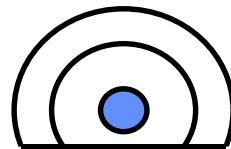




New Space Business Models for the New Century

14 December 1999



CSP Associates, Inc.



Outline

* Introduction

- The Old Model: Space Agencies and Space Programs
- The New Model: Space Businesses and Space Industry
- Conclusion
- Launch Market Backup
- Satellite Market Backup

Space Industry Inflection Point

- The space industry is reaching a critical inflection point
 - The old principles upon the industry was founded will not sustain us
 - The new principles are only beginning to emerge
- The Old Principles
 - Space exploration as a (heroic or romantic) societal enterprise
 - Space technology as an end in itself
 - Government-led investments and management of space industry
- The New Principles
 - Space development as an economic enterprise
 - Space technology as an enabler
 - Industry-led investments and management of space industry

The Future of the Space Industry Requires Both Industry and Government to Acknowledge the Paradigm Shift and Make the Tough Management Choices Necessary to Implement It: Successful Evolution is Not Guaranteed....



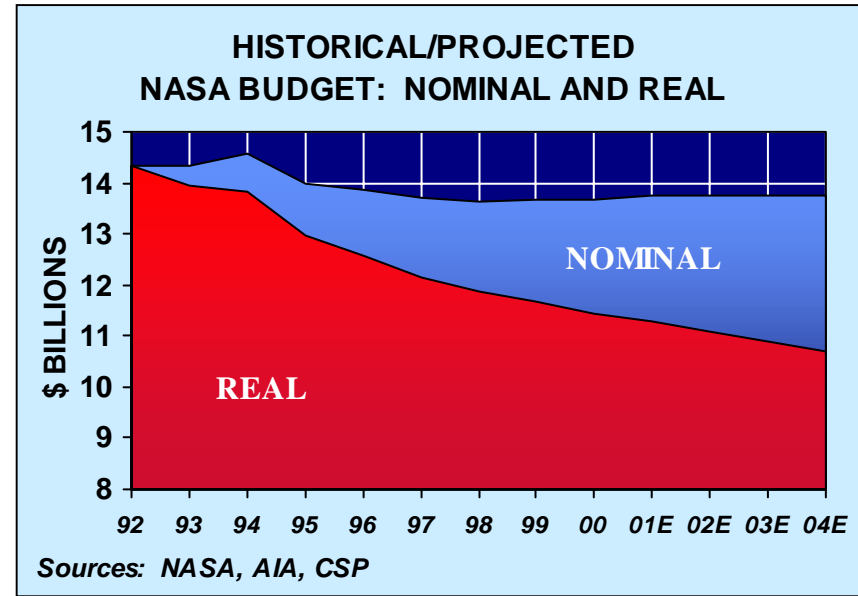
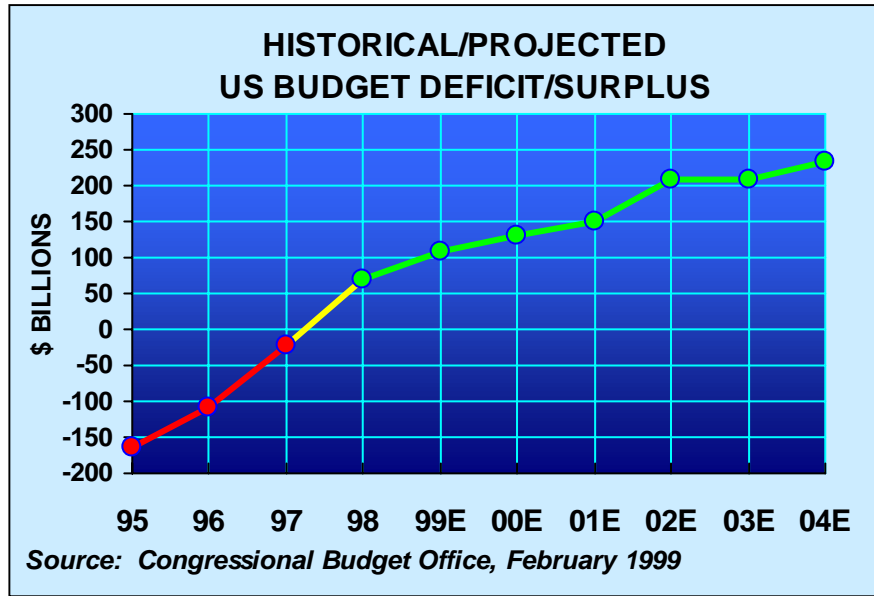
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NASA is 'Stalling Out'



- A strong U.S. economy, and controls on 'discretionary' spending accounts (including defense) have reversed federal fiscal outlook from deficit to surplus
- However, while NASA's budget is stable in nominal terms, but will fall by some 25% in terms of purchasing power from 1992 to 2004

**Despite a greatly improved federal budget outlook,
NASA's budget continues to erode**

Why?

NASA's Foundations Remain Weak

Political Foundations

- Objective: Provide an international showcase for superior U.S. economic and management capabilities
- Reality: End of the Cold War removed 'peaceful competition' dynamic; inability to meet international obligations is frequently a cause of friction among allies

Economic Foundations

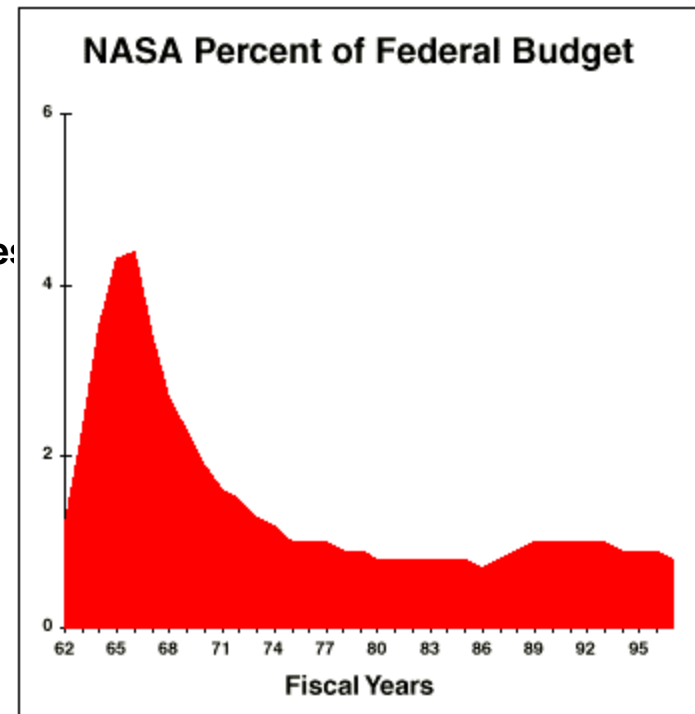
- Objective: Develop cutting edge technologies of value to US industry
- Reality: Technology development is under-funded and inward-focused; NASA investments increasingly tangential to the US economy

Spiritual Foundations

- Objective: Provide a means of expressing America's opportunity-driven, democratic spirit; space=vision
- Reality: Most people are not 'connected' to the space program; space science/exploration are not democratic enterprises

Scientific Foundations

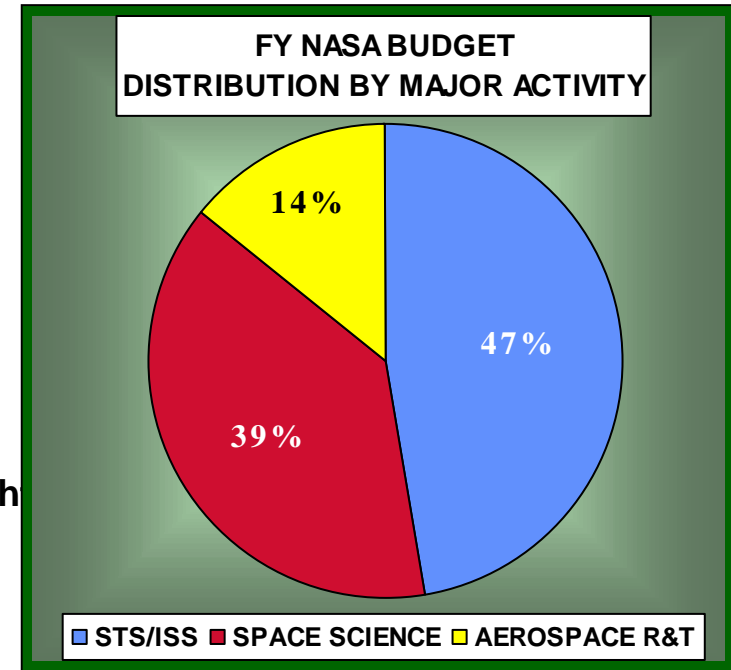
- Objective: Provide insights into fundamental questions of our universe
- Reality: The one area where the agency delivers, but space has lost its special status as a public investment account



(The lack of) public support for increasing the NASA budget reflects the agency's growing divergence from public concerns

Where is NASA Headed?

- Administrator Goldin has implemented (to varying degrees of success) three major thrusts to adapt NASA to the current environment
 - Attempt to rejuvenate focus on cutting edge technology and science
 - New Millenium program
 - Advanced space transportation initiatives
 - Increased privatization/outsourcing of operations functions programs
 - United Space Alliance
 - Spacehab
 - CSOC (Consolidated Space Operations Contract)
 - ‘Faster Better Cheaper’ program approach
 - X-Vehicles
 - Mars program
 - EOS restructuring
- Despite these actions however, NASA still remains enmeshed in its large, operational human space flight projects and supporting infrastructure
 - Nearly half of the agency’s resources are devoted to maintaining infrastructure
 - Infrastructure costs have proved to be less amenable to reduction than applications missions
- The implication is that NASA’s science and R&T efforts will be squeezed between declining real purchasing power for the agency, and a fixed cost HSF infrastructure



NASA's ability to transform itself is hindered by internal as well as external challenges

Long Term Civil Space Outlook

- The era for large, publicly-funded space efforts may be drawing to a close
- Most of the public rationales that underpinned the creation of civil space agencies have weakened or disappeared over the past decade
- Public support is strongest in areas with tangible benefits to society
 - Meteorology
 - Earth observation
 - Advanced research and technology
- Support does not presently exist for major new initiatives in human space flight or space access

While no one expects NASA to disappear, its role as the primary engine of U.S. space development is fading

