, POTS, ISP, Satellite, Cable, HotSpot)

Content & Applications

(Music, Movies, Email, VoIP, Shopping, ERP, SCM, CRM, Banking, IM, Surveillance, Photos, Games)

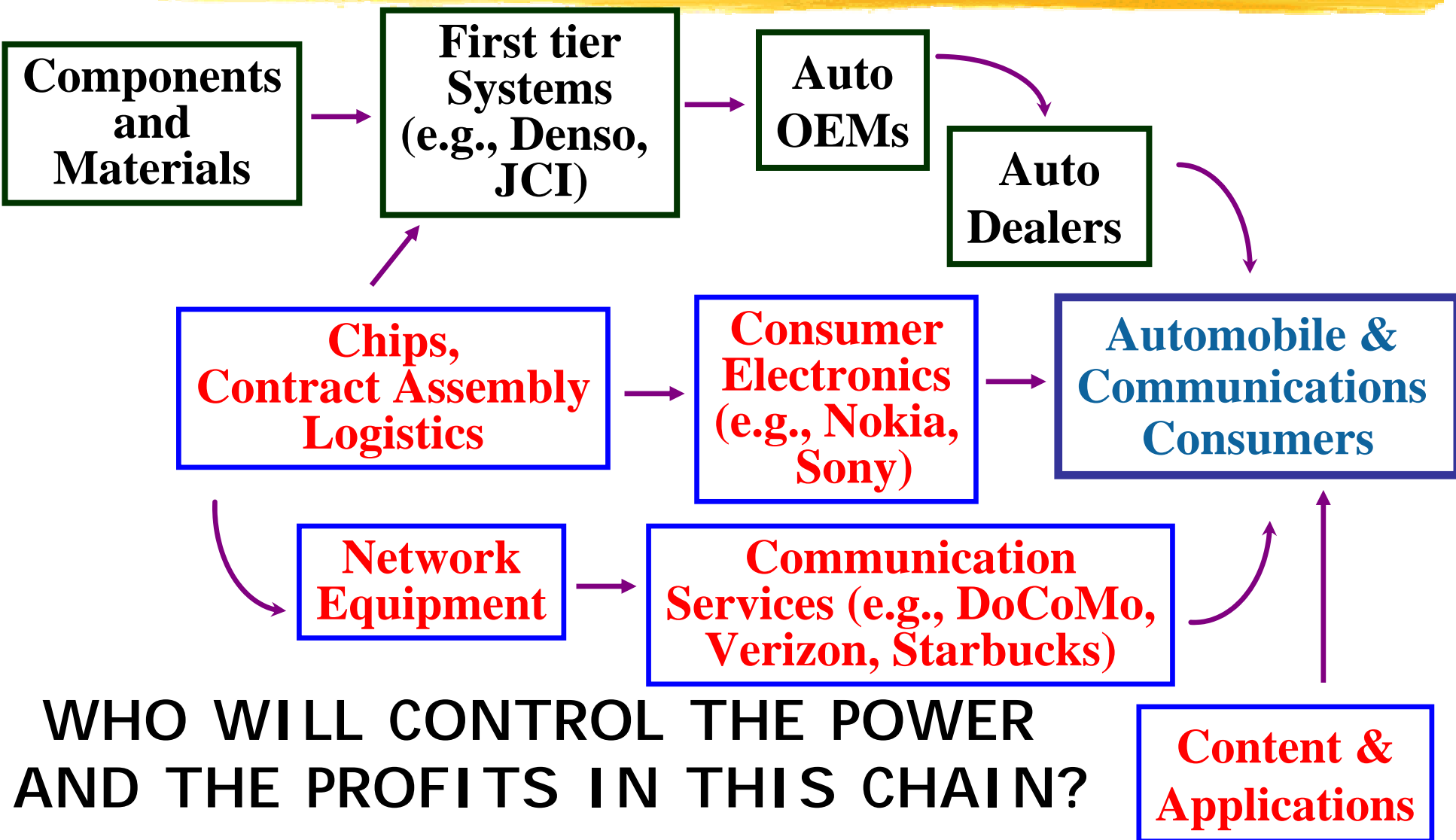
C
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Another View of the Communications Value Chain



