Silicon for 10 Gbit/s Connected World

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Hot Chips Symposium 2001

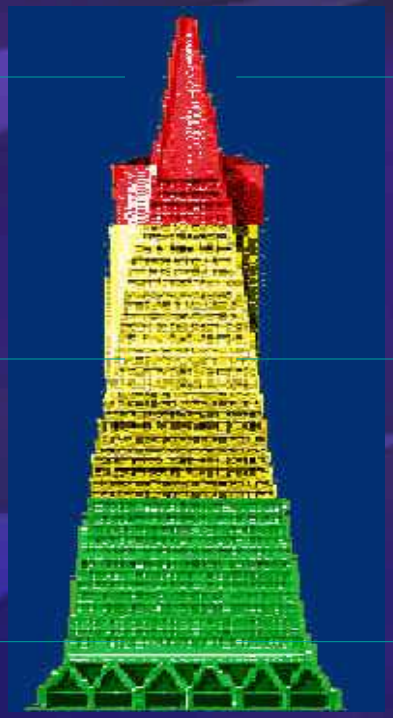
The First Inning – 1998 to 2000

- Explosion in the Use of the Internet
- Rapid Fiber Deployment and Increase of Bandwidth in Fiber (2X Moore's Law)
- Availability of lots of Venture Capital for Start-Ups
- Capital availability for CAPEX requirements of Carriers
- Large demand generated by spending-happy Dotcoms and Telecom
- Hot IPO market
- Large number of acquisitions by Equipment and Chip companies
- Start-up Success was defined by Presence in Momentum Segments

Dramatic Growth in New Companies and Market Cap

Technology Companies and Market Cap by Size Now vs. 1990

Category
> $1 Bn
$100MM - 1Bn
< $100MM



	# Companies	Market Cap ($Bn)
	33	$194
	118	$38
	134	$5
All	285	$237
1990		
	388	$3,548
	622	$234
	700	$24
	1710	$3,806
2001		

Frank Quottrone of CSFB

16.4% CAGR

29.7% CAGR

Source: Factset based on data from 4/9/90 and 7/15/2001.

Capital Markets Sow the Seed and Reap the Fruit

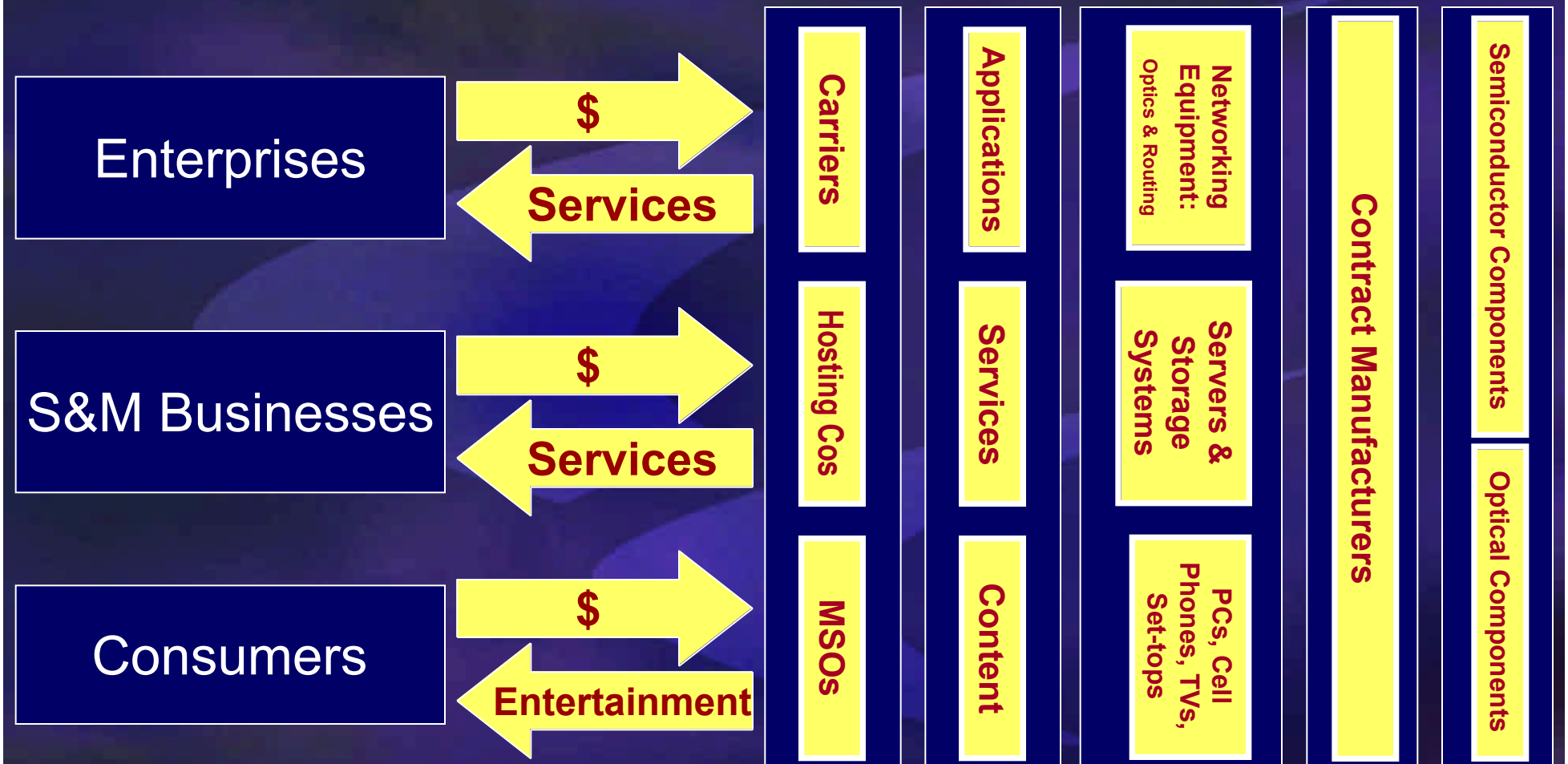
- Capital markets have always rewarded growth
- 1998-2000 hyper-growth was hyper-rewarded
- Growth metrics rewarded rather than business fundamentals
- Customers, subscribers, CAPEX budgets, multi-city expansion
- Sound and flaky businesses attracted capital alike
- Sound businesses grew flaky to demonstrate hyper-growth
- Ooops!! There are no fundamentals in sight – Stop!
- The brakes were bad and the debris is scattered far and wide