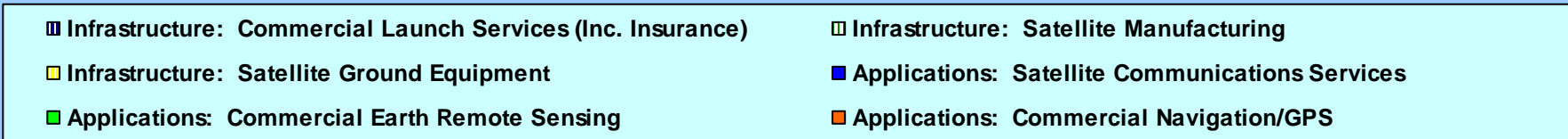
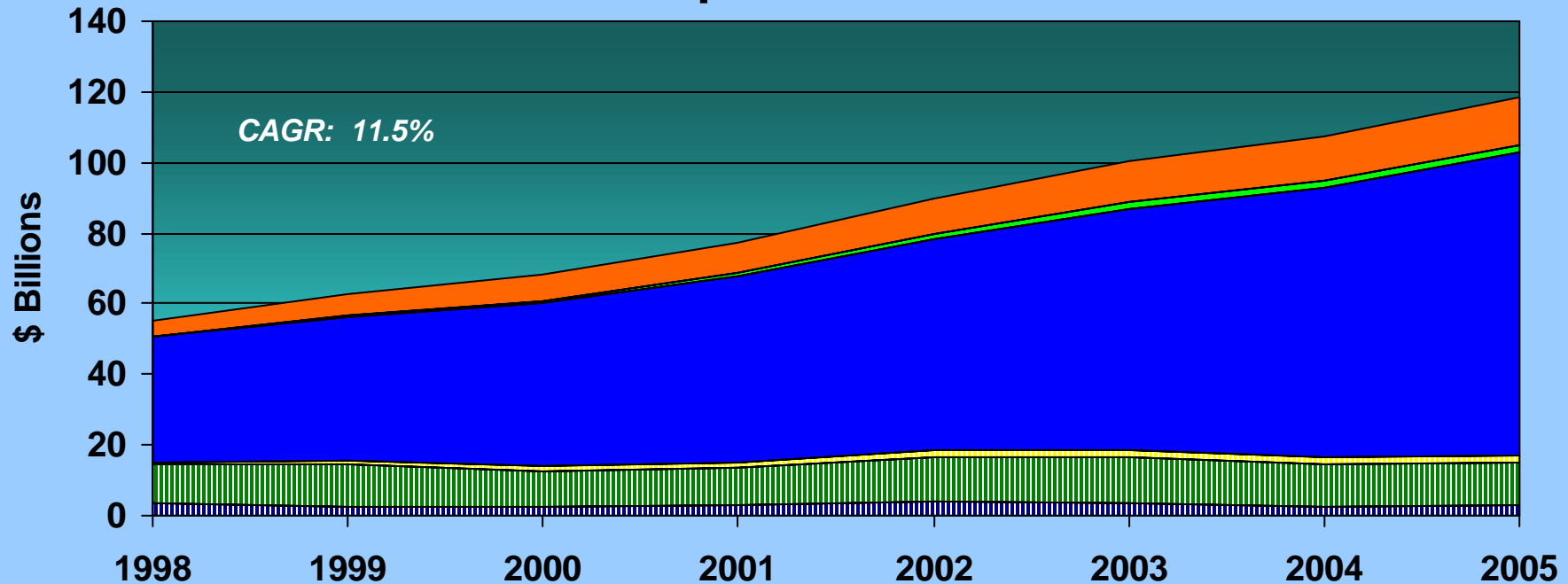


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A New Market Has Emerged

Commercial Space Market Forecast



Source: CSP Associates, C.E. Unterberg Towbin

Commercial space markets are now much larger than government space programs, and have outstanding prospects for growth

The Emergence of a New Paradigm

- The shift of satellite and remote sensing to *commercially-driven* markets has profound implications for space businesses
- Markets *are integrated with the terrestrial economy*, rather than distinct from it
 - Satellite communications is a *telecommunications service, not a space business*
 - Satellite remote sensing is a *Geographic Information System (GIS input), not a standalone product*
- By definition, these services must evolve at the same pace as terrestrial technology, or they will become uncompetitive
 - Performance improvement/cost reduction cycles *must* accelerate
 - Space-based service providers are becoming much more concerned about the cost of space access
 - Financial models succeed or fail based on the cost of transportation

A \$100B/Year space services marketplace is better able to drive investments in new space launch technology than traditional government space programs!

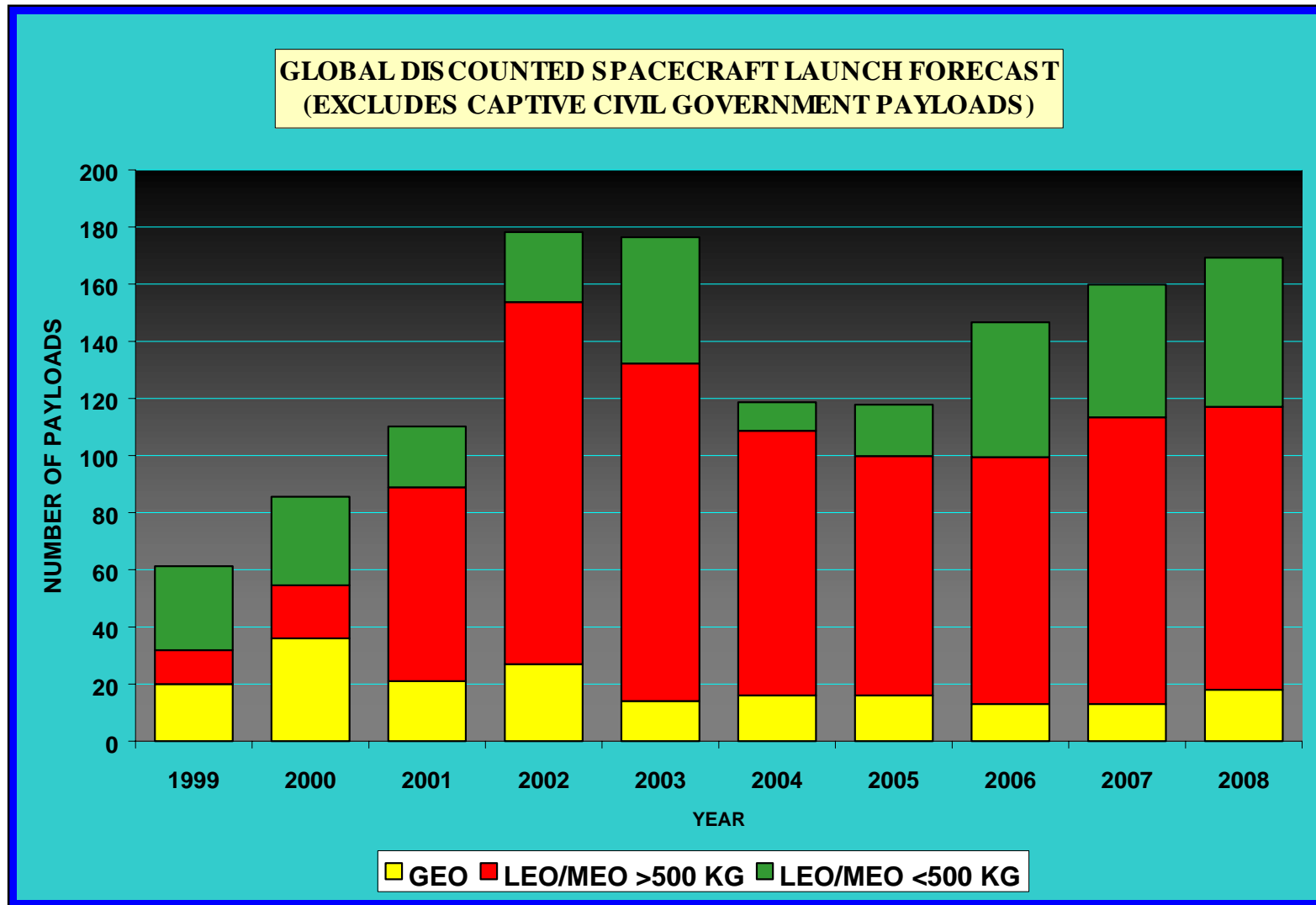
Differences Between New and Old

- **Who is the customer?**
 - Segmented markets, including government agencies, enterprises, and individual households/consumers
 - Customers with multiple choices for meeting their needs
- **Providing Value to Customers**
 - Goods and services that meet tangible economic needs
 - Competitive dynamics - multiple sources of supply
 - Selection based on provision of best value (price, performance, service)
- **Providing Value to Shareholders**
 - R&D is a cost center - a 'necessary evil' rather than an end objective
 - Broaden the customer base
 - Find ways to reduce the cost of providing goods and services
 - Compete for capital and management resources

Commercial markets are naturally biased towards growth and efficiency, while government markets are not

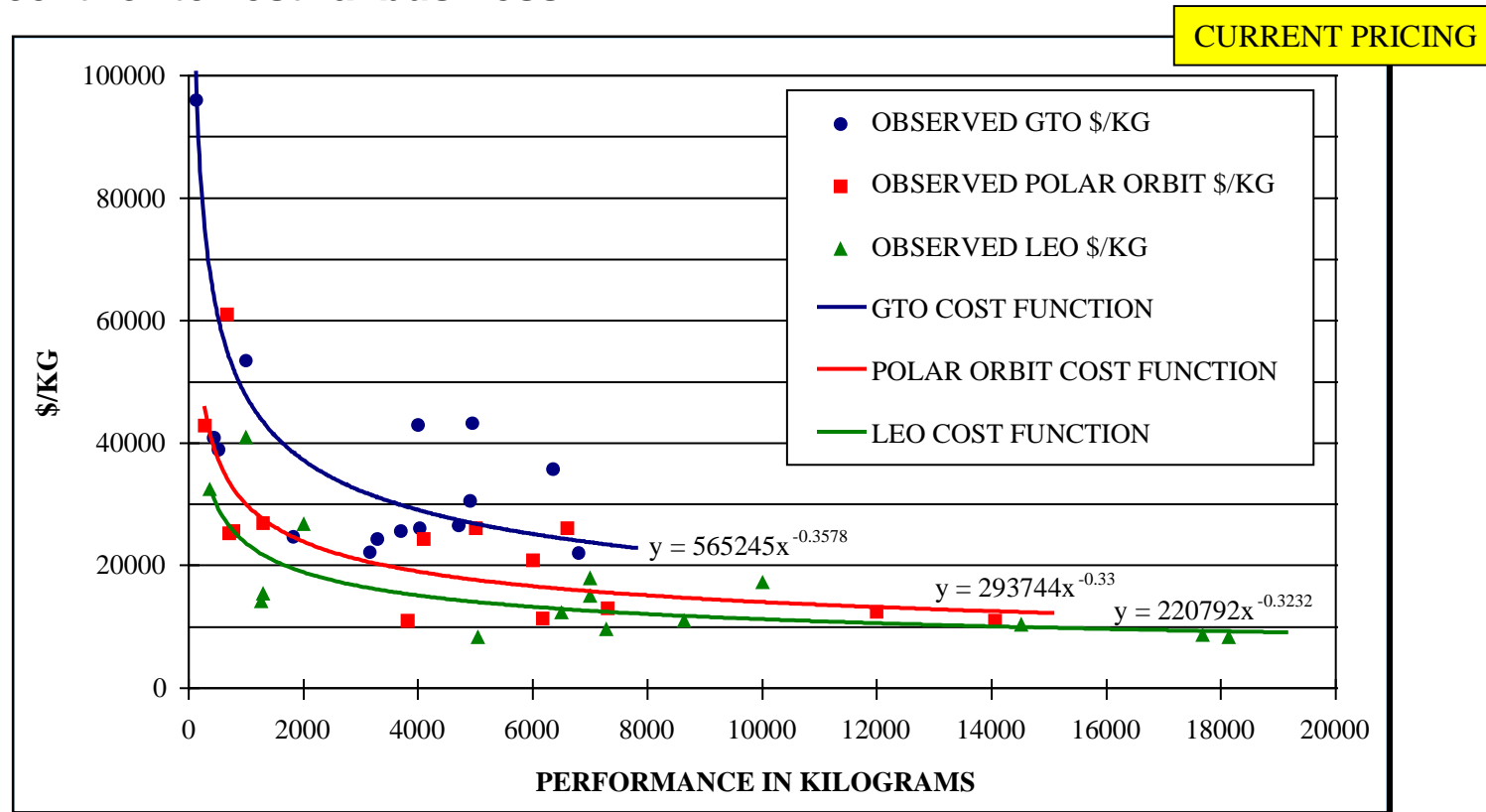
Infrastructure Market Growth

- While many applications drive top line market growth, the development of non-geostationary orbits will drive near term infrastructure growth



Space Launch Observations

- While prospects for the commercial industry are strong, growth is still limited by the difficulty of getting into space
- Transportation is typically half of the capital cost of a space venture, compared to a few percent for terrestrial business