<ul style="list-style-type: none"> •Silicon •Gaas •InP •Polymers •Steppers •Etchers •MEMS •Insertion •Etc.. 	<ul style="list-style-type: none"> •Lasers •Amplifiers •Transceiver •Filters •Processors •Memories •Fiber •ASICS •MEMS •DSP's •Etc.. 	<ul style="list-style-type: none"> •Routers •Switches •Hubs •Base Stations •Satellites •Servers •Software •O/S •Etc.. 	<ul style="list-style-type: none"> •Wireless •Backbone •Metro •Access •Substations •Satellites •Broadcast Spectrum •Communic Spectrum •Etc.. 	<ul style="list-style-type: none"> •Long dist. •Local •Cellular •ISP •Broadcast •Hot Spots •Cable TV •Satellite TV •VPN's •MVNO's •Etc.. 	<ul style="list-style-type: none"> •Music •Movies •Email •VoIP •POTS •Shopping •ERP •SCM, CRM •Surveillance •eBusiness •Etc.. 	<ul style="list-style-type: none"> •Computers •Phones •Media Players •Cameras •PDA's •Automobile •Weapons •Etc.. 	<ul style="list-style-type: none"> •Business •Consumer •Gov't •Military •Education •Medical •Etc..
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A VALUE CHAIN PERSPECTIVE ON TELEMATICS

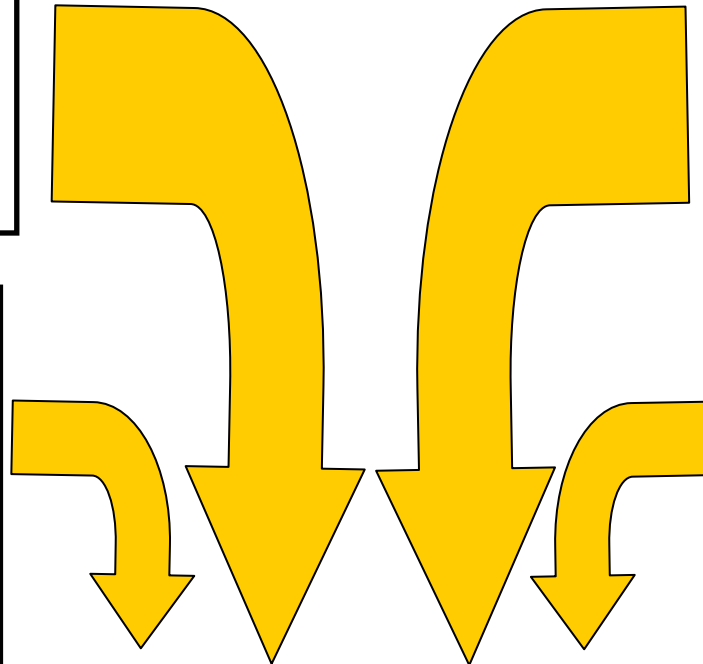


Roadmapping the Communications Value Chain:⁶ What are the Premises?

Communications Value Chain is in ill health
(ROADKILL MAPPING?)

Silos in the value chain are interdependent (integrality).

Vertical disintegration is the dominant structure. Silo execs tend to focus on their own narrow slices. Most industry consortia are *within-silo*.



Absence of leadership and coordination across an interdependent value chain creates uncertainty, risk, and reluctance to invest.