Moore's Law of Nasdaq Ran Out of Gas in Y2K

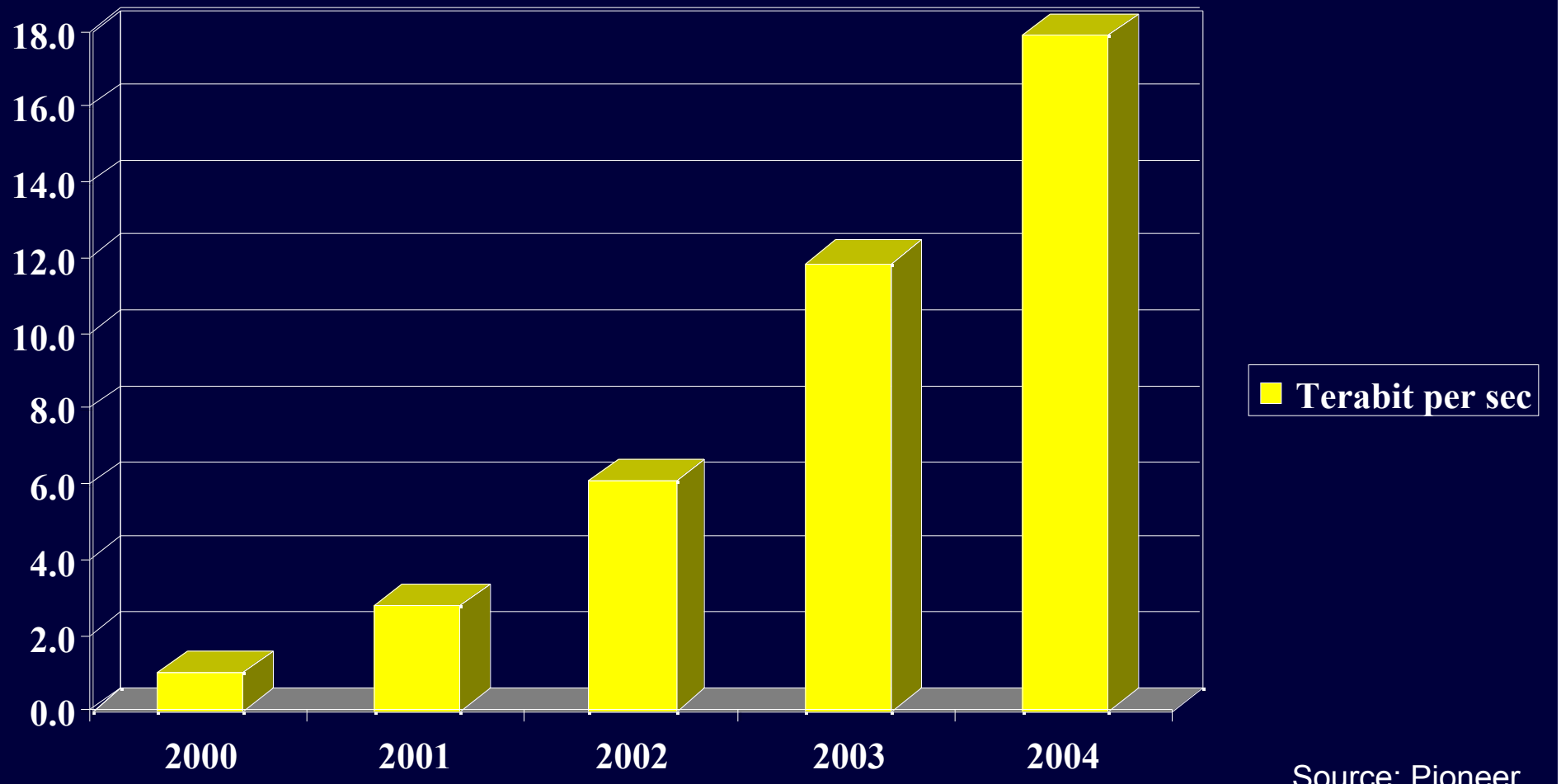
January 1983 - Present

Frank Quottrone of CSFB

Indigestion in The Terabit Food Chain



U.S. Backbone Internet Bandwidth Demand



Source: Pioneer

Bandwidth Drivers

With 5,000,000 Businesses and
100 Mbps per business the
aggregate bandwidth is

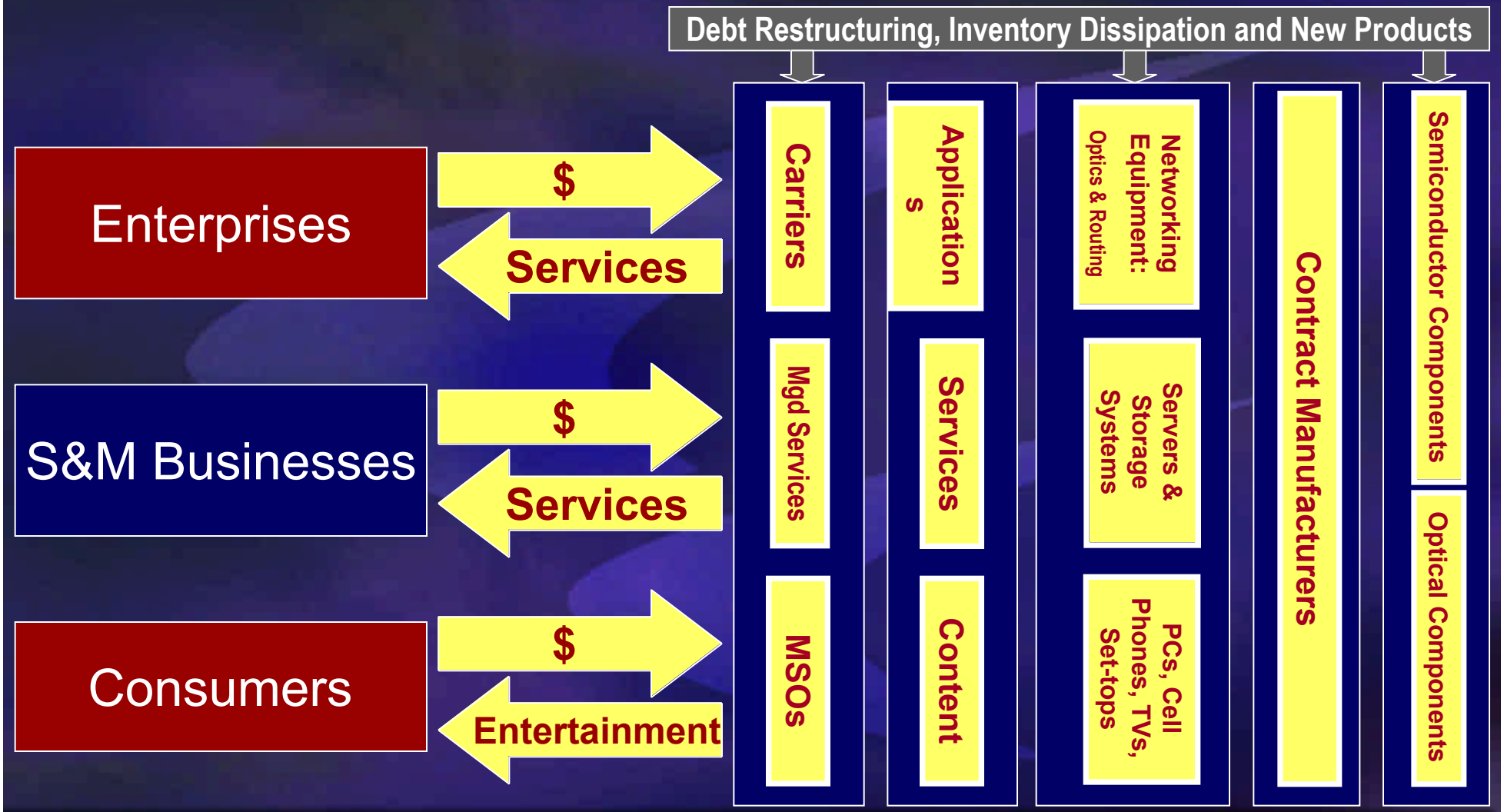
500 Terabits/second

With 100 Million active Consumers and
5 Mbps bandwidth per user
the aggregate bandwidth is