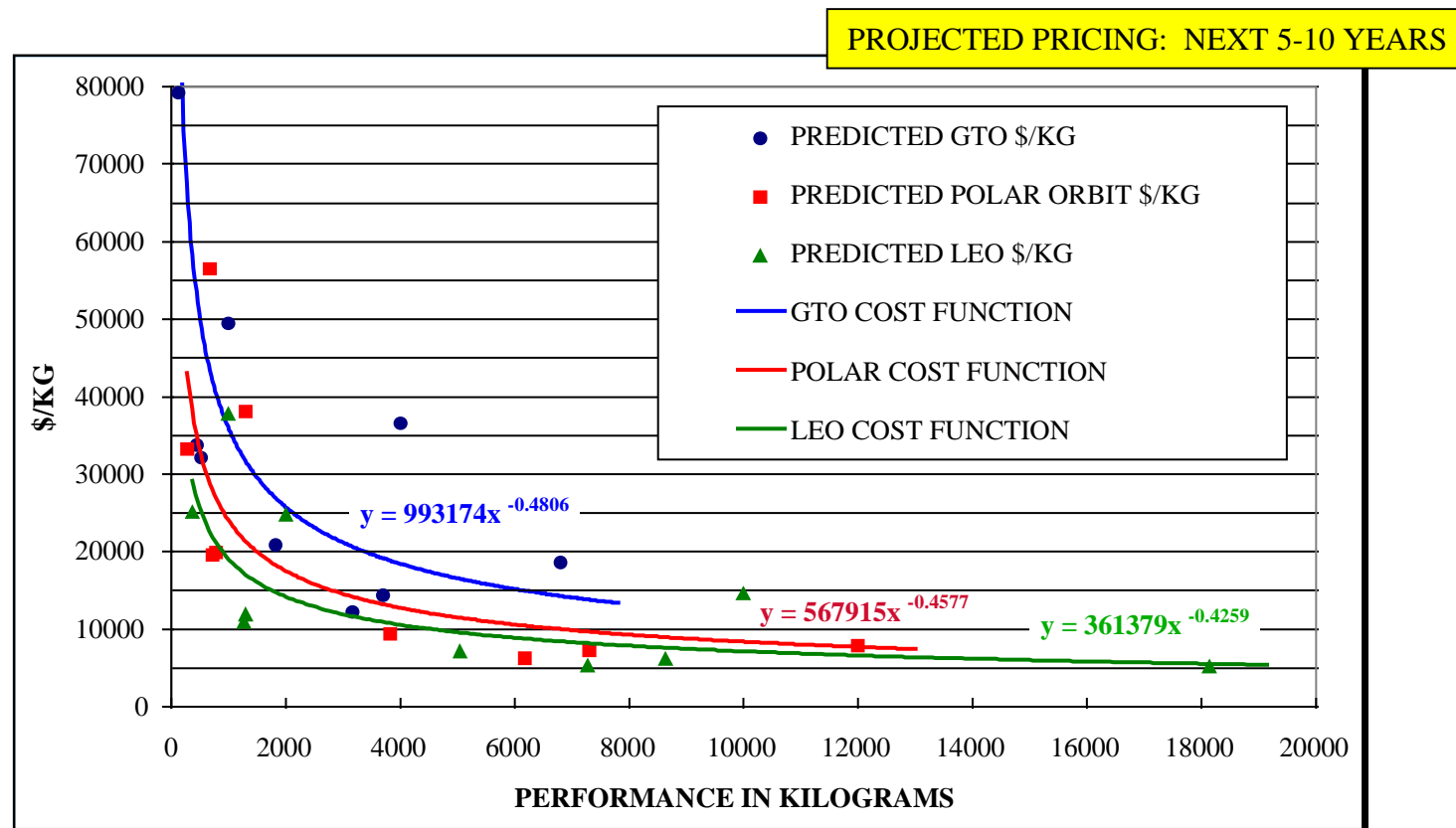


Improved Access to Space is the Most Important Challenge



Can Business as Usual Meet Our Needs?

- Government sponsored launch programs will yield only marginal improvements in access (10-25%)
- The problem: Lacking the necessary consensus for expensive 'clean sheet' development programs, governments are focusing on improvements to existing vehicles



New Commercial Alternatives ?

- Several companies have proposed new launch systems that (on paper) would achieve significant reductions in launch cost/price
- Most of these companies are targeting the emerging market for small-medium sized payloads in LEO orbits
- Reusable or Partially-Reusable approaches
 - Kelly Space Lines - Eclipse/Astroliner
 - Kistler Aerospace - K1
 - Pioneer Rocketplane
 - Rotary Rocket - Roton
- Expendable approaches
 - Beal Aerospace - BA1, BA2
 - Microcosm - Scorpius



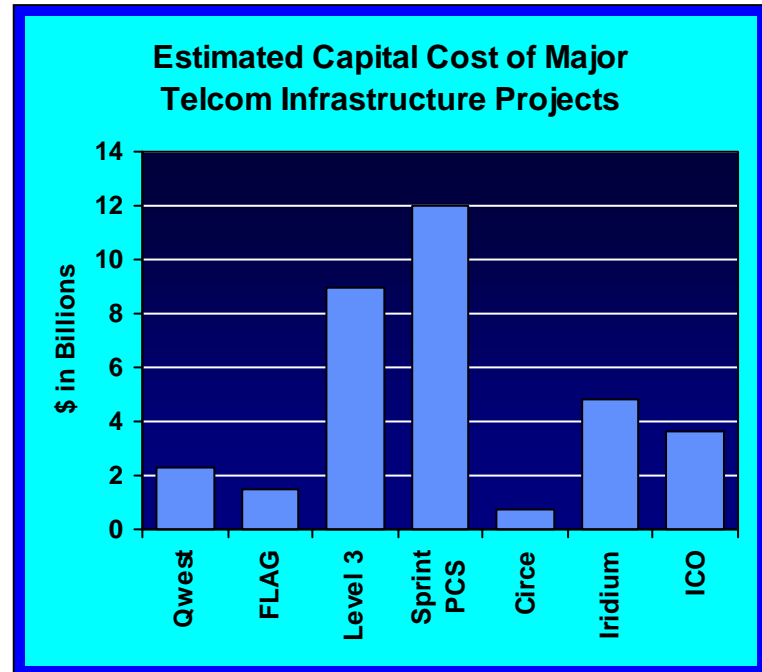
The Iridium Setback

- **Iridium Lessons Learned:**
 - Forward looking market assessment
 - Incremental buildout and testing
 - Sales and distribution
- The financial collapse of Iridium has had mixed impact on the commercial space industry

- Traditional geostationary satellite communications firms such as Panamsat been not been adversely affected

- Ironically, Iridium's failure is hitting the launch industry harder than the satellite industry

- It is important to remember however, that failures are a necessary element of *commercial markets*
 - *In the long run, how the industry responds to this failure is probably a more important indicator of the maturity of the business than how it would have handled success!*



Iridium is not a large project by telecom standards!

The Market Reality

- **The launch market is not profitable enough for established players to build a 'clean sheet' vehicle**
 - **Commercial launch services market of \$2.7-4.2B per year does not generate enough profits for a traditional launch vehicle development effort**
 - **Boeing and Lockheed Martin are investing over \$500M each in EELV, but only with government co-funding and a 'lesser of two evils' decision option**
- **New entrants believe that they can develop their vehicles for considerably less money (avg. \$200-500M), but figures are probably optimistic**
 - **Financial investors have created a Catch-22:**
 - They want the economic model of an innovator with a 'clean sheet'
 - But they also want the experience and backing of a large aerospace player
 - **Bottom line: none of the startups has raised the funding it needs**
- **Satellite operators may have to take a more active role in seeding new vehicles, if they believe cost reductions are important**
 - **Some precedent exists in Hughes' and Loral's stimulation of new entrants/upgrades via bulk purchase commitments**
 - **More direct investments may be necessary for entrepreneurial ventures to succeed**

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Sic Itur ad Astra*

- **We live in interesting times**
 - The traditional government model is reaching its limits
 - The emerging commercial market has great potential, but success is not assured
- **For governments, the shift in ‘roles and missions’ must continue to evolve**
 - Space *agencies* will contract as their missions become more closely circumscribed by public consensus
 - The importance of supportive government policy to stimulate private sector investment in low cost infrastructure should increase
- **For industry, the change is no less profound**
 - A market with expanded risk:reward profiles
 - An absolute requirement to tackle the cost of space access

***“Change is not made without inconvenience,
even from worse to better”***

Richard Hooker, 1554-1600

*Thus shall you go to the stars



Follow-Up

***For Questions of Business Inquiries
Related to this Presentation***

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Space Transportation

Major Trends

- **Substantial improvement and evolution of existing launch systems**
 - 10-25% reductions in price per pound expected in the next five years
 - Enhanced public/private sector partnerships
- **Several new low cost launch systems proposed**
 - Systems aim for 50-80% reductions in price from current standards
 - Entrepreneurs are exploring a variety of approaches
 - Ability to convince financial markets to invest is the most significant obstacle

Ariane



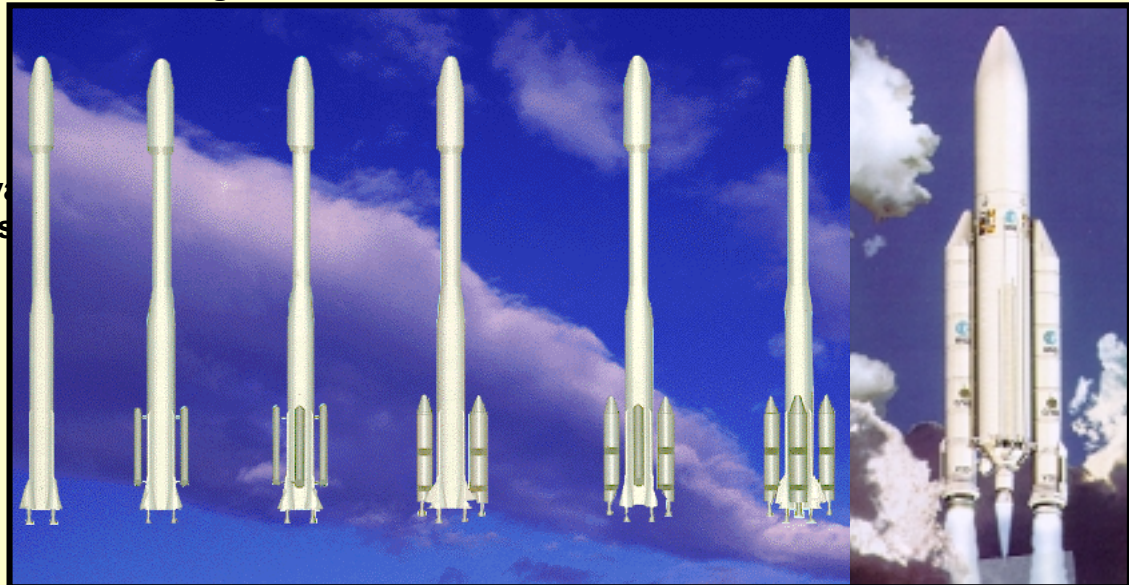
- 10 Ariane 4 vehicles produced in 1997
 Production likely to continue until Ariane 5 is 'mature' and commercially viable
 Optimized for GTO market, not an efficient vehicle for high inclination or LEO orbits

- Ariane 5 represents wholesale departure from Ariane 4
 Current production rate is 6-8 per year;
 Arianespace shareholders are evaluating a 270M FF investment to boost to 10 launches per year