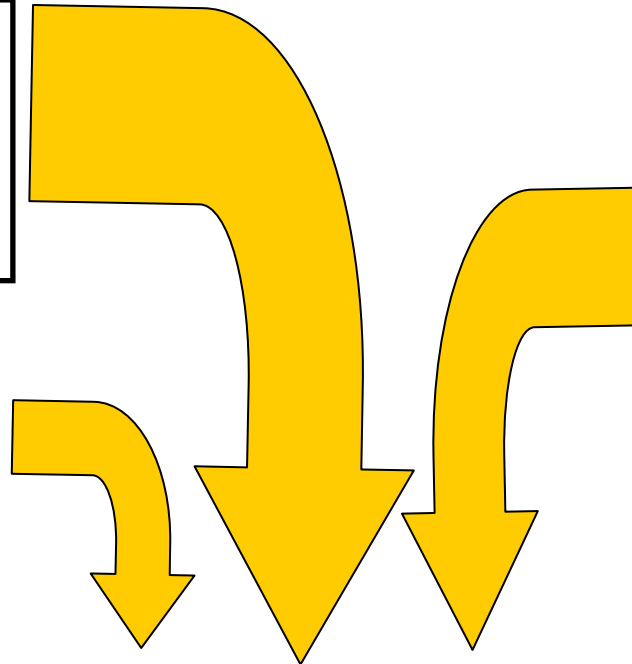
SOME VALUE CHAIN COORDINATION COULD SPEED GROWTH.

HOW TO ACHIEVE COORDINATION IN THE ABSENCE OF VERTICAL INTEGRATION?

Roadmapping the Communications Value Chain:⁷ What are the Premises?

Technology dynamics,
Industry dynamics, and
Regulatory dynamics
are interdependent.

Technology and
industry roadmapping
are typically done by
different people



SIA roadmaps provided
productive coordination in
semiconductors, but
focused only on technology
& a narrow slice of the
value chain. Industry
growth was assumed.

--> Not a good model for
Communications.

Productive roadmapping must encompass
multiple links of the value chain, a
multidisciplinary team, and the co-
evolution of technology, industry, and
regulatory policy.

Dynamic Analysis to Support Industry & Technology Roadmapping

*Corporate
Strategy
Dynamics*

*Customer
Preference
Dynamics*

*Technology
Dynamics*

*Regulatory
Policy
Dynamics*

*Capital
Market
Dynamics*

*Business
Cycle
Dynamics*

*Industry
Structure
Dynamics*

Interdependent sectors
represented as
intermeshed gears

Corporate Strategy Dynamics

BUSINESS SYSTEM/SUPPLY CHAIN ARCHITECTURE
(Geog., Organ., Cultural, Elec.)