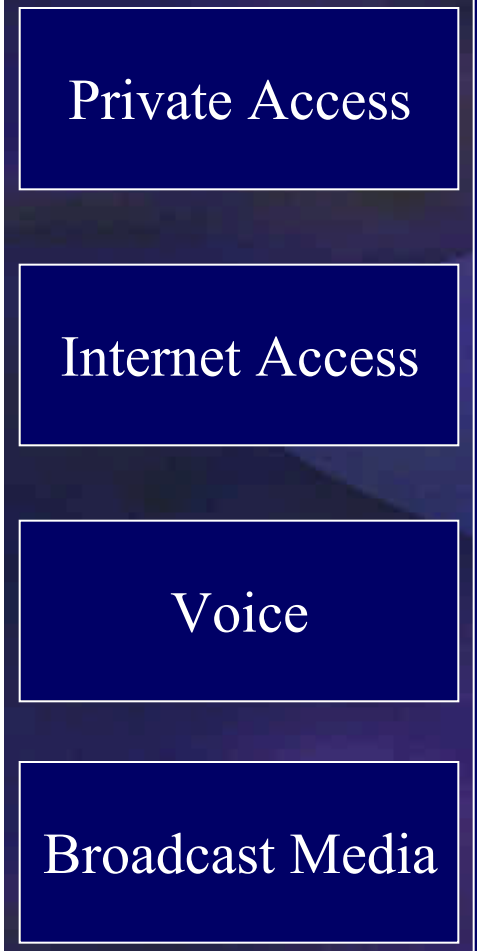
500 Terabits/second

Andreas Bechtolsheim
Cisco Systems Inc

Restoring Health for The Terabit Food Chain

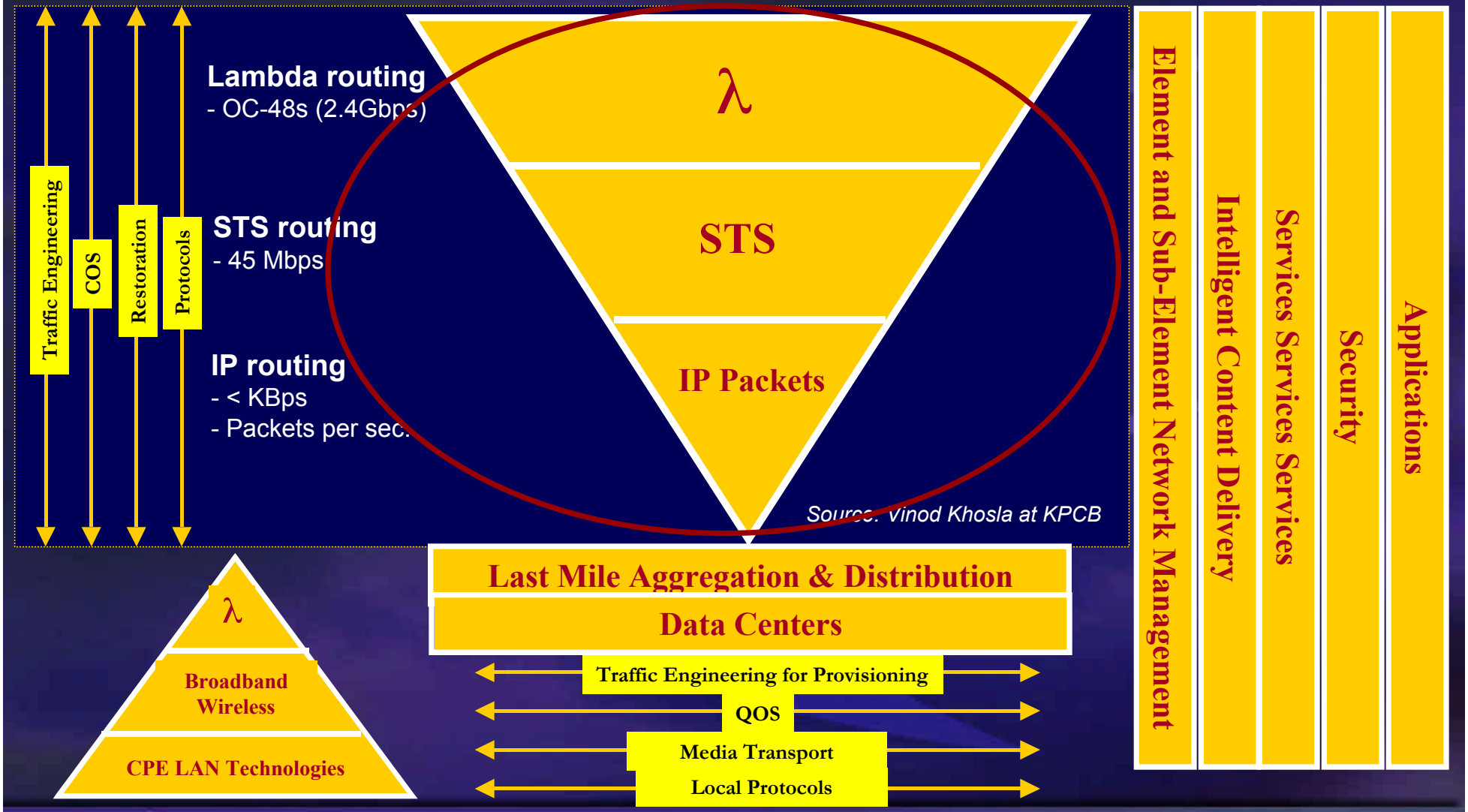


Evolutionary Revolution

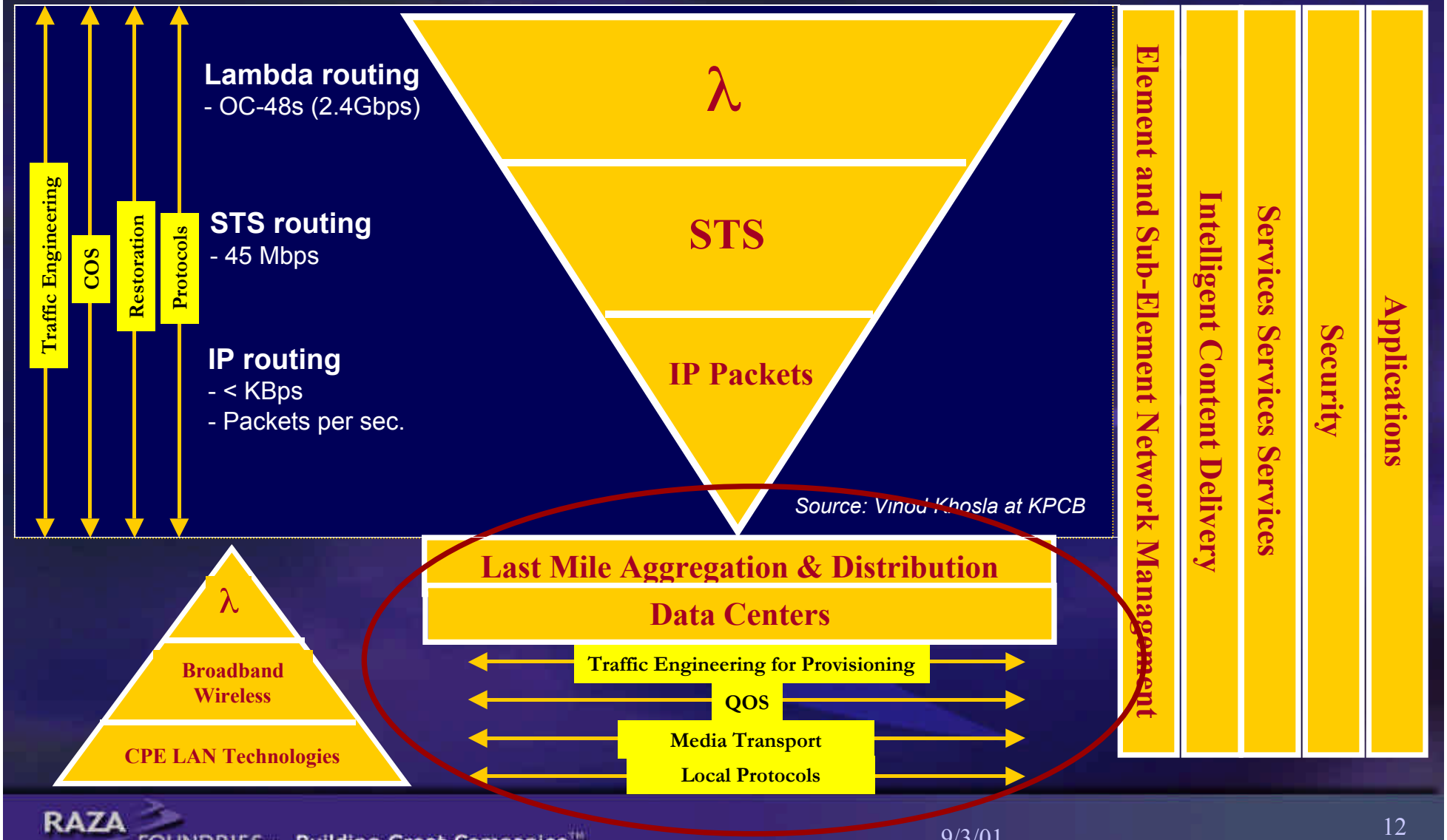


- λ **Constrained capital markets shorten ROI horizons**
- λ **Carriers focus on Delivering Enterprise Services**
- λ **Slower additional Dark Fiber deployment**
- λ **Focus on Service Generation and Market Access**
- λ **Less long haul and more Metro Services spending**
- λ **TDM with Packet services again pick up momentum**
- λ **IP-everywhere pauses as MPLS enables the trend**
- λ **OC768 on hold as transport bandwidth in fiber**
- λ **DSL connections continue – RBOCs step up**
- λ **MSOs (cable market) grow aggressive – may win big**

1996-2000: Transport and Routing Infrastructure

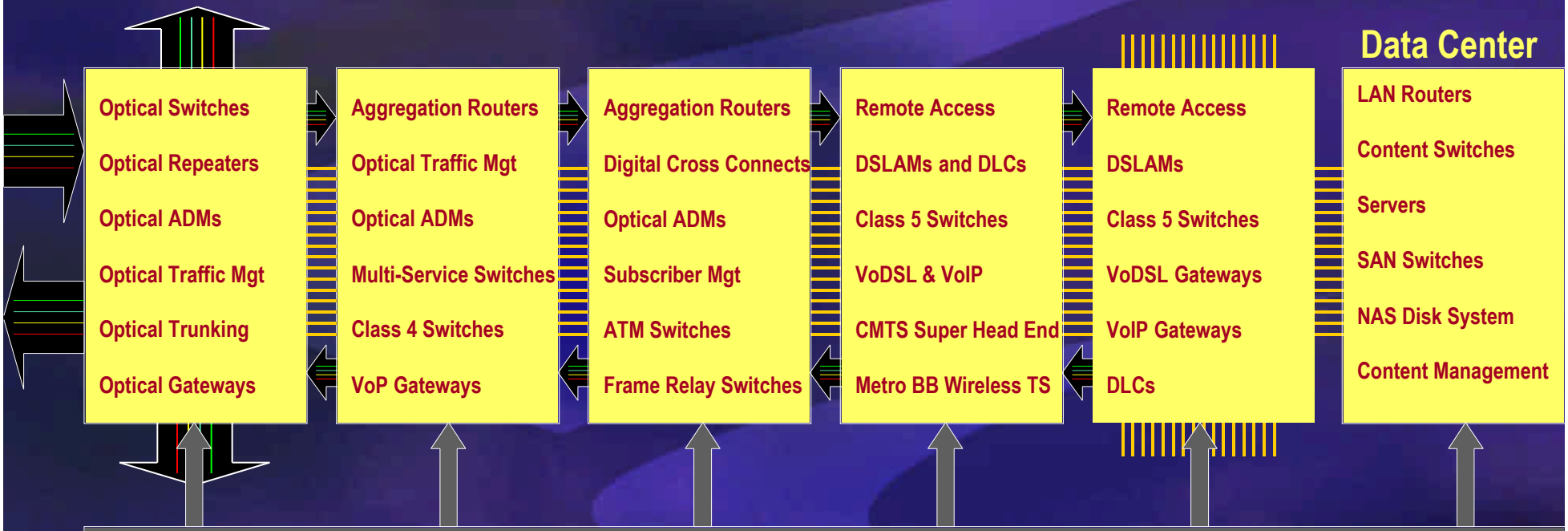


2002-2005: Data Service Delivery Infrastructure



Equipment and Components for Data Center Needs

Transport	Transit Core	Service Core	Edge	Access	Data Center
Optical	High Speed	High Speed	Medium Speed	I/O Intensive	I/O Intensive

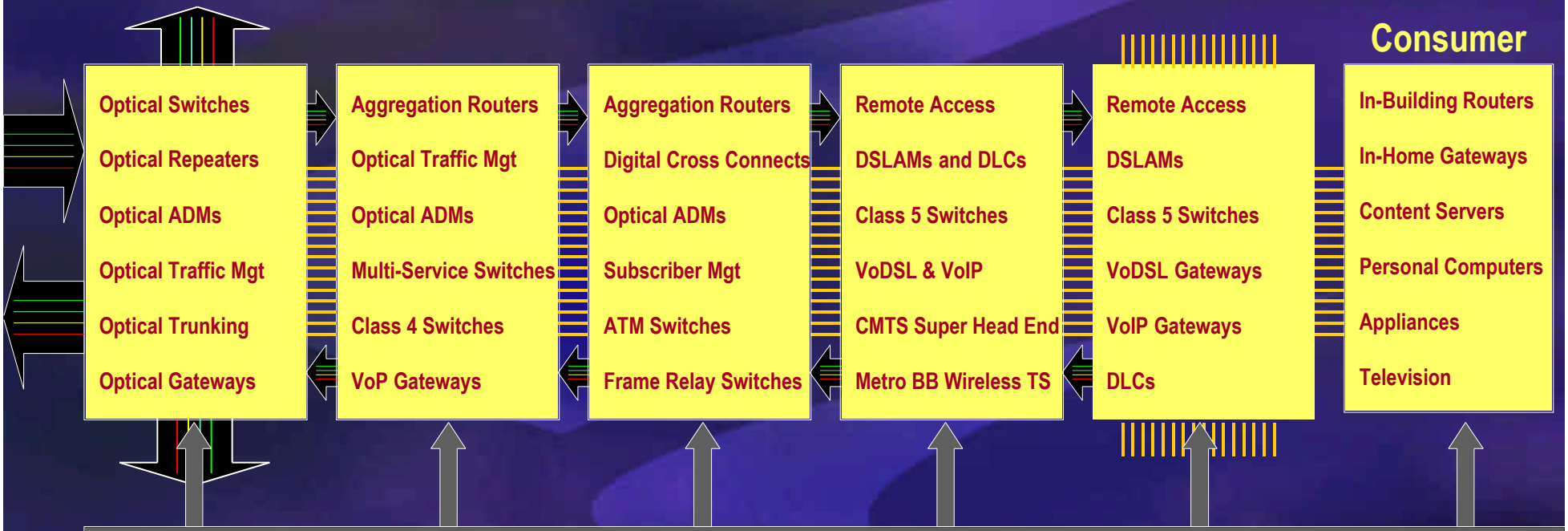


Supply Chain

Optical Components | **Semiconductor Components**

Equipment and Components for Consumer Needs

Transport	Transit Core	Service Core	Edge	Access	Consumer
Optical	High Speed	High Speed	Medium Speed	I/O Intensive	I/O Intensive