Ariane 5 is awkwardly sized for commercial market

Ariane 5E intended to grow to 'easy' dual manifesting of 4-4.5T satellites

- Like Ariane 4, Ariane 5 is not optimized for high inclination orbits



	AR40	AR42P	AR44P	AR42L	AR44LP	AR44L	AR5	AR5E
Status	-----Operational-----						1999	2003
Price (Average Price)	\$45M	\$65M	\$70M	\$90M	\$100M	\$130M	\$145M*	??
Performance 7.0° /200km (kg)	4900	6100	6900	7000**	7000**	7000**	18140	??
Performance 90.0° /200km (kg)	2700	3400	4100	4500	5000	6000	12000	??
Performance GTO (kg)	2050	2840	3320	3380	4030	4700	6800	7400
Payload Fairing Diameter (M, internal)	3.65	3.65	3.65	3.65	3.65	3.65	4.57M	4.57
Price \$/kg (LEO)	9180	10655	10144	12857	15150	18571	12100	8000***
Production Rate	-----10-12-----						6-10	8-10

*Estimate; **Structurally Limited; ***Target



The Boeing Delta



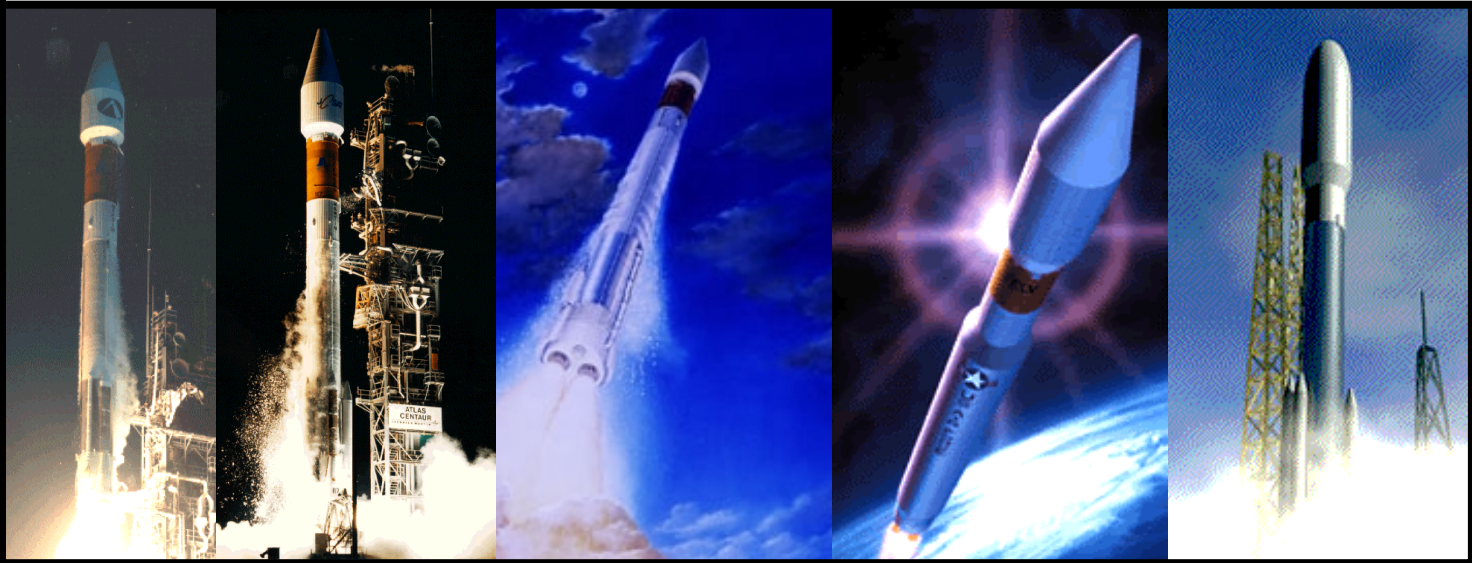
- Delta 2 is a versatile and reliable launcher used for over 30 years
- Delta 3 uses Delta 2 first stage and adds stretched SRMs and a new cryogenic second stage
- Delta 4 uses Delta 2 and Delta 3 second stages, and adds a new booster stage/engine



Status	Operational	First Flight 1998	4M/M+ 2001	4H 2001?
Price (Average Price)	\$50-60M	\$75-85M	??M	??M
Performance 28.5° /160km (kg)	5125	8292	??	??
Performance 90.0° /160km (kg)	3890	6768 (if pad at VAFB is modified)	7300-11400	21400
Performance GTO (kg)	1840	3810	4061-6337	10843
Payload Fairing Diameter (M, internal)	2.74	3.75	4.2-5.4	5.4
Price \$/kg (LEO)	~9750	~9000	~7-8000e	~7000e
Production Rate	16	6	-----25-50?-----	

The Lockheed Martin Atlas

- Atlas 3/5 incorporates the Energomash/P&W RD-180 engine (replaces Rocketdyne MA-5)
- EELV 'blends' the Atlas 3 booster engine with a Titan-derived 4M core stage
- Storable and cryogenic upper stages available for Atlas 5



	Atlas 2A	Atlas 2AS	Atlas 3A	Atlas 3B	Atlas 5-400	Atlas 5-500	Atlas 5-505
Status	Operational	Operational	1Q00	1Q01	2001	2003	2004
Price (Average Price)	\$80-90M	\$95-105M	\$80-90M	\$90-100	??	??	??
Performance 28.5° /185km (kg)	7316	8618	8641	10718	12500	10300	20050
Performance 90.0° /185km (kg)	6192	7212	7121	9180	10750	9050	17000
Performance GTO	3066	3719	4037	4477	5000	4100	8200
Payload Fairing (internal, meters)	2.92-3.65	2.92-3.65	3.65	3.65	4.2	5.4	5.4
Price \$/kg (LEO)	\$11618	\$11600	\$9863	\$8863	\$8000e	\$9500e	\$6000*
Production Rate	----- 8-12-----		----- 10-12-----		-----25-50?-----		

*Target

Kelly Aerospace/ Eclipse Space Lines

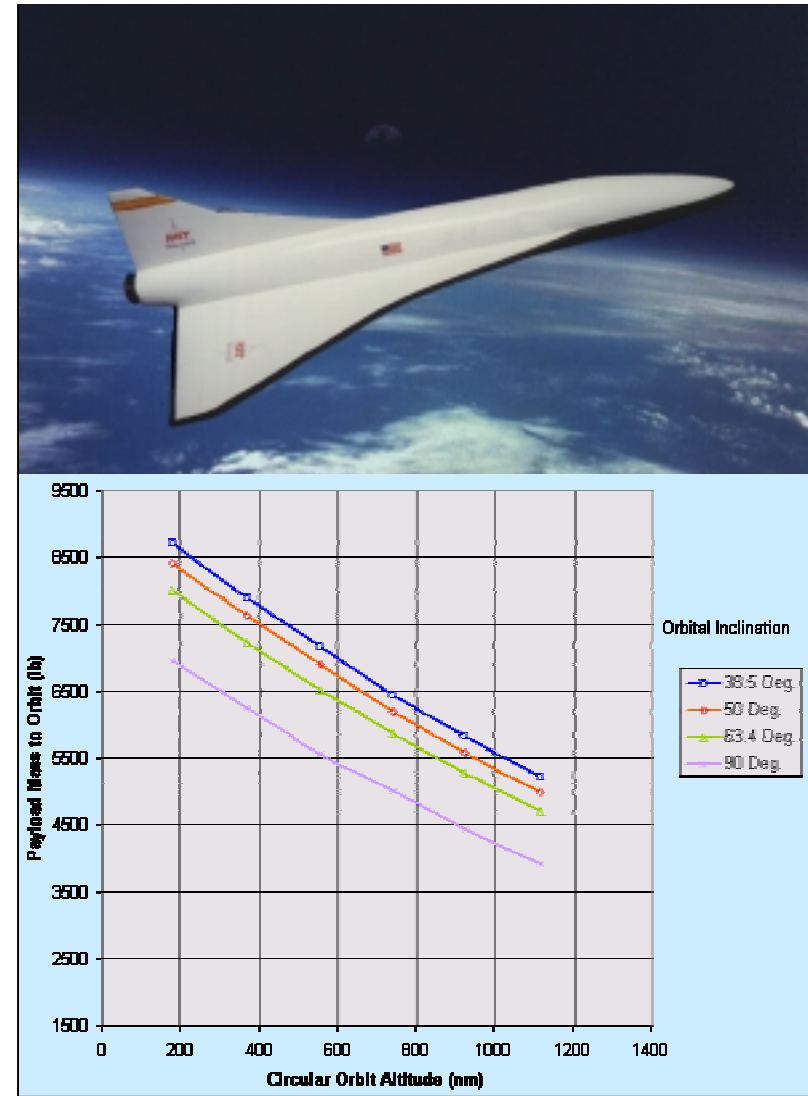


- Kelly Aerospace has proposed the 'Astroliner'
 - Reusable, air-towed first stage which deploys an expendable insertion stage
 - Projected Performance: 3175-4500 kg
 - Projected Launch rate: TBD
 - Projected price (LEO): \$4400/kg

- Current status:
 - Tow tests using an F-104 have proven the feasibility of tow-takeoff

- Technical risks
 - Propulsion systems not selected
 - Reusability of low cost hypersonics
 - Winged vehicles very sensitive to weight growth

- Business risks
 - Startup company
 - Small fleet of vehicles



- Kistler Aerospace proposes to develop a family of lower cost, two stage reusable vehicles

- The most advanced of the entrepreneurs
- K-1 in development, larger K-2 and K-3 vehicles planned
- Contractors
 - Aerojet - NK-33/34 engines
 - Northrop Grumman - structure
 - Allied Signal - avionics
 - Lockheed Martin Michoud - LOX tank, final integration
 - Irvin Aerospace - parachutes/airbags

- Current status of K-1

- Schedule
 - Hydrostatic fuel tank tests completed
 - First test flight (suborbital) planned for 1998
 - Commercial IOC in 1999
- Financing
 - Approximately \$200-250 million secured thus far
 - High yield financing in process
- Good management team

- Technical risks

- Reusability
- Limited number of vehicles



- K-1 performance

- 2700-4700 kg to LEO
- Price (\$/kg) to LEO: 2500-3500
- Official launch rate
 - 6 flights in 1999
 - 20 per year beginning 2000
- Ability to achieve cost/price targets given technology and contractor base is an issue to watch

Beal Aerospace

- Beal is developing a family of low-cost expendable launchers
 - Big Dumb Booster
 - BA-1: 7,400-9,700 kg to LEO; BA-2: 5 tons to GTO
 - Target price (LEO): “less than 50% of projected EELV pricing” (\$1500-2000/kg)
- BA-1 uses large, low cost, pressure-fed engines using hydrogen peroxide as oxidizer
 - Extra design margin in lieu of expensive manufacturing or materials
 - 1.4M lb. thrust first stage
 - 440k lb. thrust second stage
 - 44k lb. thrust third stage
- Current status
 - \$250 million of personal funds reportedly committed by Andy Beal
 - IOC: BA-1 early 2000; BA-2 early 2003
 - Engine testing schedule
 - 5k test engine will begin shortly
 - Testing of flight engines will follow, from the top of the stack down
 - Manufacturing facilities under construction
 - Launch site location negotiated (Caribbean)
 - Dummy payload flight tests planned in late 1999



- Technical Risks
 - Scale-up of pressure-fed engines
 - Payload fraction
 - Plan for in-house manufacturing
- Management Risks
 - Technical staffing ramp-up
 - Relatively untested management

Microcosm

- Microcosm proposes to develop a family of low-cost expendable launchers designated 'Scorpius'
 - Liberty: 1000 kg to LEO (IOC 2000)
 - Antares: 2950 kg to LEO (IOC 2001)
 - Exodus: 6800 kg to LEO (IOC 2002)
 - Projected price (LEO): \$1400-2000/kg
- Scorpius designs employ low cost, pressure-fed engines
 - Extra design margin in lieu of expensive manufacturing or materials
 - Technology can also be applied to upper stages
- Current status
 - Financial: ~\$25M of DoD R&D funding secured
 - Suborbital flight test (SR-1) in 1998
 - 5k engine has been successfully tested
 - 20k and 40k engines in development/test
 - Brassboard avionics suite is developed
 - Company has initiated search for a Chief Eng.