INTEGRAL



MODULAR

TECHNOLOGY/PRODUCT ARCHITECTURE

INTEGRAL



MODULAR

**Microprocessors
Mercedes
& BMW vehicles**

**Lucent
Nortel**

Polaroid

MSFT Windows

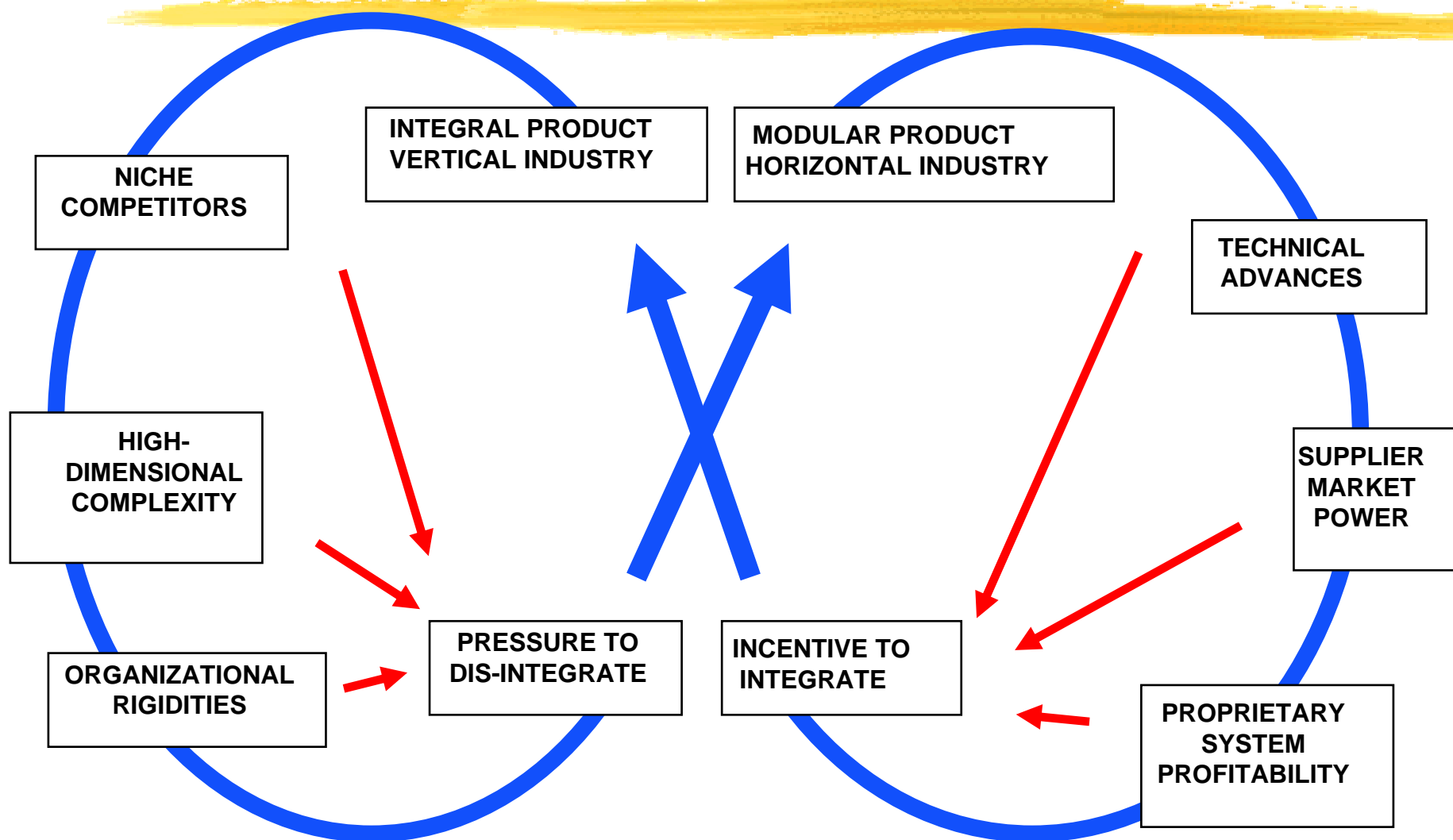
**Chrysler
vehicles**

Cisco

**Digital Rights/
Music Distribution**

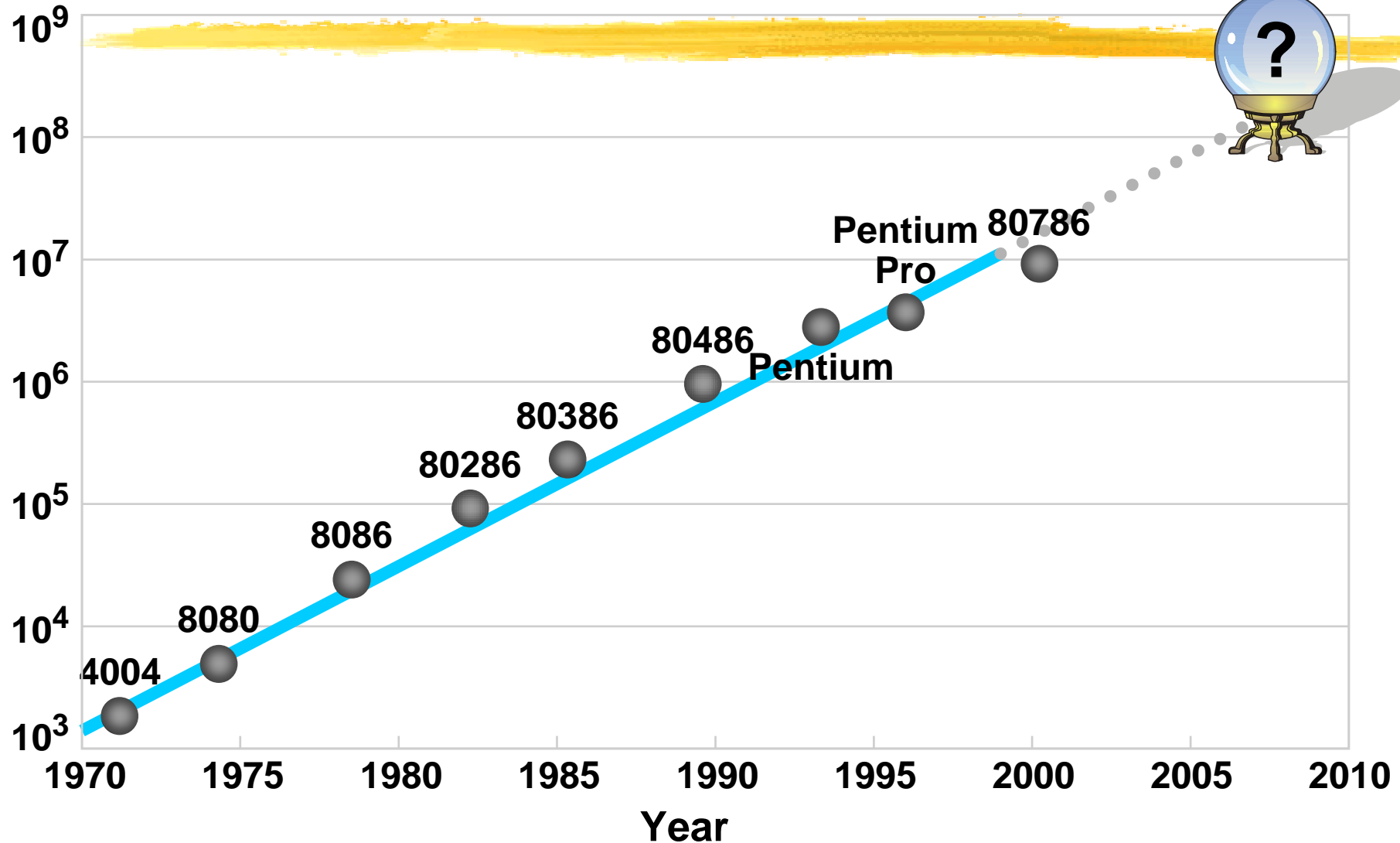
**Dell PC'S
Bicycles**

Industry Structure Dynamics



Moore's Law

Transistors per chip



Source: Joel Birnbaum, HP, Lecture at APS Centennial, Atlanta, 1999

International Technology Roadmap for Semiconductors '99

Year	2005	2008	2011	2014
Technology (nm)	100	70	50	35
DRAM chip area (mm ²)	526	603	691	792
DRAM capacity (Gb)	8		64	
MPU chip area (mm ²)	622	713	817	937
MPU transistors (x10 ⁹)	0.9	2.5	7.0	20.0
MPU Clock Rate (GHz)	3.5	6.0	10.0	13.5

Disk Drive Development 1978-1991

Disk Drive Generation	Dominant Producer	Dominant Usage	Approx cost per Megabyte
14"	IBM	mainframe	\$750
8"	Quantum	Mini-computer	\$100
5.25"	Seagate	Desktop PC	\$30
3.5"	Conner	Portable PC	\$7
2.5"	Conner	Notebook PC	\$2

From 1991-98, Disk Drive storage density increased by 60%/year while semiconductor density grew ~50%/year. Disk Drive cost per megabyte in 1997 was ~ \$.10

Technology Innovation in the Information Age: 14

Semiconductors, Disk Drives, Info. Networks



Key Question:

Will Wireless Networks evolve linearly like

- A. Semiconductors with Moore's Law and
- B. Bandwidth in wired Networks,
or **nonlinearly** like
- C. Disk Drives with repeated industry disruptions?