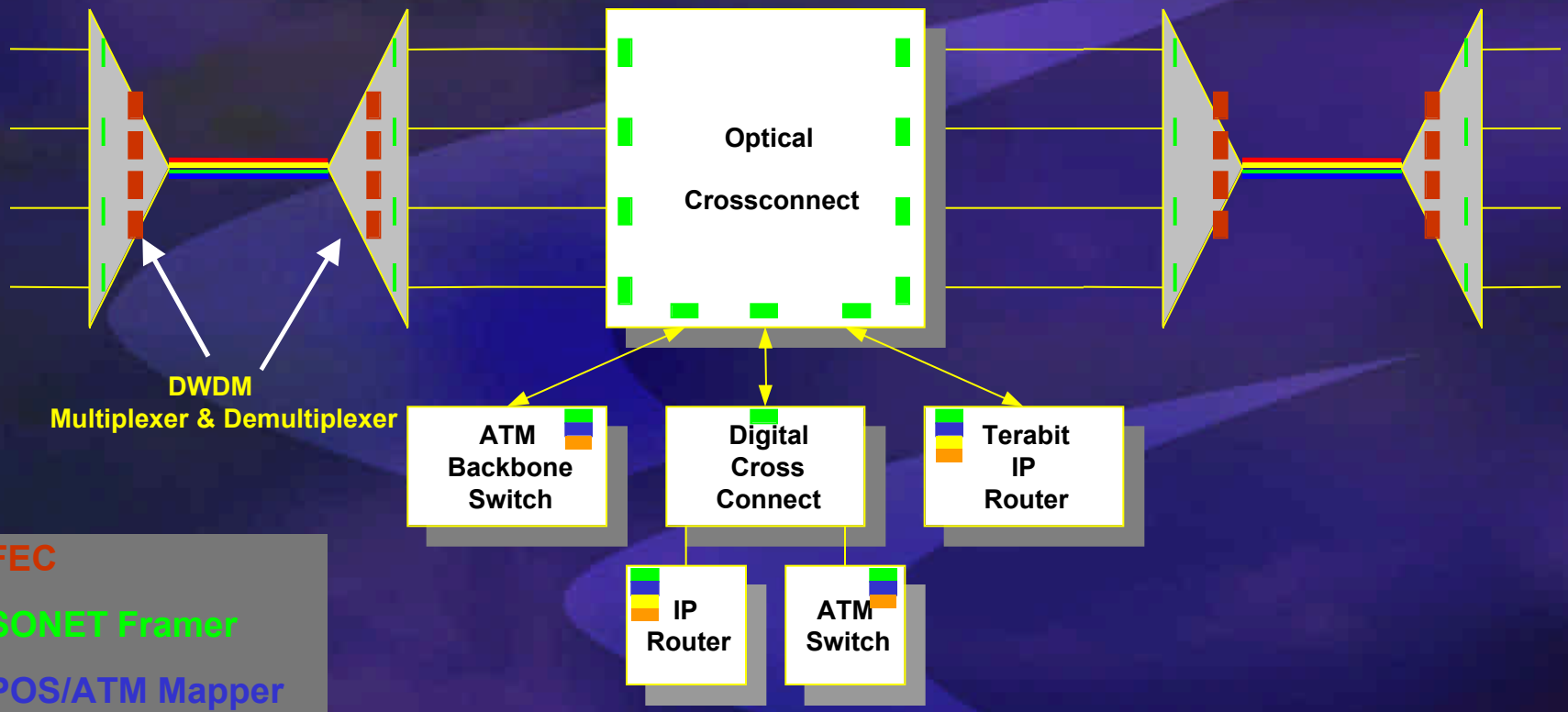


Supply Chain

Optical Components

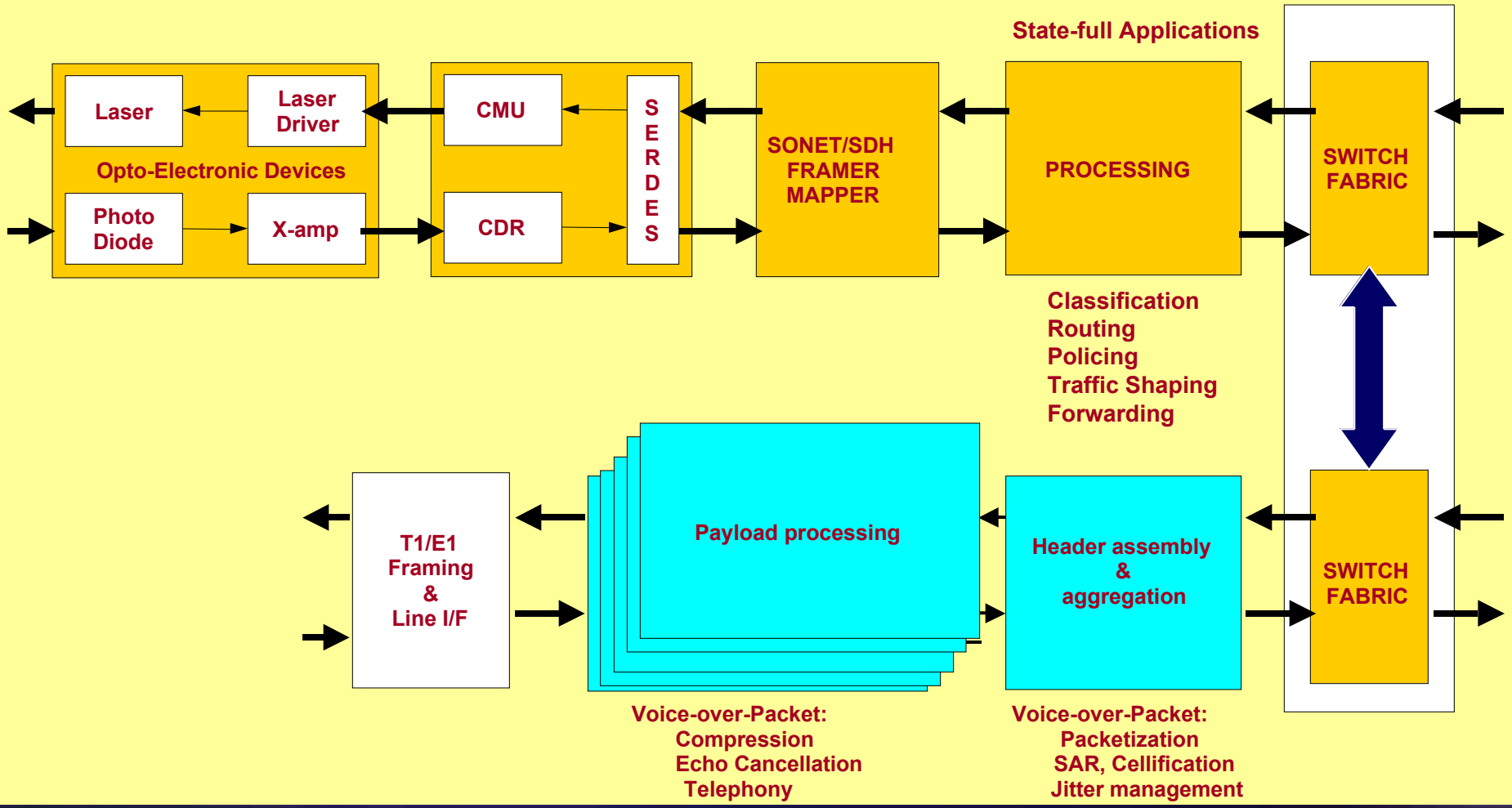
Semiconductor Components

DWDM Application Example



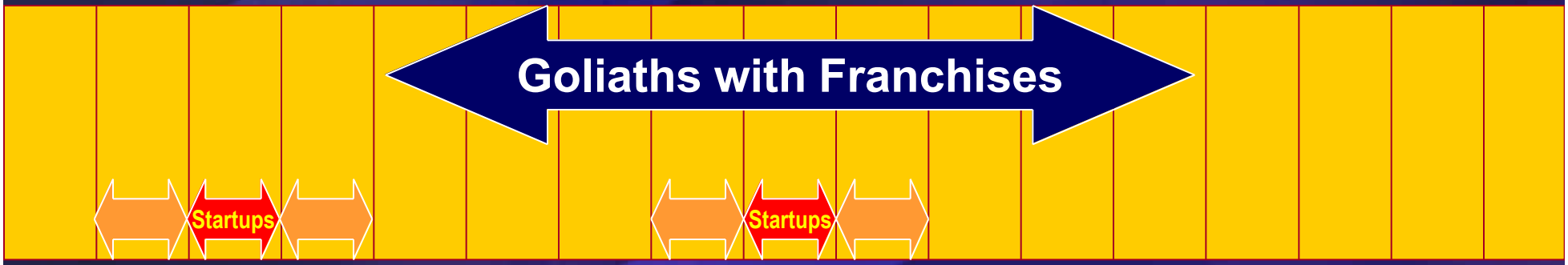
Source: JPMS

Components for the Terabit Age



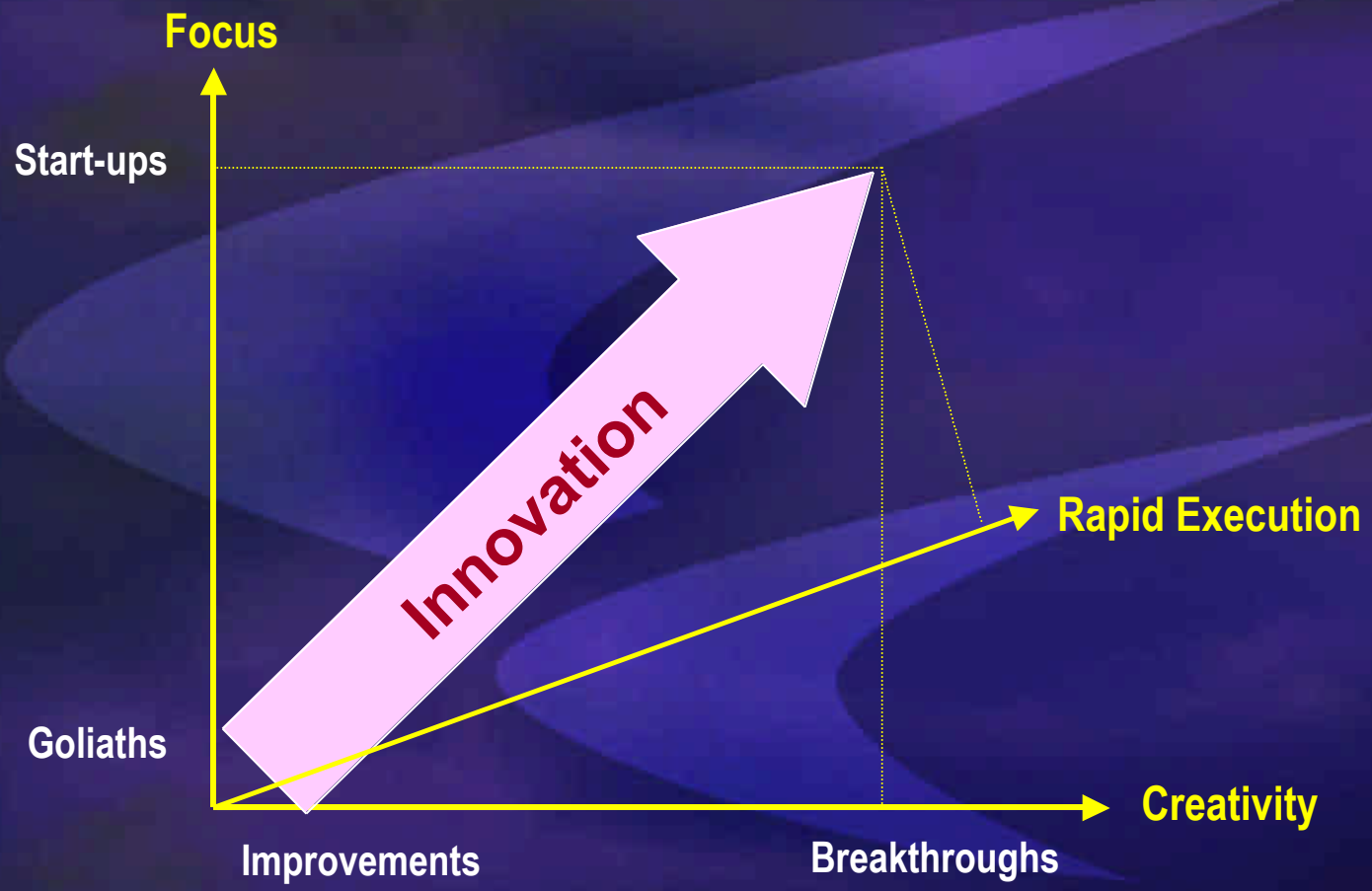
Market Segments and the Goliath Franchises

- Market Segments defined by Product or Service, Technology, Sales Channels, Customers
- Large Companies "Goliaths" develop broad multi-segment Franchises
- Start-ups succeed with a "Compelling Product or Service Focused in One Segment"

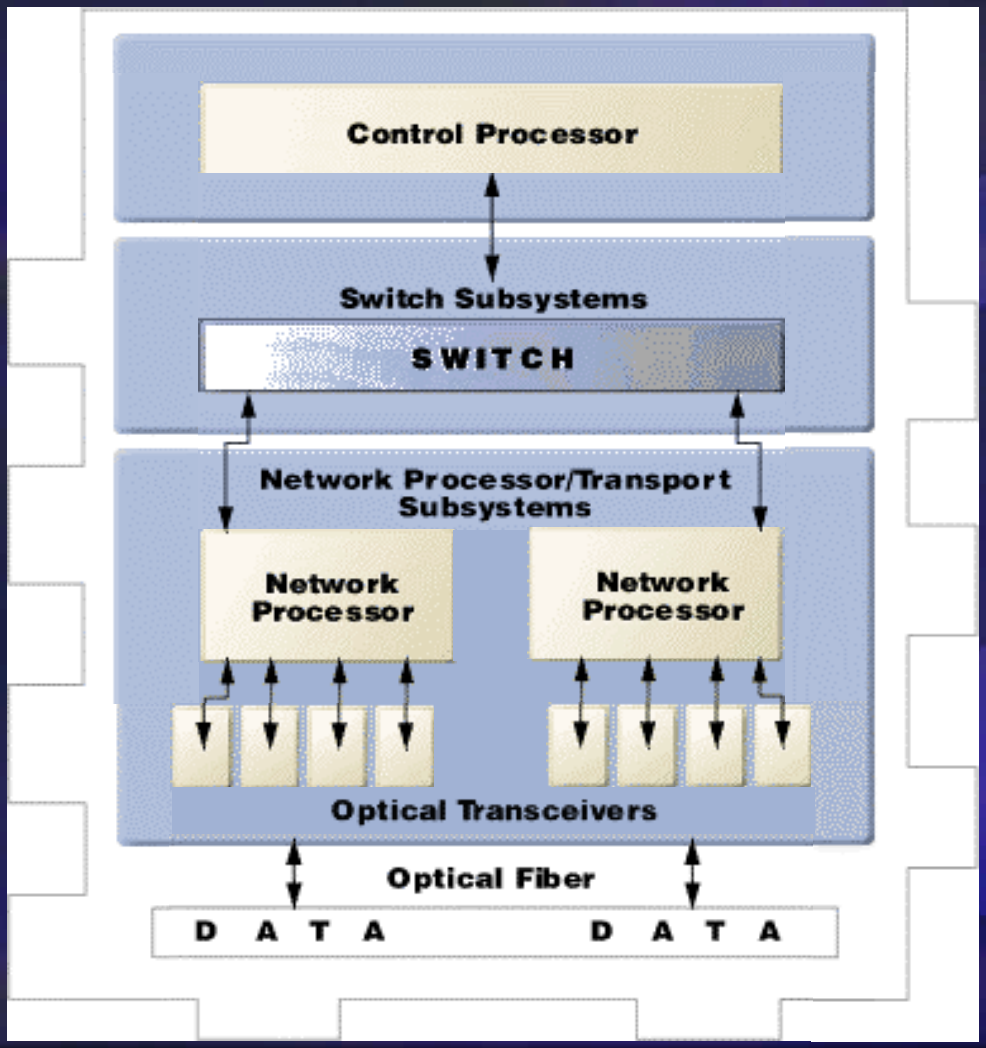


- Start-ups become Goliaths by adding products or services in contiguous segments
- Diminished Focus in one Segment creates new opportunities for Start-ups

Focus*(Innovation + Rapid Execution) = Success



Communications Chip Companies Aim to Control Line Card



Example: IBM Microelectronics

Message: Works best as one solution

Economic Drivers For Terabit Revolution

- **Enterprise**
  - Supply Chain Compression, Web based Business Transactions
  - Integration of Data Center Storage and Compute with WAN
- **Carriers and Service Providers**
  - Compelling Services (Faster time to Revenue)