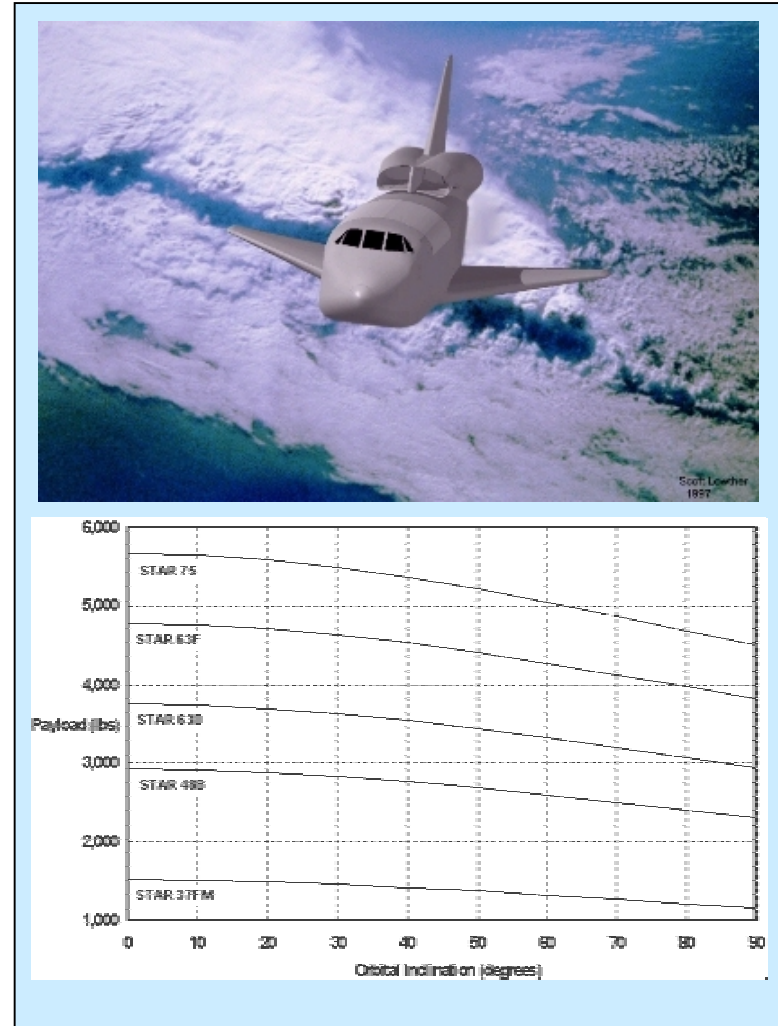
- Technical Risks
 - Scale-up of pressure fed engines to booster engine size
 - Subcontractor team not in place
- Management Risks
 - Relatively untested management

Note: CSP Associates has been retained by Microcosm to assist in business plan development

Pioneer Rocketplane



- Pioneer Rocketplane Corporation proposes to develop the Pathfinder
 - Fully-reusable flight vehicle deploys satellites with expendable insertion stage
 - 2-man crew
 - Jet-powered to 30k feet; LH2 transferred from KC-135
 - RD-120 boosts the vehicle to 400k ft and Mach 12
 - Payload and expendable upper stage are deployed at apogee; vehicle then returns to Earth
 - Projected performance: 1000-2500 kg
 - Projected price (LEO): \$1800/kg
- Current Status
 - Design studies proceeding
 - Building strong management team
 - Lawrence Hecker, Merrill McPeak, Dan Raymer
 - Several million dollars of financing secured
- Technical risks
 - Reusability
 - In-air LH2 fueling
 - Scalability
 - Small number of flight vehicles



Rotary Rocket



- Reusable rocket vehicle which uses a rotary blade to return the vehicle to earth
 - Rotary aerospike engine
 - Performance to LEO: 3150 kg
 - Price to LEO (\$/kg): 2200+
 - Company advertising 7 day lead time (with a fleet of vehicles)
- Current status
 - \$17M in venture financing raised; supporting design studies
 - Barclays retained for a \$30M private placement for full scale ground test vehicle
 - Nominal IOC is early 2000, building high-bay facility at Mojave Airport
- Technical risks
 - Rotary concept never tested in a re-entry environment
 - New engine (rotary aerospike)
 - Graphite composite fatigue in space environment



- Management team is derived from (defunct) American Rocket Company

Summary Data

Key Data Venture (Vehicle)	Flight Test Date	Comm'l Ops Date	Payload (kg) @ LEO (100 nm)	Projected Price (\$/kg)	Launch Contracts	Dev. Cost & % Raised	Key Subs	Key Mgt.
Kistler Aerospace (K-1)	Late 1998	Early 1999	2,700-4,700 (Polar-Eq)	\$2,500-3,500	Space Systems/ Loral: \$100m	\$750M (5 vehicles) >30% Raised	<ul style="list-style-type: none"> Aerojet Lock-Mart Northrop Grumman 	Chair: Robert Wang CEO: George Mueller
Beal Aerospace (BA-1)	Late 1999	Early 2000	7,400-9,700 (Polar-Eq)	\$1,500-2,000	None	\$250-300M 100% Raised?	In-House	Pres & CEO: Andrew Beal VP Bus Dev: David Baker
Microcosm <ul style="list-style-type: none"> Liberty Antares Exodus 	<ul style="list-style-type: none"> Early 2000 Mid 2001 Mid 2002 	Mid 2000	<ul style="list-style-type: none"> 1000 2900 6800 	<ul style="list-style-type: none"> \$2000 \$1700 \$1400 	None	\$275M 10% Raised	<ul style="list-style-type: none"> TRW? 	Pres: Jim Wertz Chief Eng: Bob Conger
Kelly Space & Technology (Eclipse Astroliner)	Mid 1998	Mid 2001	4,500 (Polar)	\$4,500+	Motorola: \$89m	\$450M (3 vehicles) <5% ?	<ul style="list-style-type: none"> TRW Oceanering Space Sys. 	Pres. & CEO: Michael Kelly COO & EVP: Michael Gallo
Rotary Rocket (Roton)	Mid 1999	Mid 2000 (Limited)	3,150	\$2,200+	None	\$? \$17M Raised	<ul style="list-style-type: none"> Scaled Composites Advanced Rotarcraft Techs. Aerotherm 	Pres. & CEO: Gary Hudson CTO: Bevin McKinney
Pioneer Rocketplane (Pathfinder)	Mid 2000	Late 2000	1000-2,500 (Polar-Eq)	\$2,400-3,400	None	\$275M (1 vehicle) \$3.5M Raised	<ul style="list-style-type: none"> Thiokol 	Pres & CEO: Lawrence Hecker Chairman: Gen. Merrill McPeak



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* Satellite Market Backup



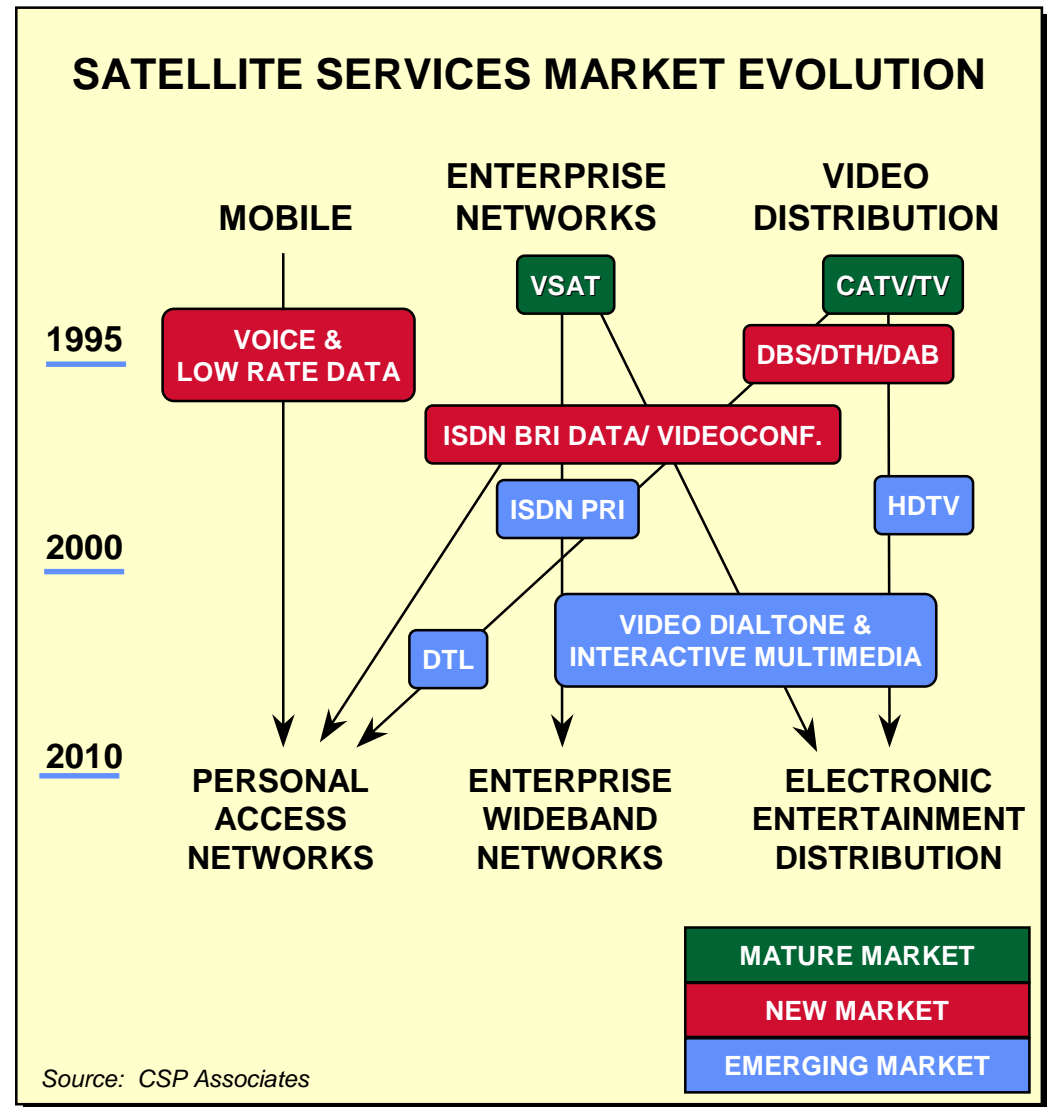
Satellite Communications

Major Trends

- **Larger, more capable satellites**
 - Higher power
 - On-board switching/signal processing
 - Advanced antennas
- **Improvements in ground system economics**
 - Cheaper, personal communications equipment
- **New applications focusing on business and consumer users, rather than as backbone for telecommunications carriers**

Satellite Services Evolution

- Tomorrow's applications evolve from today's
 - Technology enables customers to migrate to improved levels of performance and functionality
- Service types
 - Networks (the system is the product)
 - Distribution (the content is the product)
 - Hybrid (value-added network)
- Customer bases
 - Telecom services companies (transmission extension/overlay)
 - Large enterprises (bypass or high performance internal networks)
 - Mass market services



