



WORKSHOP on  
On-Orbit Servicing of Space Infrastructure Elements  
Via Automation & Robotics Technologies

1-2 October 2004  
Vancouver - Canada

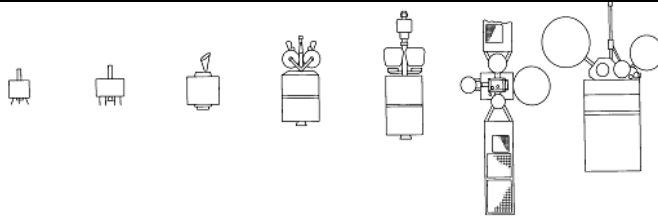


## SKYKIT NEW APPROACH TO IMPROVE COMMUNICATION SATELLITE PERFORMANCE

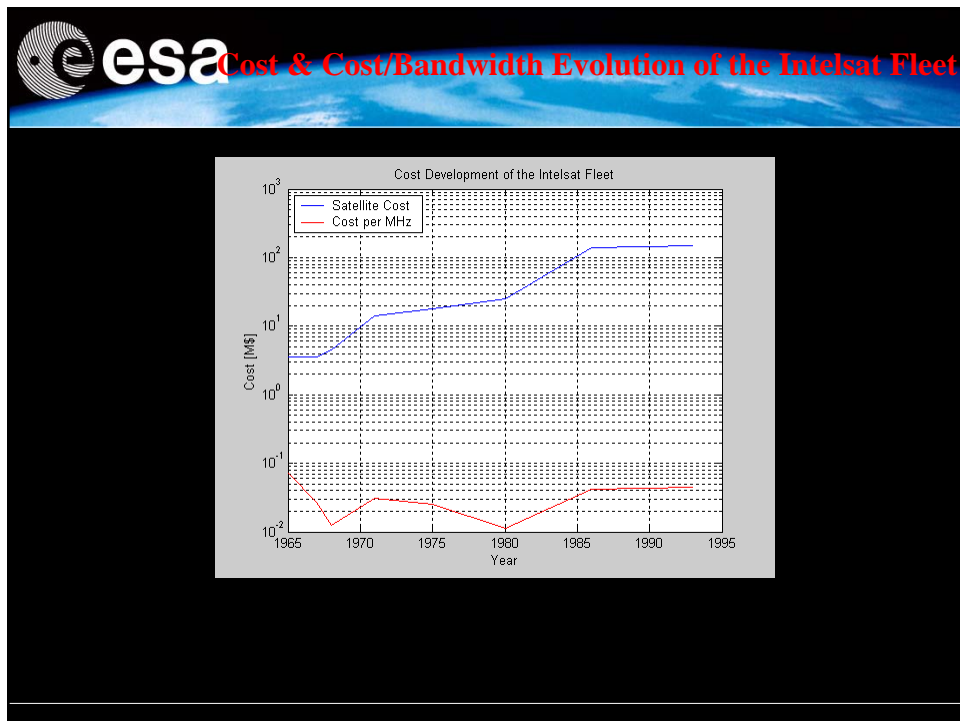
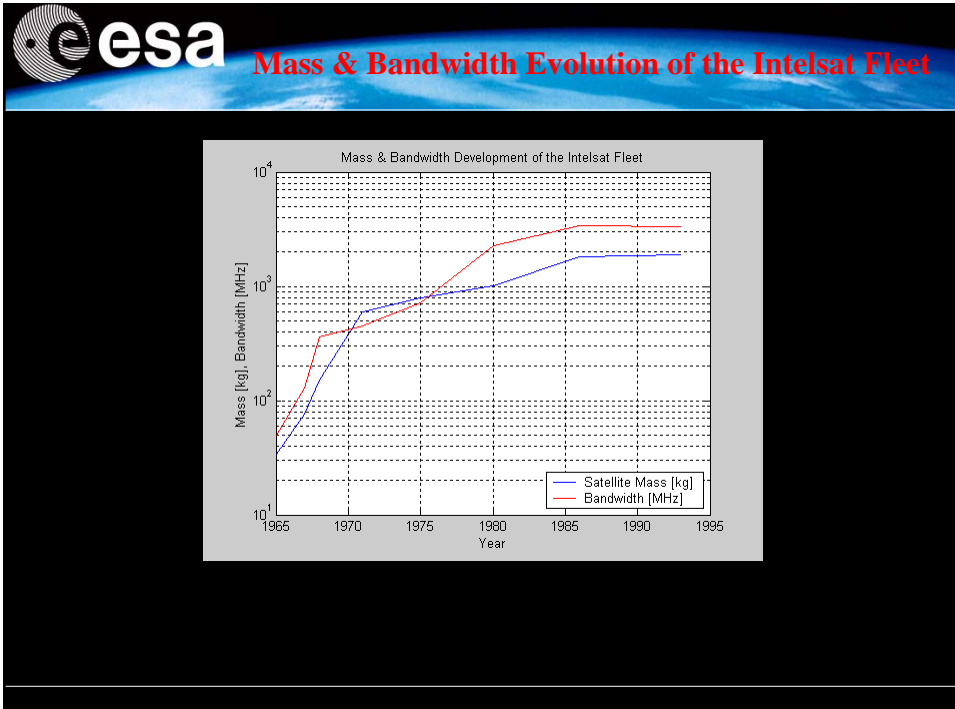
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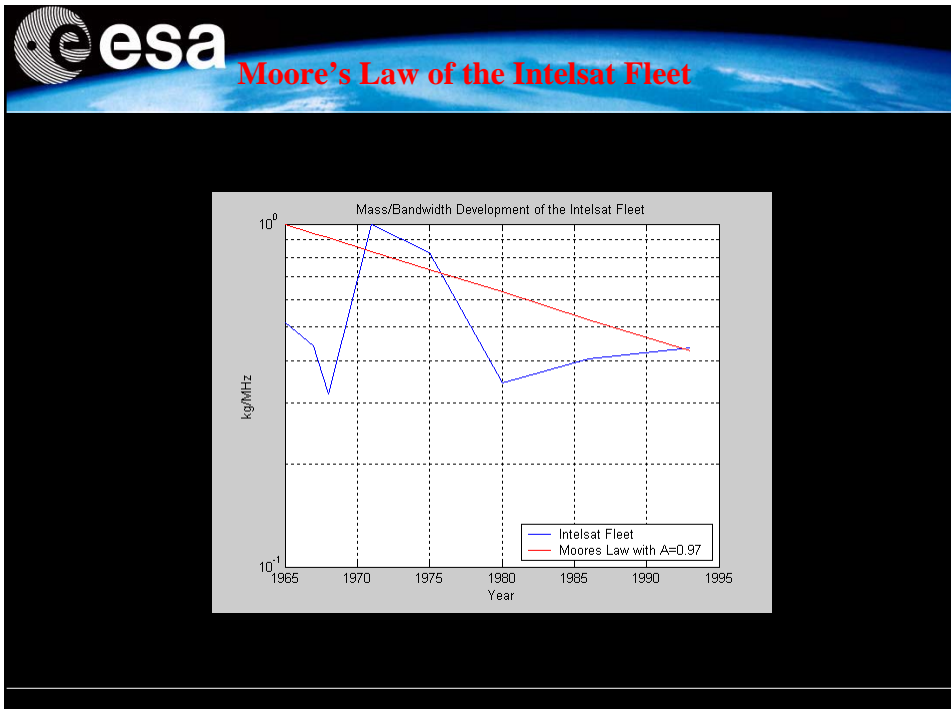