  - Expanded Market Access
- **Multi-Service Operators**
  - Providing multiple channels, data, voice and other services
  - Targeted Advertisement Revenue
- **Mobile Business End-User**
  - Mobile Data Access
  - Base Station WAN Integration

Investment Hot Spots

- Enterprise Spending Increases in IT
- Service Providers focus on Delivering Managed Services
- **Data Centers**
  - Enterprises
  - Carriers and Service Providers
- Mobile Wireless Data Delivery
  - 802.11
  - 2.5G and 3G
- Rich Media Content Service and Delivery

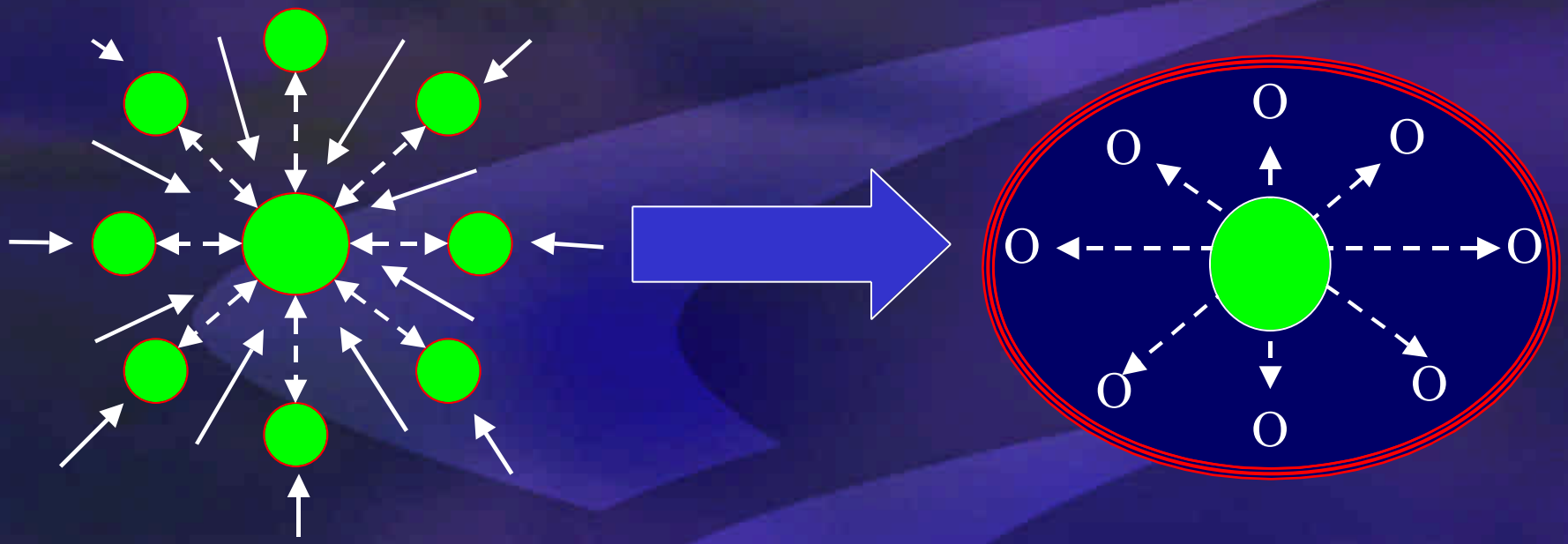
Enterprise Economic Drivers

- **Commerce over the WAN**
  - Web based Commerce
  - Supply chain compression
  - Integration of WAN with the data-center resources
- **Secure Data Center Operation**
  - Enabling a secure data-center perimeter – **Wire-speed Firewalls**
  - Managing the security of distributed Data Centers – **SAN/WAN Integration**
  - Security of business information over the WAN – **Hard Secure WAN Flows**
- **Data Storage Consolidation and Warehousing**
  - Data backup
  - Disaster based data-recovery
  - Better Storage Utilization
- **Network Equipment Management**
  - Load-balancing
  - LAN-SAN-WAN Integration