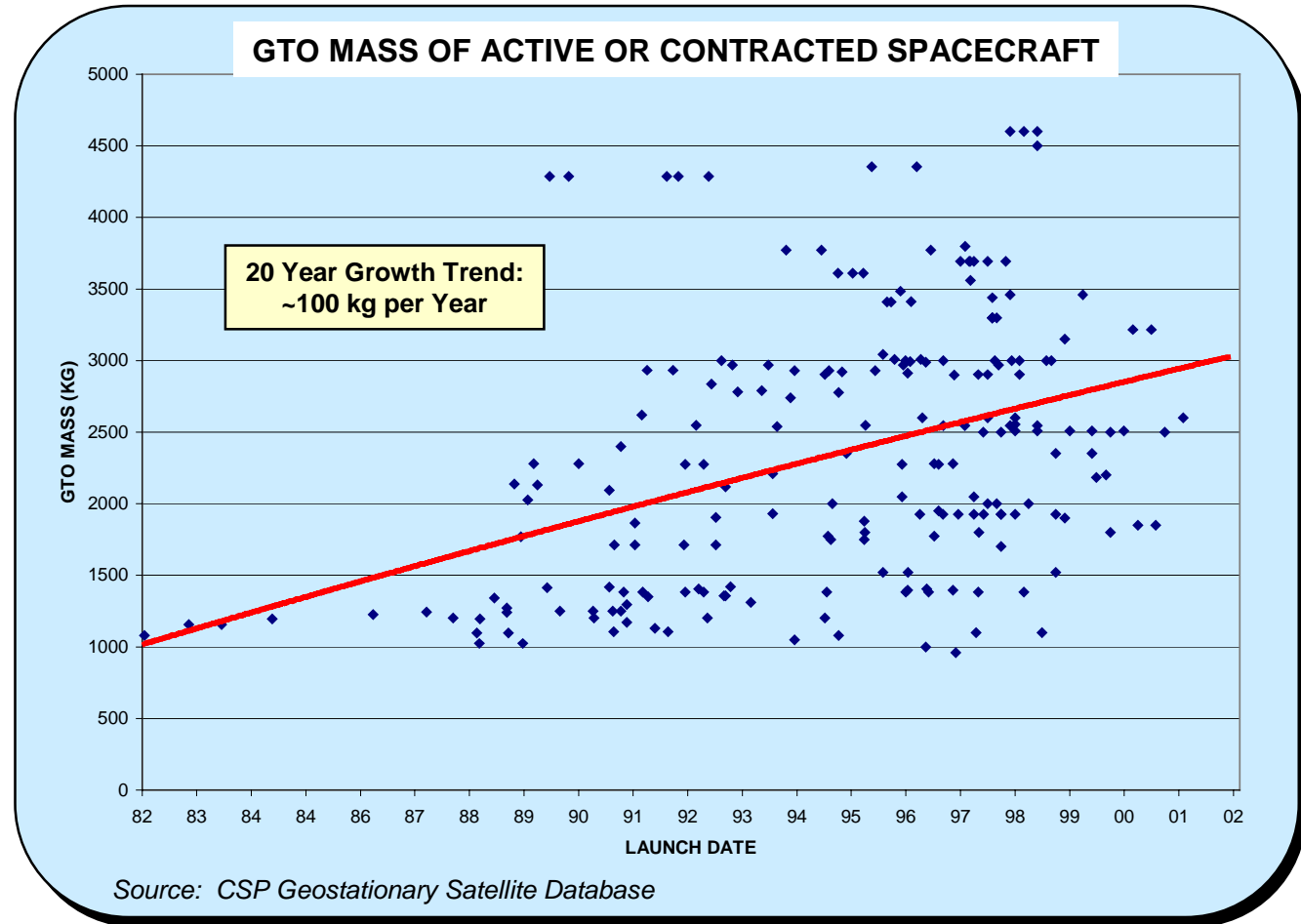
ComSat Trends Yield Increasing Value

- **Current drivers**

- Higher power
- Frequency reuse
- Higher frequencies
- Multi-frequency
- Digital signals
- Larger antennae
- 12-15 yr. lifetime
- Launch capacity

- **Emerging Drivers**

- ISL
- Onboard switching
- Active arrays



**Market needs are being met with more complex, larger spacecraft
(Capacity/revenues grow faster than the number of satellites on orbit)**



Declining Cost of Capacity

- **New generation of satellites continue to yield economies of scale**
 - Higher power
 - More transponders
 - Longer life
 - Lower operating costs

- **Cost per transponder year for new large C/Ku satellites is as much as 50% lower than previous generation**
 - Increased power per transponder also yields increase in footprint, throughput, or ability to operate with smaller aperture CPE

Satellite Class	Technology	Representative Bus	Design Life (Yrs)	Deployed Cost	Average TR Cost/Yr (\$M)		
					C	KU	BSS
Small	1980-1990	HS-376	8-10	\$95M	0.4	1.2	1.9
Medium	1985-1995	HS-601	10-12	\$175M	0.2*	0.4*	0.9
Intermediate	1990-2000	HS-601HP	12-15	\$235M	0.2*	0.3*	0.5
Large	2000-	HS-702	15+	\$260M	0.1*	0.3*	0.3

Note: 'Deployed Cost'=Spacecraft+Launch+Insurance; does not include financing, pre-operating or operating costs

**Calculation based on hybrid C/Ku band payload*

Market Concerns

- **Satellite services are a 'niche' in dynamic equilibrium with terrestrial media**
 - Satellites used where terrestrial technology is inadequate or uneconomical
 - Target market demographics are constantly shifting
- **Many of the new services proposed for satellites are embryonic**
 - Wideband/broadband applications such as Electronic Product Distribution
- **Satellite-to-terrestrial interconnections**
 - Some ITU standards do not work well in a satellite environment (esp. high-speed protocols such as SDH and ATM)
- **Cyclical supply side**
 - Capacity increases have usually been non-linear, with boom-bust cycles for operators
 - Survivors must have deep pockets and differentiable product

***Satellite ventures are not homogeneous
Each addresses unique market, technology and financing issues***



Market Overview

Current Status of The Comsat Market

- **Four primary applications**
 - Traditional fixed satellite service (C/Ku Band)
 - Direct to Home (Ku-BSS Band)
 - Regional Mobile (L/S Band)
 - Broadband Networks (Ku/Ka Band)

- **The market is also regionally segmented**
 - North America
 - Latin America
 - Europe/Middle East
 - Africa
 - Asia
 - Intercontinental

- **Market maturity varies by application and region**
 - North America and Europe are the most mature

	FSS	DTH	MOBILE	BROAD-BAND
NORTH AMERICA	Blue	Blue	Green	Yellow
LATIN AMERICA	Green	Green	Yellow	Yellow
EUROPE/ MIDEAST	Blue	Blue	Yellow	Yellow
AFRICA	Yellow	Yellow	Yellow	Grey
ASIA	Green	Green	Green	Yellow
INTER-CONTINENTAL	Blue	Grey	Green	Yellow

Mature Market:	Steady Growth and Number of Players, Dominated by Replacements
Growth Market:	Rapid Growth, Many New Entrants, Dominated by New Capacity
Emerging Market:	Initial Deployments, Pathfinders, Dominated by New Capacity
Future Market:	No Meaningful Provision of Service at this Time

C/Ku Trends: Asia

- Asian market will have highest growth rates, but access tightly regulated in dominant countries:

- Video broadcast
- Voice trunking
- Network services

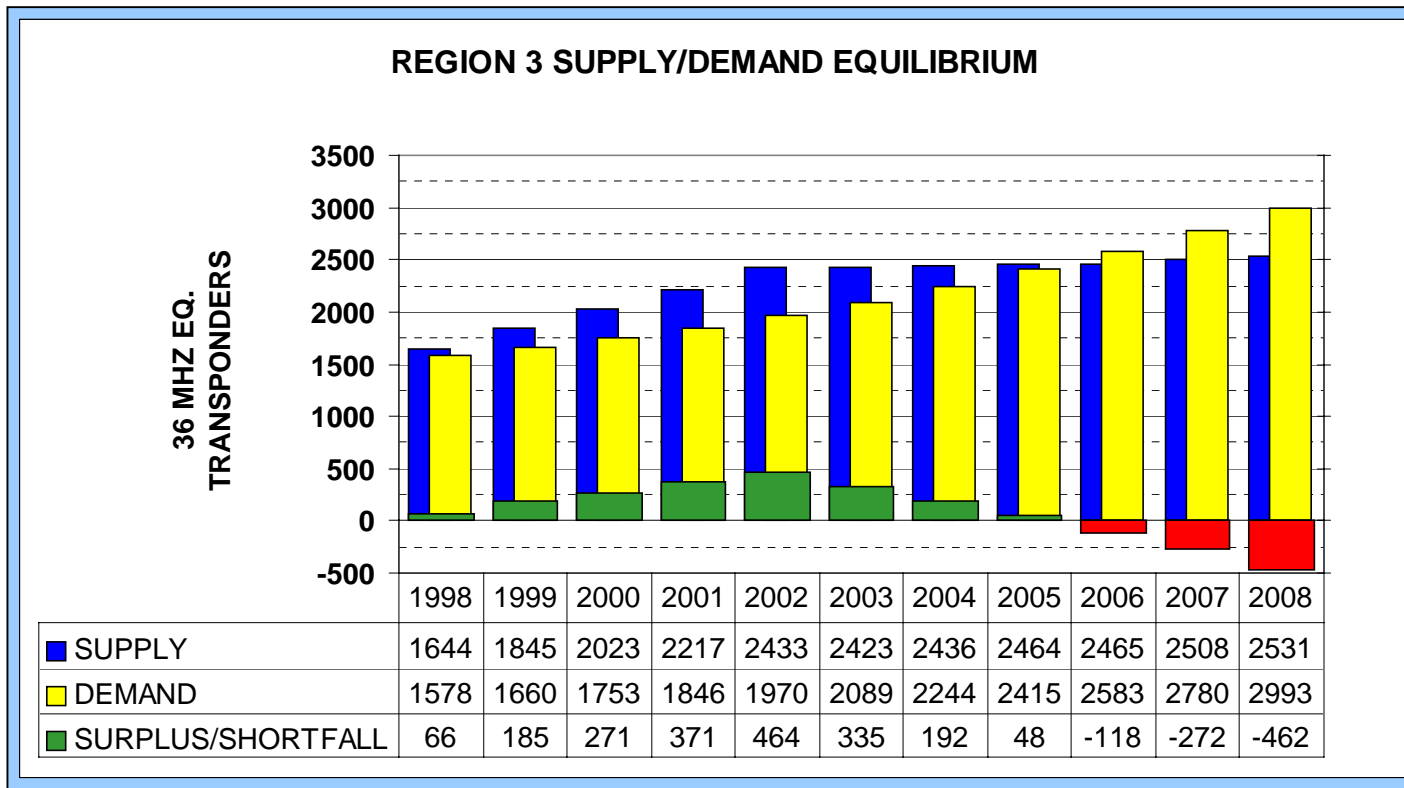
THE PLAYERS
 THE 'GANG OF FIVE'
 (CHINA)
 INTELSAT
 JSAT PT SATELINDO

THE REST OF THE PACK
 KOREASAT
 SHIN SATELLITE
 OPTUS
 ORION
 THAICOM
 MEASAT
 PANAMSAT
 INSAT

Segment	Trends	Anticipated Growth Rates	
		1999-2003	2004-2008
Broadcast	No dominant video platforms yet (Asiasat?) Lack of indigenous language programming Regulatory overlap ('CNN everywhere')	4-5%	5-7%
Networking	Strong demand for Internet access, but regulatory barriers likely to focus/restrict operators in China, India, S.E. Asia	3-5%	7-10%
Trunking	Strong short-medium term demand for international gateway links; demand shifts med-long term to domestic 'last mile'	8-10%	8-10%

Region 3 C/Ku Forecast

- The Asian market will have excess capacity through 2005
 - Peaking in 2002 at 464 TRs, or 19% of total capacity
- Impact of overage will be unevenly distributed
 - Companies shut out of China, India, Indonesia will be most vulnerable
- Shortfall at the end of the decade is within the embedded 20% reserve, suggesting that modest additions to capacity will be required



C-Ku Trends: North America

- North American C-Ku market is the most difficult to predict, due to potential swing in broadcast
 - DTV threatens C-Band cablesat
 - HDTV will grow Ku/DTH req.
- Networking and trunking unlikely to offer growth
 - Ka-band likely to absorb growth in broadband