## The INTELSAT Fleet



Spacecraft	INTELSAT I	INTELSAT II	INTELSAT III	INTELSAT IV	INTELSAT IV-A	INTELSAT V	INTELSAT VI
Year of first launch	1965	1967	1968	1971	1975	1980	1996 (planned)
Dimensions	0.71 m dia x 0.59 m high	1.42 m dia x 0.67 m high	1.42 m dia x 1.98 m high	2.38 m dia x 7.01 m high	2.38 m dia x 7.01 m high	15.27 m across solar sails x 6.71 m high	3.6 m dia x 11.7 m high
On orbit weight	34 kg	76 kg	152 kg	595 kg	786 kg	1020 kg	1800 kg
End of life primary power	46 W	85 W	125 W	569 W	708 W	1220 W	2100 W
Total bandwidth	50 MHz	130 MHz	360 MHz	450 MHz	720 MHz	2250 MHz	3360 MHz
National capacity two-way telephone circuits	240	240	1500	5000	11,000 plus 2 TV channels	24,000 plus 2 TV channels	33,000 plus 2 TV channels
Design lifetime	1.5 years	3 years	5 years	7 years	7 years	10 years	10 years
Spacecraft cost	\$3.6 M	\$3.5 M	\$4.5 M	\$14 M	\$18 M	\$25 M	\$140 M (first five satellites)
Launch cost	\$4.6 M	\$4.6 M	\$6 M	\$20 M	\$20 M	\$23 M	?
Cost per telephone circuit year	\$23,000	\$11,000	\$1,600	\$810	\$494	\$200	?
Contractor	Hughes	Hughes	TRW	Hughes	Hughes	Ford Aerospace	Hughes







Basic Idea:

**Separation of Antenna Satellite and Modem/Switch Satellite**

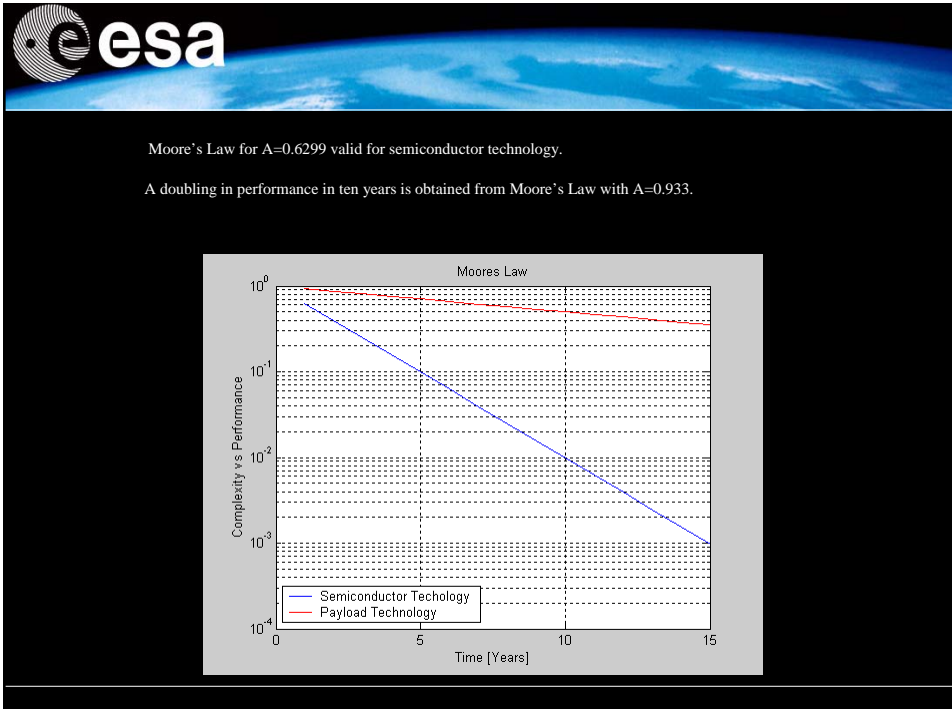
Justification for this Approach:

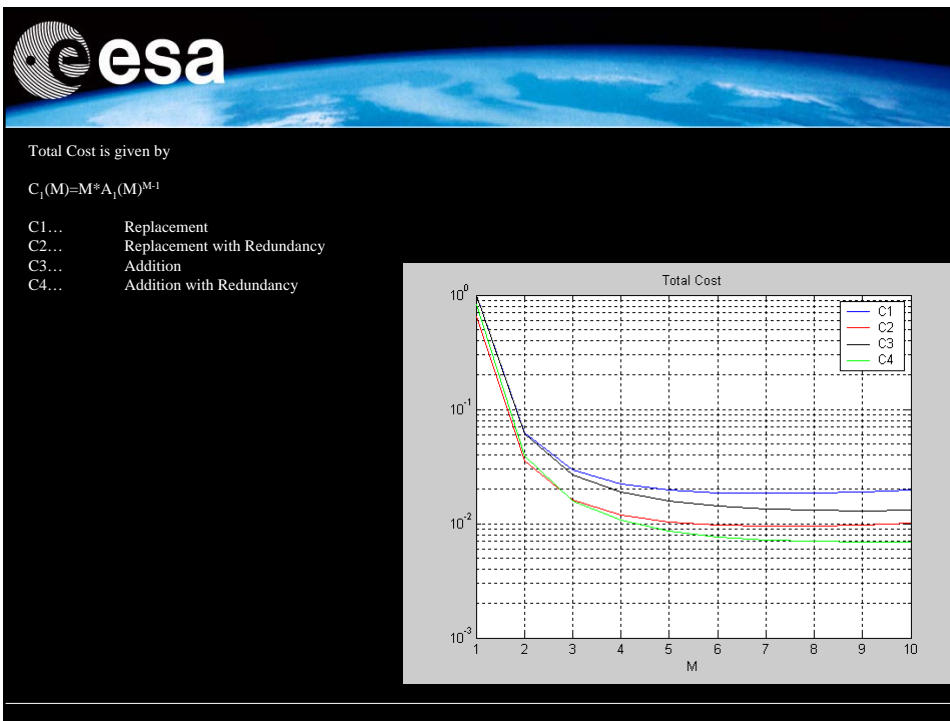
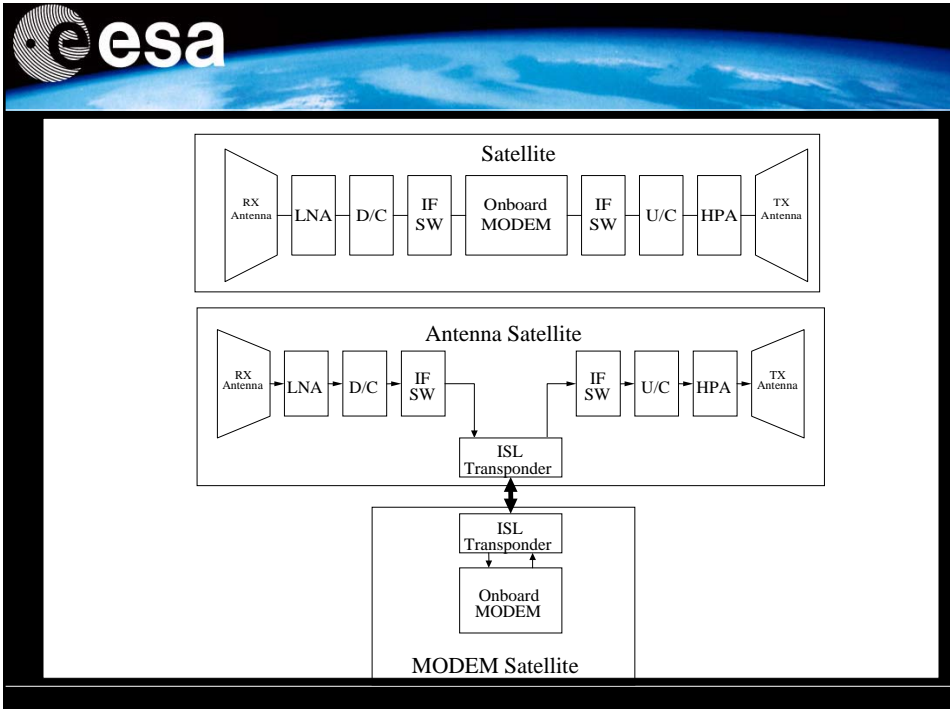
Moore's Law for TWTA's and Antennas is assumed to double performance every ten years.

For processing devices Moore's Law is the one for semiconductor technology, i.e. doubling every 18 month.

Moore's Law

$$A_1 = A^{t/M}$$







**ASIC – FPGA State of the Art TECHNOLOGY**

Skyplex ASIC's	MCD	360 KGates
	MTD	360 KGates
	MUX	260 KGates
EuroSkyWay UMCD		360 KGates
Rad-Hard FPGA's		< 1 M Gates
Commercial Grade FPGA SoA		< 10 MGates



**SoA DVB-RCS MCD**

6 M Gates devices, price per part ~ 2000 €





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FPGA

Today we can launch Rad Hard FPGA's (< 1MGates)  
And implement In-Orbit Programmable Functions



Micro-Optical Terminal