Carrier and Service Provider Economic Drivers

- **Metro Services**
  - Managed Data Services to Points-Of-Presence closer to Enterprise Customers
  - Hard QOS flows delivered from Carriers to Enterprise
  - Web hosting, Application hosting
  - Storage Service integration
- **Media Delivery**
  - Video-On-Demand distribution
  - Advertisement integration
  - Web hosting for data delivery
- **Data Center Managed Services**
  - Resource Usage Based Billing model
  - Virtualization of Storage and Compute Resources
  - Security – Firewall, Intrusion Detection, Secure Transport

Virtual Control of Data Center Resources



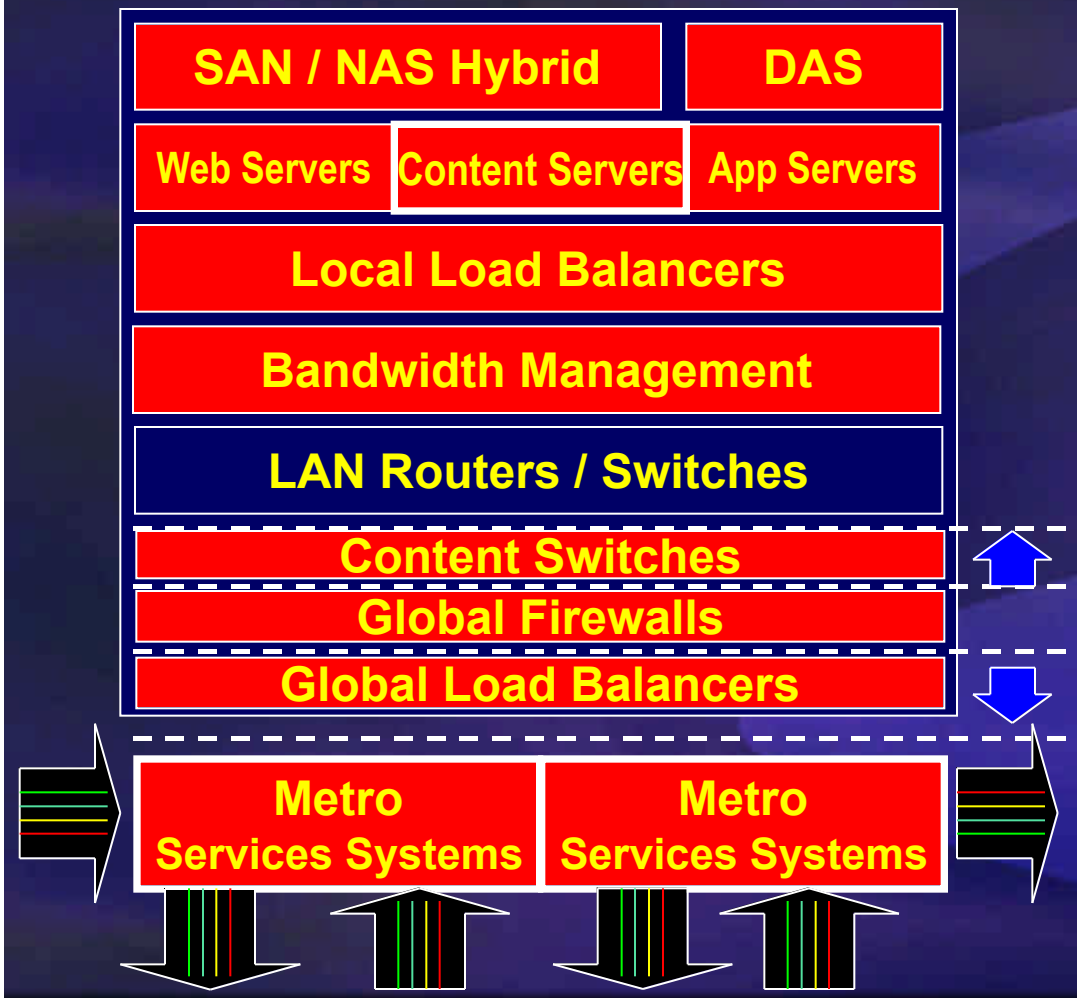
Current Enterprise Data Center Model

New Enterprise Data Center Model

Secure Boundary

Data Flows

Data Center Evolution



Trebia

Afara WebSystems

RSM Media Networks

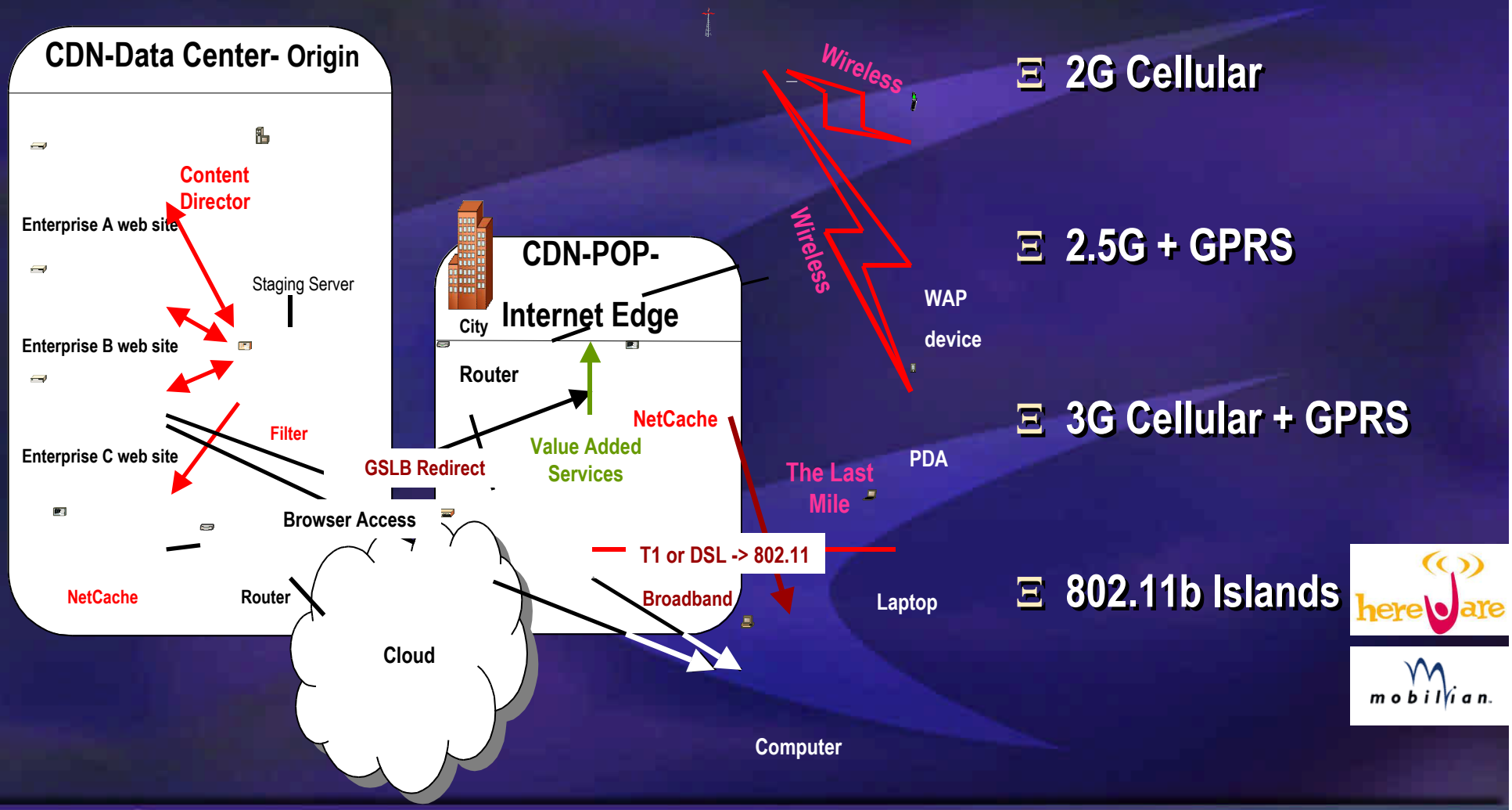
IntruVert

Nexsi

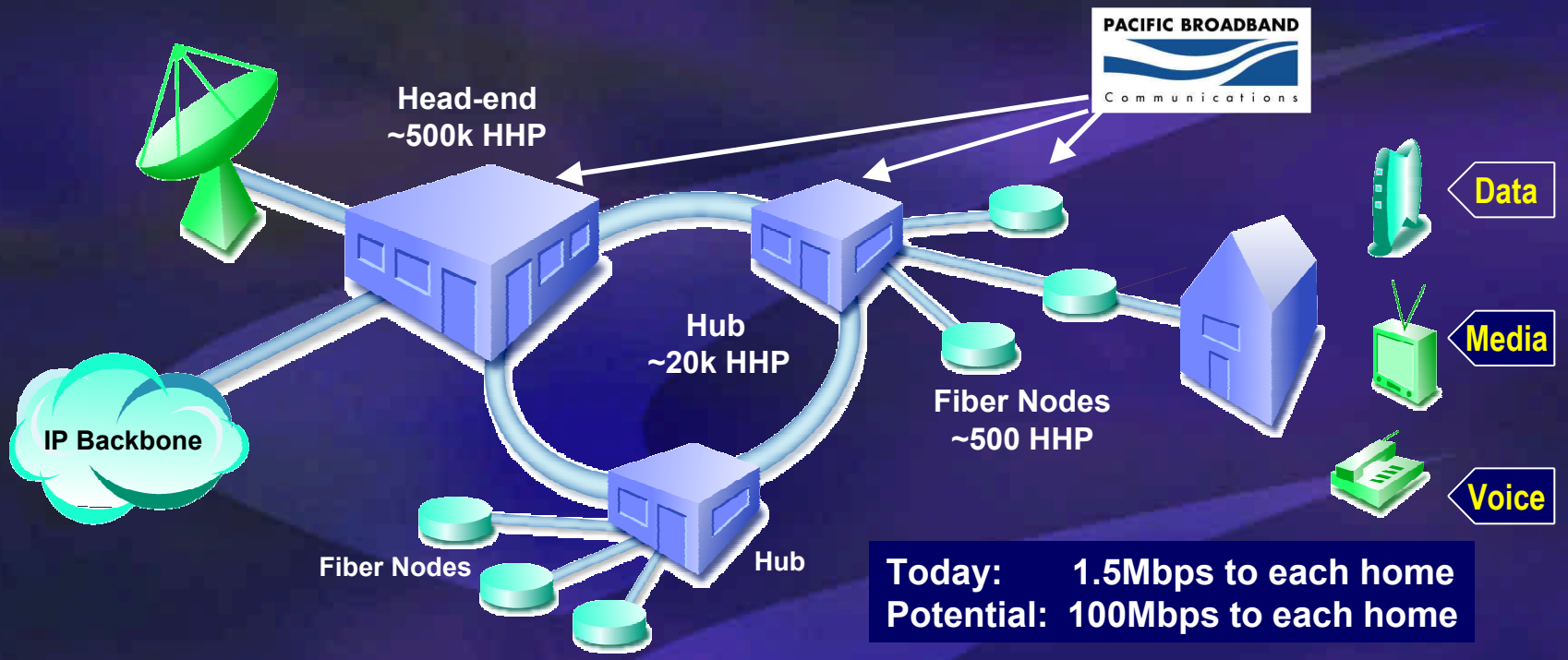
Maple Optical Systems

Redwave Networks

Mobile Wireless Data Integration with WAN



Media and Data Distribution over HFC and Cable



Today: 1.5Mbps to each home
Potential: 100Mbps to each home

Engines to Generate Services From Optical Traffic

Custom processors for processing OC-192 routes and beyond	Custom ASIC Products
Ultra-high performance parallel I/O processors for Web Servers	Custom ASIC Products
Packet processors for TCP/IP termination and re-direction	Custom ASIC Products
Stateful packet processors for processing secure traffic	Custom ASIC Products and Standard Products
Programmable packet processors for packet forwarding	Custom ASIC Products and Standard Products
Digital signal processors for RF for wireless, HFC and Coax	Custom ASIC Products and Standard Products
High performance programmable control processors	Standard Products
Special purpose processors for classification acceleration	Standard Products