THE PLAYERS
 PANAMSAT
 LORAL
 AMERICOM

THE REST OF THE PACK
 TELESAT
 INTELSAT

Segment	Trends	Anticipated Growth Rates	
		1999-2003	2004-2008
Broadcast	Mature segment, secular shift due to impending shift to digital terrestrial and cable; Data broadcast at Ku?	2-3%	0-2%
Networking	Current networking capacity is inefficiently utilized; user population grows 3-4x as quickly as bandwidth requirement	1-2%	3-5%
Trunking	Continued erosion; backup role now dissipating as terrestrial trunks grow beyond satellite capacity and are internally redundant	0%	0 - -5%

C/Ku Trends: Latin America

- Strong Latin American markets resulting from pro-competition policies and pent-up demand:

- Video broadcast
- Voice trunking
- Network services

THE PLAYERS
 PANAMSAT
 BRASILSAT
 SATMEX/ORION

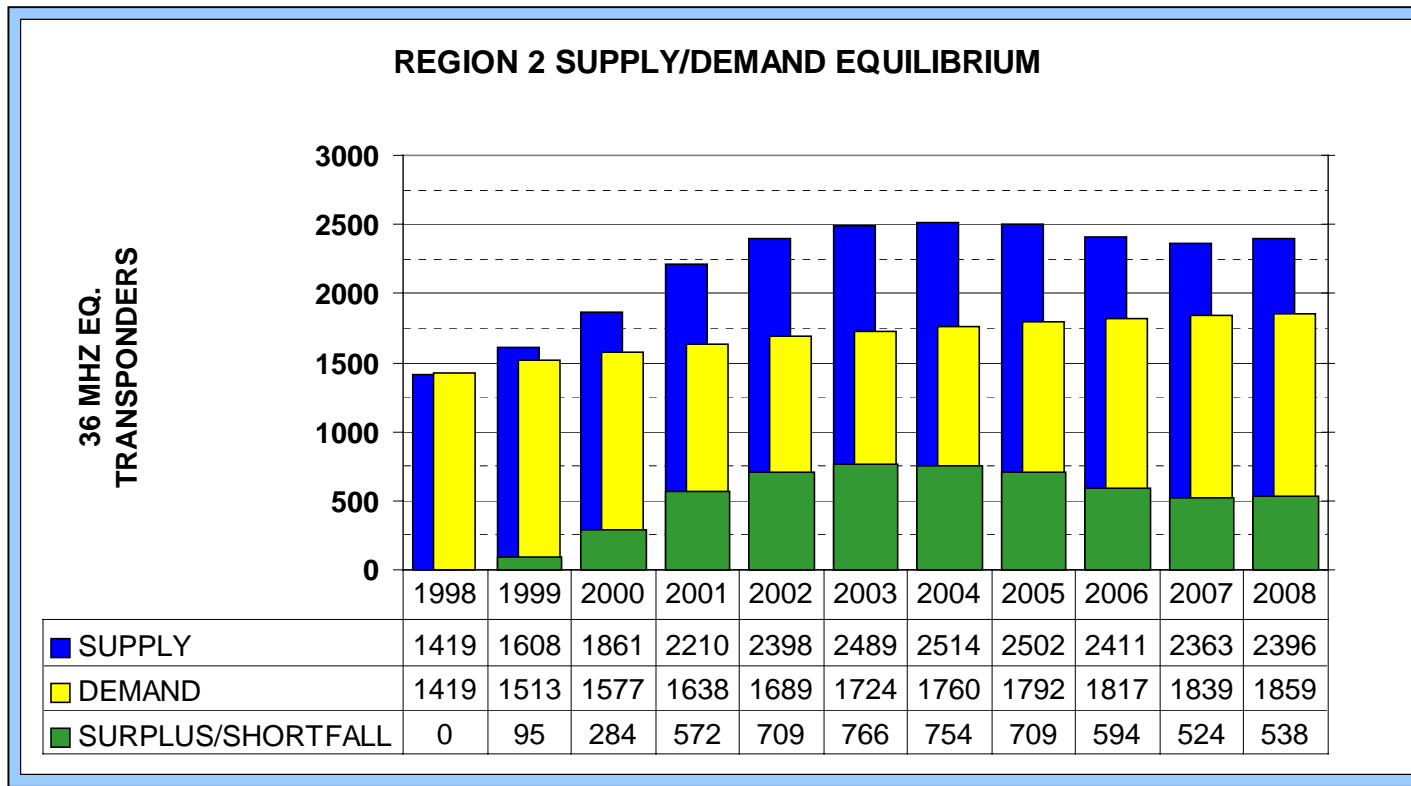
THE REST OF THE PACK
 AMERICOM/NAHUEL TELESAT
 ANDESAT INTELSAT
 HISPASAT

Segment	Trends	Anticipated Growth Rates	
		1999-2003	2004-
2008			
Broadcast	Two DTH players, <i>maybe</i> three European distribution model likely to emerge (all Ku digital); Internet broadcast growing	4-5%	5-7%
Networking	Strong demand for business lines currently, but extensive fiber deployments underway in most urban areas (business sites)	7-10%	2-4%
Trunking	Currently strong growth for Internet	10-15%	0-5%

trunking, but segment is vulnerable to fiber deployments serving businesses/ISPs

Region 2 C/Ku Forecast

- Region 2's supply growth far outstrips forecast demand
 - Imbalance peaks in 2003 with 766 excess TRs - ~30% of total capacity
- Portends a major 'buyer's market' and weeding out of competitors who have not established defensible neighborhoods
 - A replay of the U.S. market of the 1980s?



C/Ku Trends: Europe

- European satellite demand has three major elements (in order of importance):

- Video broadcast
- Data networking
- Internet trunking

<p>THE PLAYERS</p> <p>EUTELSAT</p> <p>ASTRA</p>

<p>THE REST OF THE PACK</p> <p>SIRIUS</p> <p>HISPASAT</p> <p>ORION</p> <p>SPACECOM</p>	<p>LMI</p> <p>INTELSAT</p> <p>TURKSAT</p> <p>MOST</p>
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Segment	Trends	Anticipated Growth Rates	
		1999-2003	2004-2008
Broadcast	<p>Maturing segment</p> <p>Duopoly with marginal players</p> <p>Analog services disappearing</p>	2-4%	2-4%
Networking	<p>Expanding, European networks</p> <p>Regulatory/tariffing barriers disappearing</p> <p>'Bundled' internet with DTH</p>	6-8%	8-10%
Trunking	<p>Expanding traffic based on lack of terrestrial infrastructure; short term phenomenon?</p>	10-20%	0 - -5%

C/Ku Trends: Africa/Middle East

- Middle East demand centered on video distribution; Africa still relies on satellites for long distance trunking and other basic comm. services:
 - Video broadcast
 - Voice trunking
 - Network services

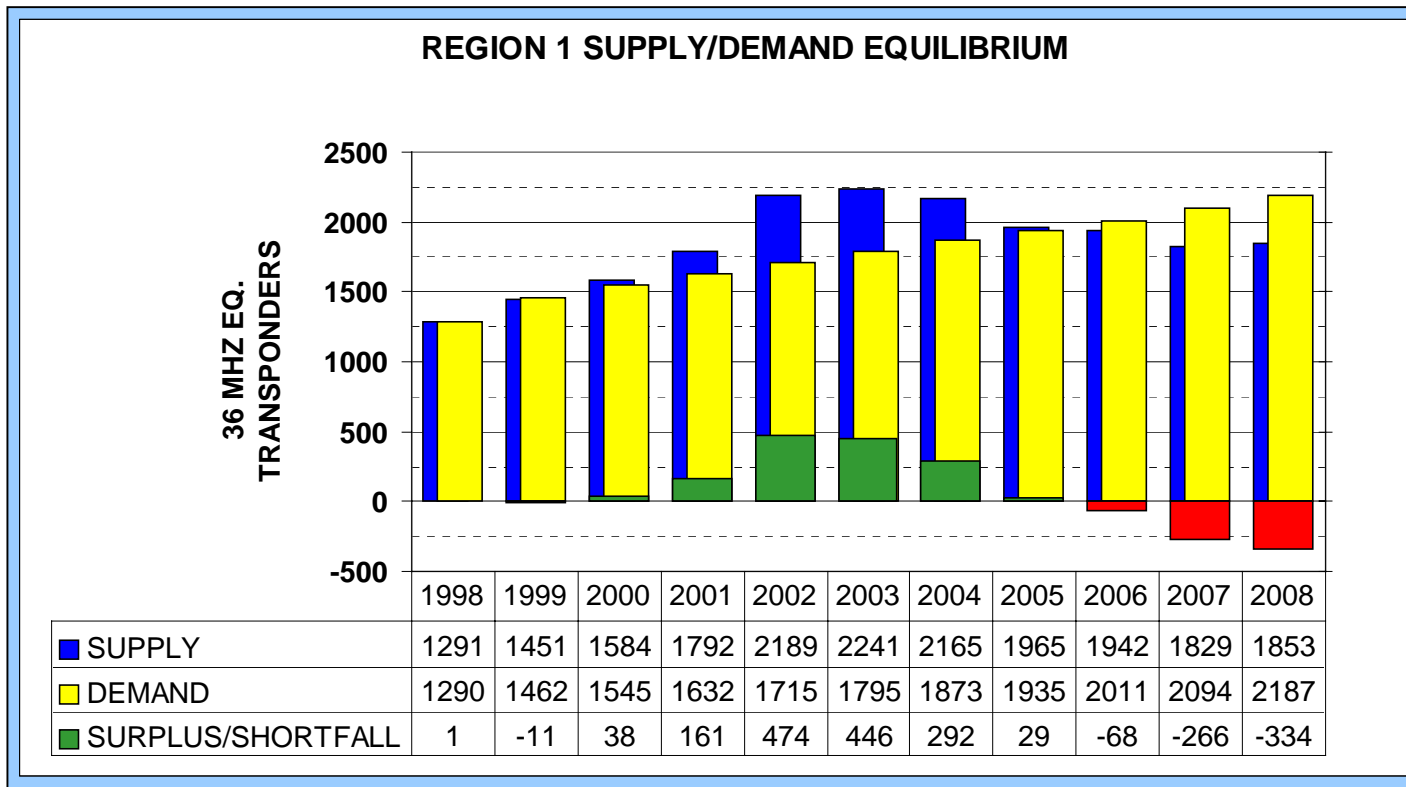
THE PLAYERS
ARABSAT
INTELSAT

THE REST OF THE PACK
NILESAT HISPASAT
INTELSAT PANAMSAT
TURKSAT EUTELSAT

Segment	Trends	Anticipated Growth Rates	
		1999-2003	2004-2008
Broadcast	Maturing segment (Arabsat/Nilesat) African 'proto-DBS' via Intelsat	2-4%	3-5%
Networking	Modest requirements; demographics and population concentrations favor terrestrial solutions	4-5%	4-5%
Trunking	Building need for domestic long distance and Internet trunking, but on small population base; submarine fiber rings the continent	8-10%	12-15%

Region 1 C/Ku Forecast

- Region 1 supply/demand is stable through 2001
- Deployment of new capacity leads to 2-3 year glut in the 2002-2003 period
- Shortfall emerges ~2005; however shortfall is still within the model's built-in 20% reserve, suggesting that modest additions to capacity will be sufficient (i.e. maintain 2002-2004 capacity levels)