Viral Communications: Wireless Networks without Carriers



Imagine a Mobile Peer-to-Peer ("*mP2P*") network where

1. Each mobile device is a transmitter, receiver, and router
2. Information Packets hop from device to device
3. Network capacity increases with adoption density

And, either

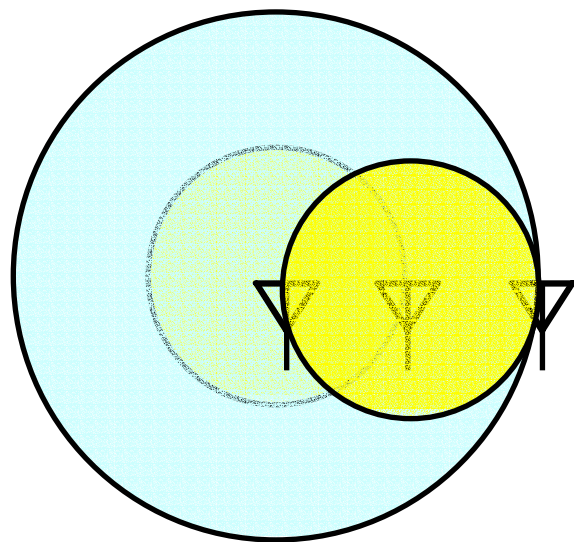
A. Network is "ownerless" and "open," running on standardized protocols

or

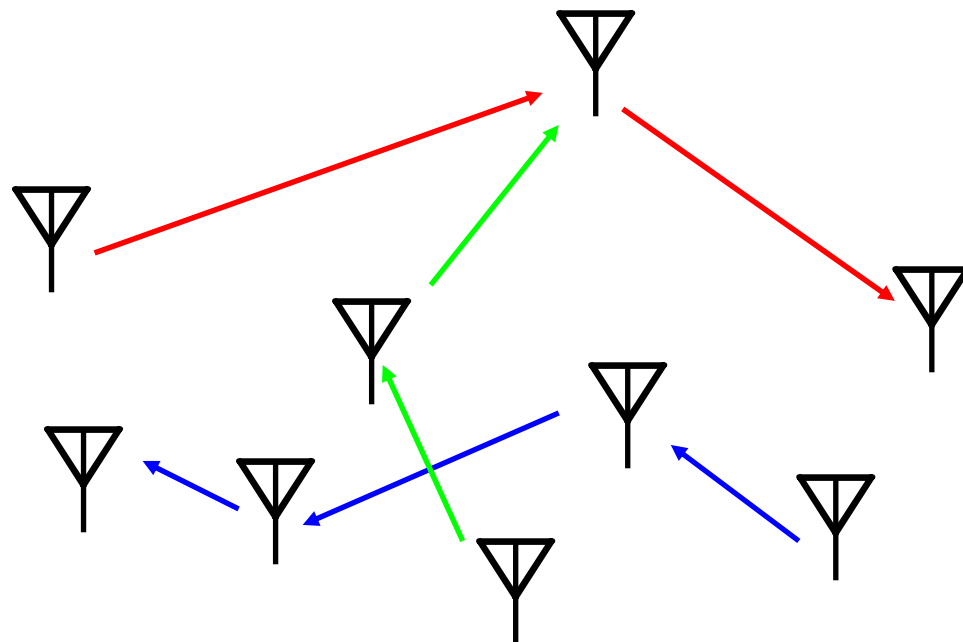
B. Network is owned and operated by the manufacturer(s) that sell the devices

Architectural improvement:

Repeater networks provide high capacity with low energy




Energy/bit reduced by
1/hops.



Many paths can operate concurrently.

What role can Automotive OEM's play in the deployment and use of mP2P networks?



In the 1980's:

Most mobile phones were called "Car Phones" because they were too large and power-hungry to be carried outside the car.