Digital signal processors for Voice-over-Packet applications	Standard Products

Equipment Companies with ASICs vs. Standard Chips

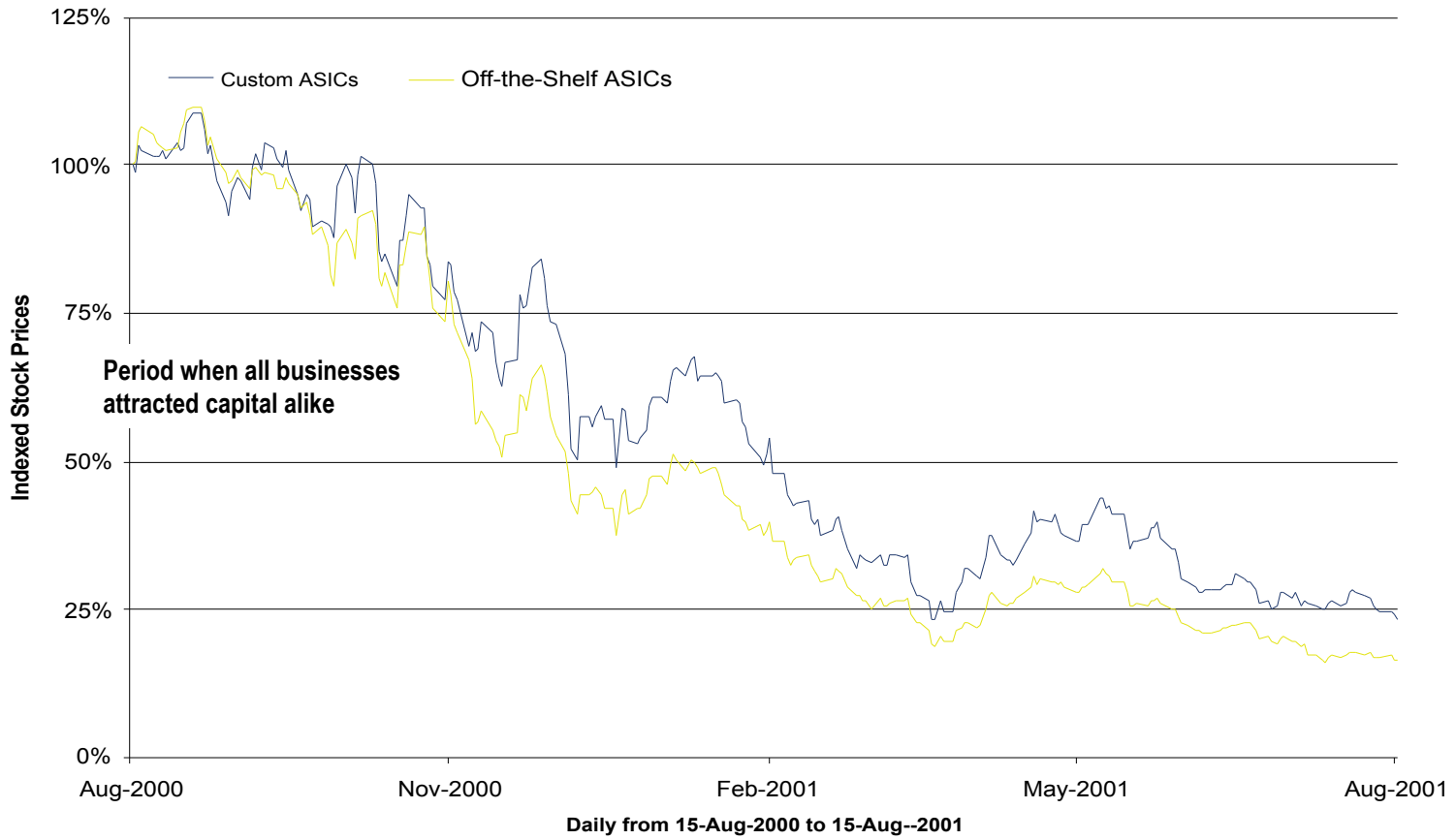
Companies with Custom ASICs 8/13/2001

Company	Equity Market Cap	Cash	Total Ent Value	Revenues 2001	Revenues 2002	Multiple of TEV 2001	Multiple of TEV 2002
Alcatel	20,447	3,083	25,172	2,979	3,141	8.4 x	8.0 x
Brocade	8,018	218	7,800	515	670	15.1 x	11.6 x
Ciena	10,001	1,501	9,365	1,741	2,632	5.4 x	3.6 x
Cisco	132,800	6,200	126,600	18,336	20,441	6.9 x	6.2 x
Extreme Networks	2,910	271	2,639	491	540	5.4 x	4.9 x
Foundry Networks	2,129	260	1,869	355	440	5.3 x	4.2 x
Juniper	7,347	1,600	5,747	941	989	6.1 x	5.8 x
Nortel	23,235	1,930	25,605	18,895	19,363	1.4 x	1.3 x
ONI Systems	2,865	739	2,426	281	470	8.6 x	5.2 x
Redback	952	314	1,142	277	380	4.1 x	3.0 x
Riverstone	1,463	176	1,287	219	404	5.9 x	3.2 x
Sonus	4,021	136	3,885	207	311	18.7 x	12.5 x
Tellabs	6,372	1,034	5,341	2,269	1,873	2.4 x	2.9 x
Tellium	1,111	231	882	130	288	6.8 x	3.1 x
Sun Microsystems	52,800	1,860	53,389	18,250	17,147	2.9 x	3.1 x
Average						**6.9 x**	**5.2 x**
Median						**5.9 x**	**4.2 x**
Companies with Off the Shelf ASICs							
ADC	3,900	432	3,602	2,530	2,229	1.4 x	1.6 x
3Com	1,721	1,847	(126)	1,864	1,755	-0.1 x	-0.1 x
CacheFlow	191	82	110	86	119	1.3 x	0.9 x
f5 Networks	310	69	241	117	169	2.1 x	1.4 x
Network Appliance	4,580	364	4,216	1,006	921	4.2 x	4.6 x
Lucent	22,036	2,285	25,961	21,528	20,446	1.2 x	1.3 x
Marconi	3,398	728	2,670	9,927	8,746	0.3 x	0.3 x
Scientific Atlanta	4,393	754	3,639	2,511	2,254	1.4 x	1.6 x
Sycamore	1,873	1,300	573	226	308	2.5 x	1.9 x
Average						**1.6 x**	**1.5 x**
Median						**1.4 x**	**1.4 x**
Premium on Average for Custom ASICs						**4.3 x**	**3.5 x**
Premium on Median for Custom ASICs						**4.1 x**	**3.0 x**