Summary C/Ku Demand

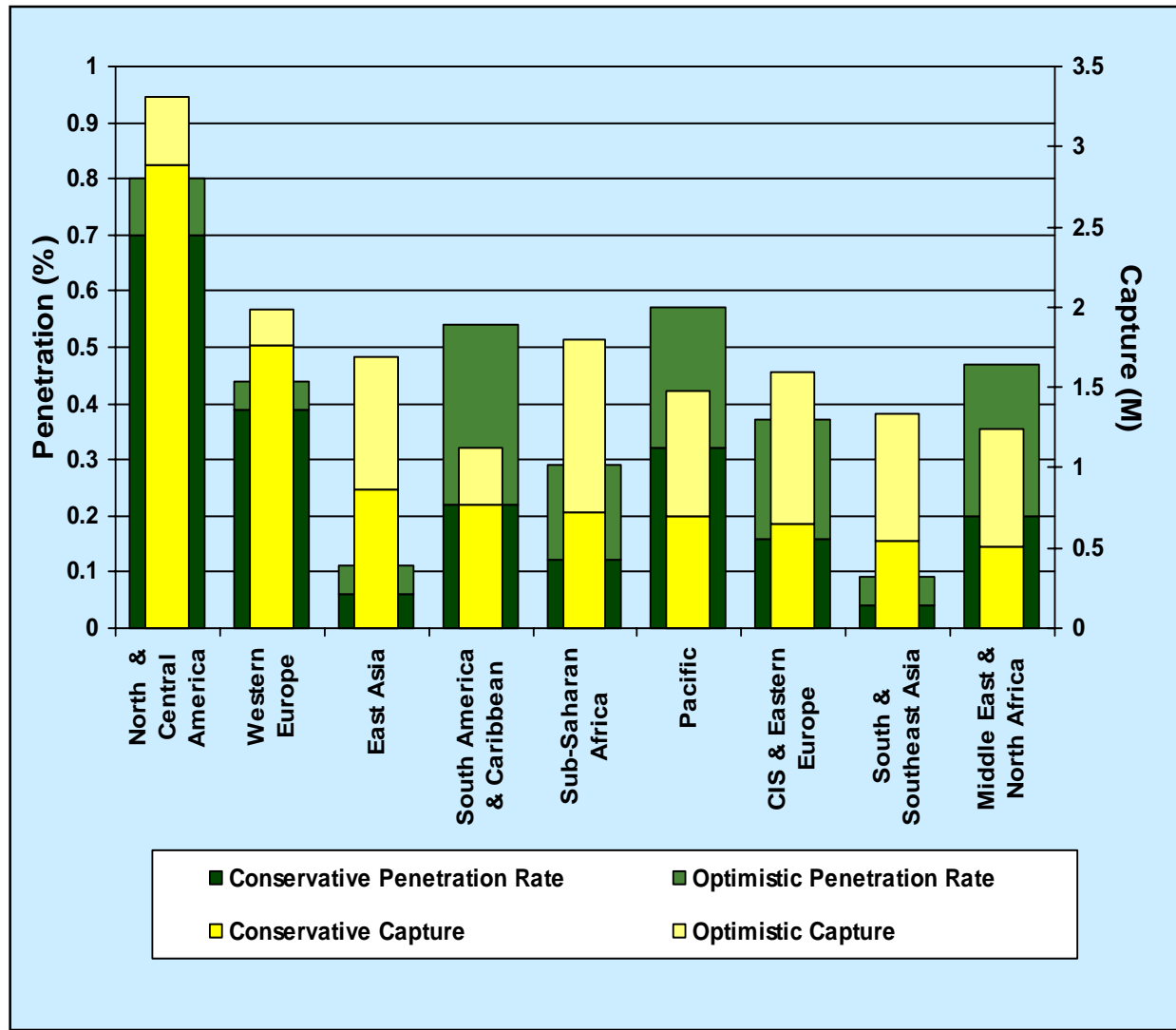
Region	1998TR (36MHz)	2008TR (36MHz)	CUM. %	CAGR %
North America	1088	1276	17	1.6
Latin America	331	586	76	5.9
Europe	1139	1880	65	5.1
Middle East/Africa	151	305	102	7.3
Asia	1578	2993	90	6.6
TOTAL	4287	7040	64	5.1

- North American ‘stasis’ is the most controversial element of the analysis
 - Rationale hinges on the outcome of two major issues: DTV conversion in terrestrial and CATV systems, and introduction of HDTV



New Markets: Satellite Mobile

- **Two demographics**
 - 'Global roamers', 'elites', and 'outposts' (high income, high usage per capita)
 - Rural/developing region (low income, low usage per capita)
- **Two services**
 - Full duplex voice and/or data
 - Alphanumeric messaging
- **Issues**
 - Market size and pricing sensitivity are largely untested
 - Local access/tariffs not clearly defined
 - Technology risks in both LEO and GEO approaches



New Markets: Broadband

- **New technology (Ka/V-band + spot beam + on-board switching + intersatellite links) being combined for customized wideband network applications**
- **Multiple demographics**
 - Enterprise network integration (LAN-to-LAN, CIM, etc.)
 - Electronic product distribution (retail and/or direct to consumer)
 - High speed internet access
- **Multimedia emphasis**
 - Digital pipelines capable of multiplexing multiple data streams including full motion video
- **Issues**
 - Terrestrial analogs do not exist (satellites leading rather than following terrestrial infrastructure in this domain)
 - Latency issues affect quality of service and terrestrial interoperability

Ka-Band and V-Band Proposals

Geostationary Systems

AstroLink

Cyberstar/Orion/Cyberpath

Echostar

GE*Star

Ka-Star

Millenium

Morningstar

Netsat 28

Spaceways/Panamsat/Spacecast/V-Stream

VisionStar

LEO/MEO Systems

Globalstar GS

Orblink

Skybridge

Teledesic

Wireless Broadband Services

Satellites offer ubiquitous coverage from a single location

Terrestrial systems offer superior traffic/density characteristics



Application

Frequency Band

Footprint/Range

Data Rate

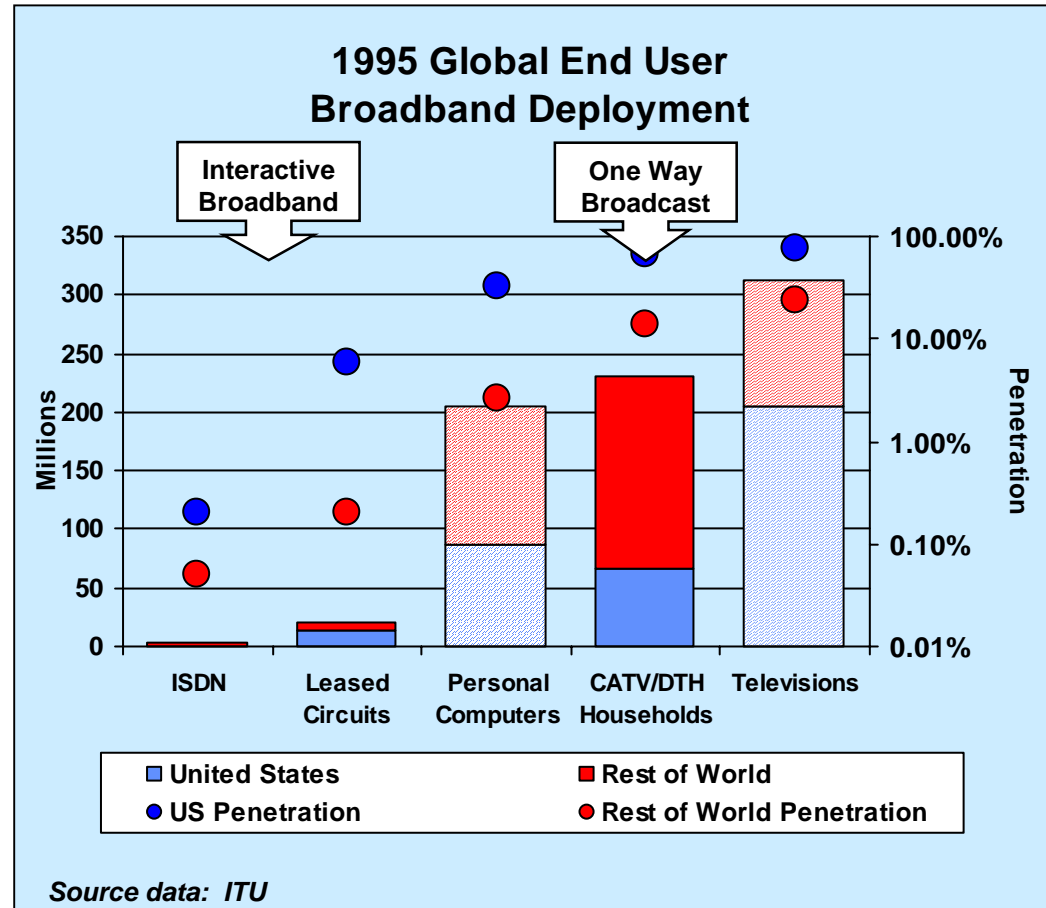
Services

• ISM	2.4, 5.7 GHz	5-25 miles	1.5-2.0 Mbps	WLAN, PCS Backbone
• C-Band Satellite	6/4 GHz	5000-7000 miles	51 Mbps	Video Distribution
• Ku-Band/VSAT	14/12 GHz	5000-7000 miles	9.6-64 kbps	Video, Corporate VSAT
• DBS Satellite	18/14 GHz, 12/11 GHz	5000-7000 miles	6-8 Mbps	Video Distribution
• Fixed Radio	18, 23 GHz	<10 miles	1.5-155 Mbps	Local LAN-LAN; Video
• DEMS	24.25/25.05 GHz	<25 miles	64 kbps-155 Mbps	Voice to T-1 Data
• Ka-Band Satellite	28.35, 29.25/18.8 Global w/ISL	5000-7000 miles	64k bps-155 Mbps	Enterprise Data
• LMDS	27.5, 29.1, 31.0 GHz	3-5 miles	64 kbps-155 Mbps	Consumer Internet
• Fixed Radio	37-39.5 GHz	1-2 miles	51-155 Mbps	Consumer Internet

Where is Broadband Today?

- The current market is a poor indicator of broadband potential
- Excluding television broadcast, broadband infrastructure is currently very limited and very expensive
- Telecommunications services are extremely elastic - declines in price generate significant increases in volume

Typical US Broadband Prices	
Local ISDN	\$80-300/month
Local T-1	\$800-1200/month
National T-1	\$6000-15000/month
Transatlantic ATM 10MBps	\$100000/month



Costs/accessibility have limited penetration of two-way broadband technologies to well under one percent, even in the U.S.

Where is Satellite Broadband Today?

- **Current satellite networks are not well-designed for broadband applications**
 - Limited bandwidth
 - Large area footprints limit constrain effective capacity
- **Existing Ku-Band satellites do have a 'niche' providing long-distance Internet backbone (especially international)**
 - Situation is analogous to the role of satellites for intercontinental telephony during the 1970s and 1980s
- **Existing Ku-Band assets also offer a limited 'proving ground' for services that will be prevalent in Ka-Band**
- **Ka-Band capacity is now entering development**
 - GEO Ku/Ka hybrid satellites in development for Europe and North America, with deployments beginning in late 1998
 - GEO Ka-Band satellites now in design and development phase, with deployments beginning ~2000
 - LEO Ka-Band satellites in design phase, with deployments planned for ~2002

Full-scale deployment of satellite capacity optimized for broadband service is still two to three years away

Consumer Broadband Outlook

- **Consumer broadband requirements have two drivers**
 - Entertainment ('traditional' broadcast application)
 - Home computing (Internet access)
- **Consumer markets are delineated by cost**
 - Strong consumer response to newer options - cable modem and XDSL - when priced similar to existing telephone/cable services \$40-75/month
 - Lower rate and higher price services (e.g. ISDN at \$50-75 per month) have been a failure
- **Satellite role in interactive broadband will be analogous to that played by DBS in entertainment**
 - Most cost-efficient infrastructure for non-metropolitan areas
 - Bypass alternatives in areas with terrestrial broadband bottlenecks