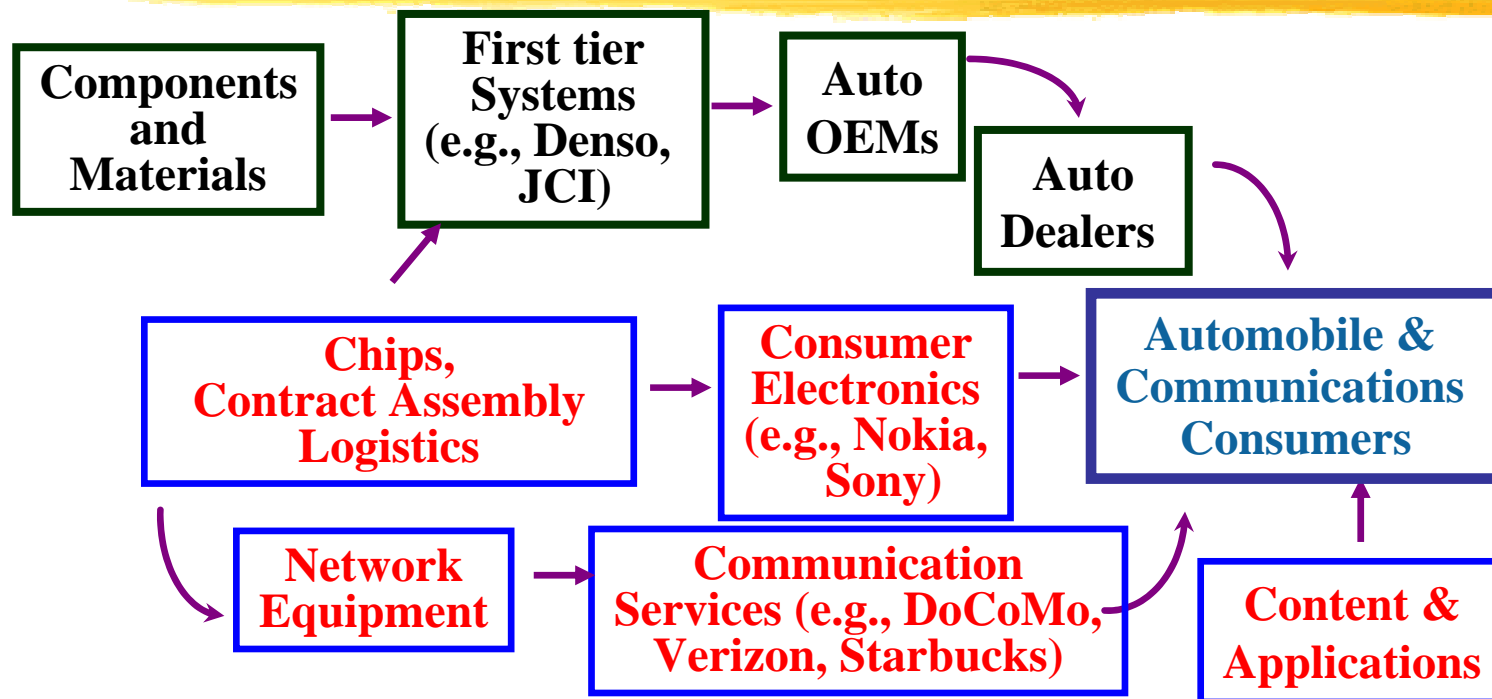
Car companies passed on the opportunity to be mobile phone companies.

Today:

Fixed-location companies like Starbucks and McDonald's are deploying wireless hotspots at the rate of hundreds or thousands per year.

Car companies could deploy mP2P hotspots at the rate of millions per year.

What role should Automotive OEM's play in the deployment and use of mP2P networks?



Car Company Advantages for mP2P:

1. Installation cost/hotspot
2. Number of nodes (vs. Starbucks, but not Nokia or DoCoMo)
3. Power available at node (vs. Nokia & DoCoMo, but not Starbucks)

All Conclusions are *Temporary*



Technology and Industry Clockspeeds are *Fast in Telecom* and *Increasing in Automotive*.

Dynamic Value Chain Analysis is critical in fast-clockspeed environments.

Value Chain Roadmapping provides a comprehensive, dynamic analysis tool.