Goldman Sachs

Indexed Stock Price History

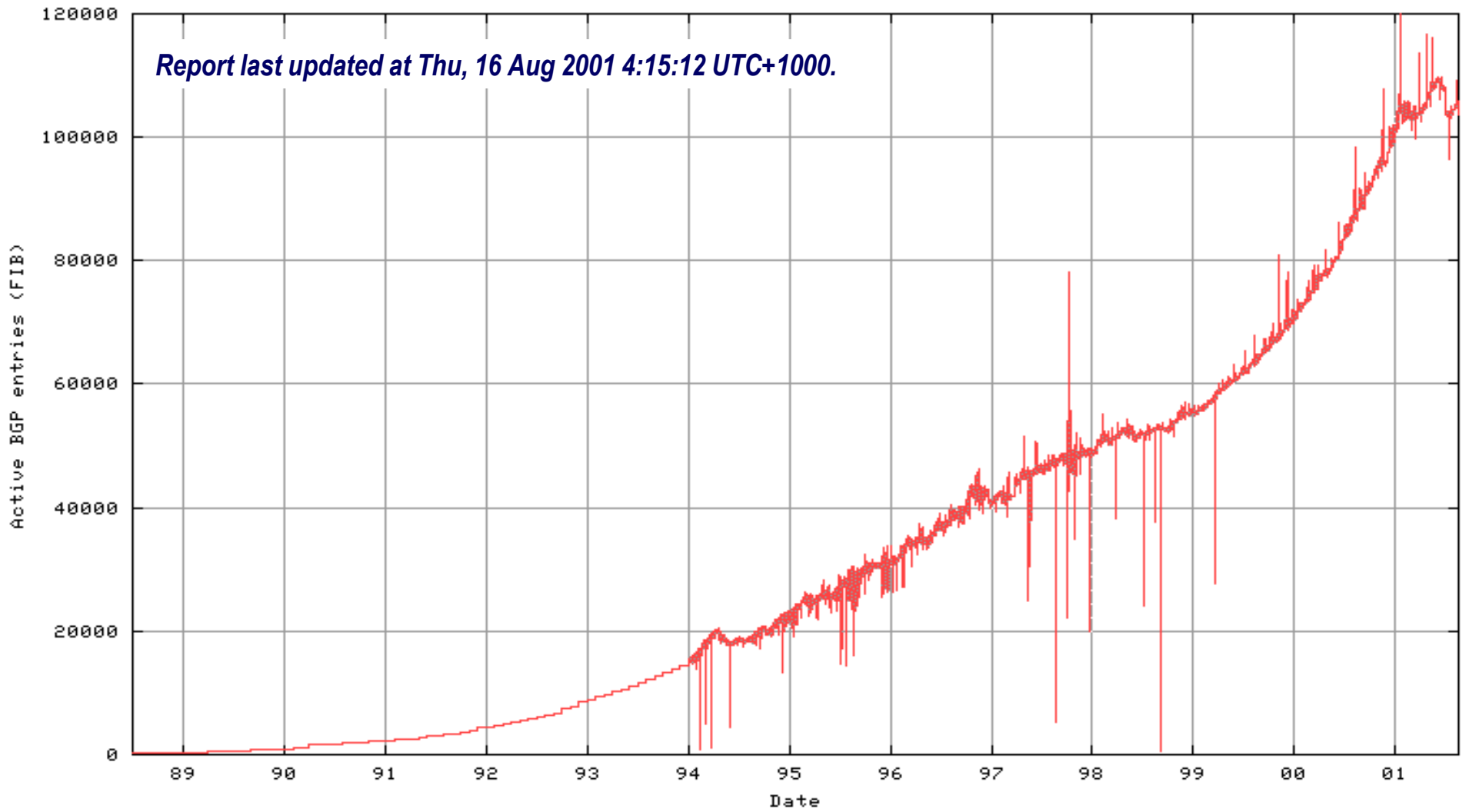
Daily from 15-Aug-2000 to 15-Aug-2001



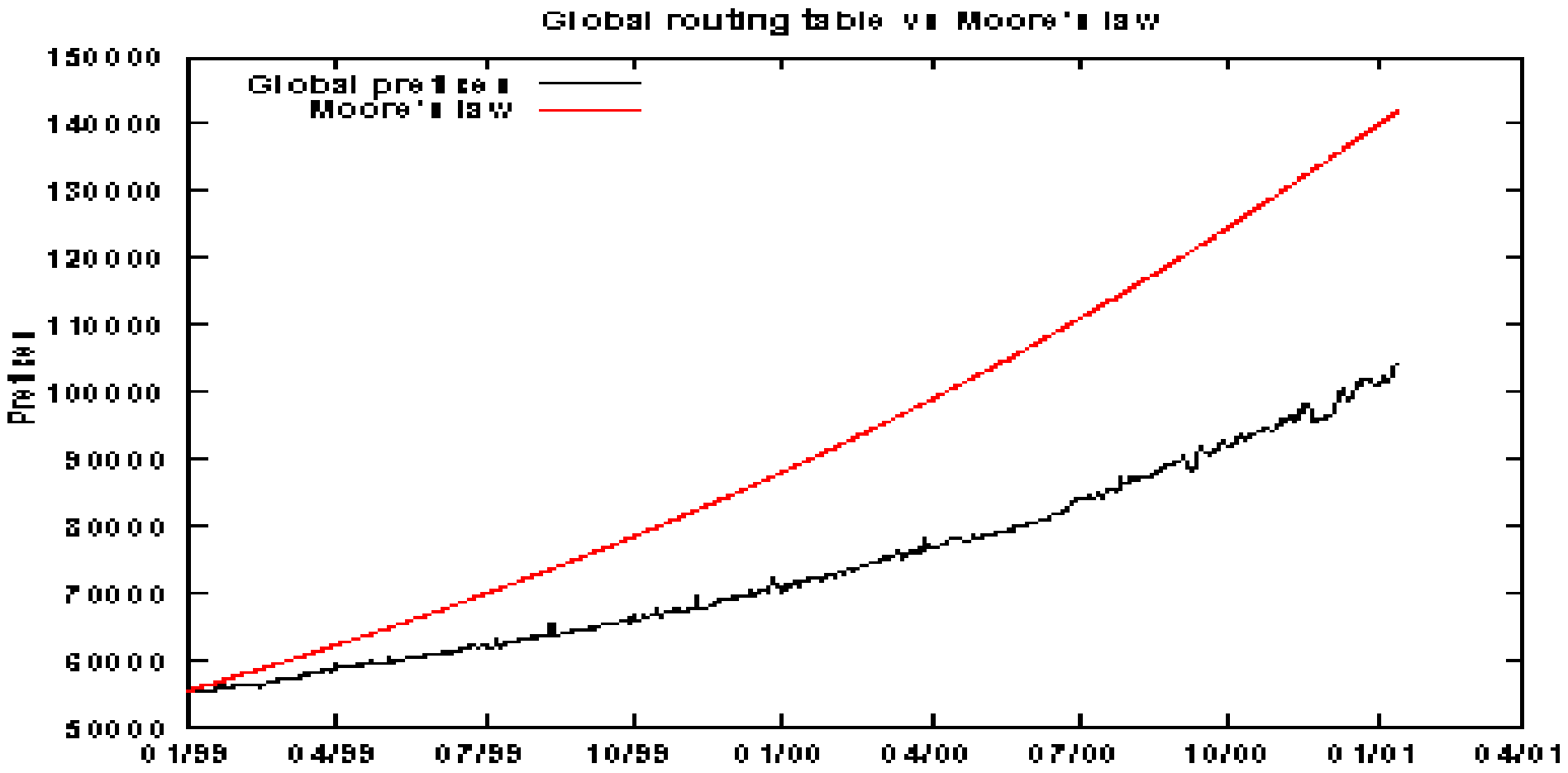
Critical Technological Challenges

- **Routing Multiple (N) 10G flows in a unified Routing Engine**
  - High Performance Route Processors and Classification Engines
  - Enabling High Speed SERDES on chip
- **Supporting the Routing Table bloat for the future**
  - Get the highest performance out of Moore's Law
  - Distributed Routing Models
  - High Speed Packet Memory buffers and next generation TCAMs
- **Enabling latency control and QOS at 10G rates**
  - MPLS at the Core
- **Transitioning from 1G to 2.5G/3.125G to 10G line rates**
- **10G Ethernet requires XAUI (4x3.125) to 10Gbps SERDES**
- **Switch Fabrics with QOS and TDM support with on-chip SERDES**
- **40G line rates will require all-optical ADM**

Growth of BGP Routing Table



BGP Routing Table Growth Chasing Moore's Law



Source: Tony Li, Procket: "Hyperexponential Growth will exceed Moore's Law"

Raza Foundries Partner Companies

Acquired by AMCC

Terabit Switch Fabric

Content-Aware Delivery System

Metro Wireless and Optical Systems

Next Generation Web Server

Broadband Access Systems

Global Ethernet Wireless Solutions

Acquired by Cisco

Optical Packet Processor Engine

Advanced SAN Chipsets

Hardened QOS over Optics

Distributed Application Delivery

Hyper Fabric

Transparent Optical Switch

Advanced Service Delivery

Intruvert Networks

Wire-Speed Security Systems

Raza Venture Fund A/B Investments - Broad Perspective

Investments	Co-Investors	Products	Segment	Business
Procket	NEA, USVP, Redpoint	Router	Core Router	Equipment
Switch-On	Sequoia, Redwood	Classification Accelerator	Router Chips	Acquired by PMCS
SiByte	Cisco, Bowman, ATI	Comm Processors	Line Card Control	Acquired by BRCM
Nexsi	Sequoia	10G Content Switch	Data Center System	Equipment
Silicon Access	Norwest Ventures	Network Accelerators	Router Chips	Chips
VxTel	Sequoia, Telesoft	VOP Chips	Chips for Class 4	Acquired by Intel
Optovation	NEA, Redwood	Optical Components	Optical Transport	Modules
Nishan	WP&G, Comm Ven	Storage Area Networking	Data Center System	Equipment
Cyras Networks	NEA	Optoelectronic ADM	Optical Networking	Acquired by Ciena
Mobilian	Bessemer	802.11+ Bluetooth	Wireless LAN	Chips
Zeevo	Sequoia	Blue Tooth Chipset	Wireless LAN	Chips
Euclid	Redwood	Network Services	Data Center Services	Services
PaxoNet		Framer/POS chips	Optical Linecard	Chips
Mellanox	Sequoia, USVP	Infiniband ICs	Server & Storage Fabric	Chips
Quantum Bridge	TPG, NEA	PON Switch	Transport Equipment	Filed for IPO
Celox	TPG, Apex Partners	Optical ATM Transport	Transport integration	Equipment
Arcot	Accel, Onset	User Authentication	Security Software	Software
Everypath	Sevin Rosen, USVP	Web Access by Phone	Wireless Access Software	Services
Magma DA	NEA, CMEA	Synthesis/P&R Fusion	Next gen CAD	Filed for IPO
Lara Networks	Battery, Telesoft	CAM & Processors	Router Chips	Acquired by Cypress

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Highlights of the Raza Portfolio – Eighteen Months

- Highest Valuation private "Chip Company" - SiByte - $2.2B
- Highest Valuation acquisition after downturn - VxTel - $500M
- Fastest path to liquidity for "Chip Company" - Yuni - $250M
- First acquisition by Cisco after downturn - AuroraNetics - $150M
- Seven acquisitions
- Two IPO filings

Dr. Lawrence Roberts

August 17/2001 Contrary to some opinions, the Internet is not shrinking, nor does it appear to be slowing yet in its growth, says Internet veteran and network scientist Dr. Lawrence Roberts. In fact, new measurements by Roberts and his research team suggest traffic on the Internet has recently been growing faster than ever before, increasing as much as an unprecedented four times annually through the first quarter of 2001.

Roberts believes this data has implications for service providers and communications equipment vendors. "Carriers have been holding back on purchases due to spending constraints. Recently, some had been growing their capacities by redeploying equipment and capacity they'd previously acquired for OC-192 testing. But this borrowed time is about to run out -- if traffic continues to grow at rates like these, network buildouts will need to continue soon."