DELTA VEHICLE IMPROVEMENTS

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The history of Delta has been characterized by configuration changes which have periodically increased the performance of the vehicle, while maintaining a high reliability and relatively low cost.

Shown in Figure 1 are the performance increases associated with the 14 major configuration changes to date in terms of spacecraft weight into synchronous transfer orbit – from 45 kilograms (100 lb) in 1960 to 680 kilograms (1500 lb) when the H-1 booster becomes operational next year. Also shown is the per-mission cost history, which very nearly follows the 5 percent inflation curve. Note that all costs are included except range cost and amortization of development.

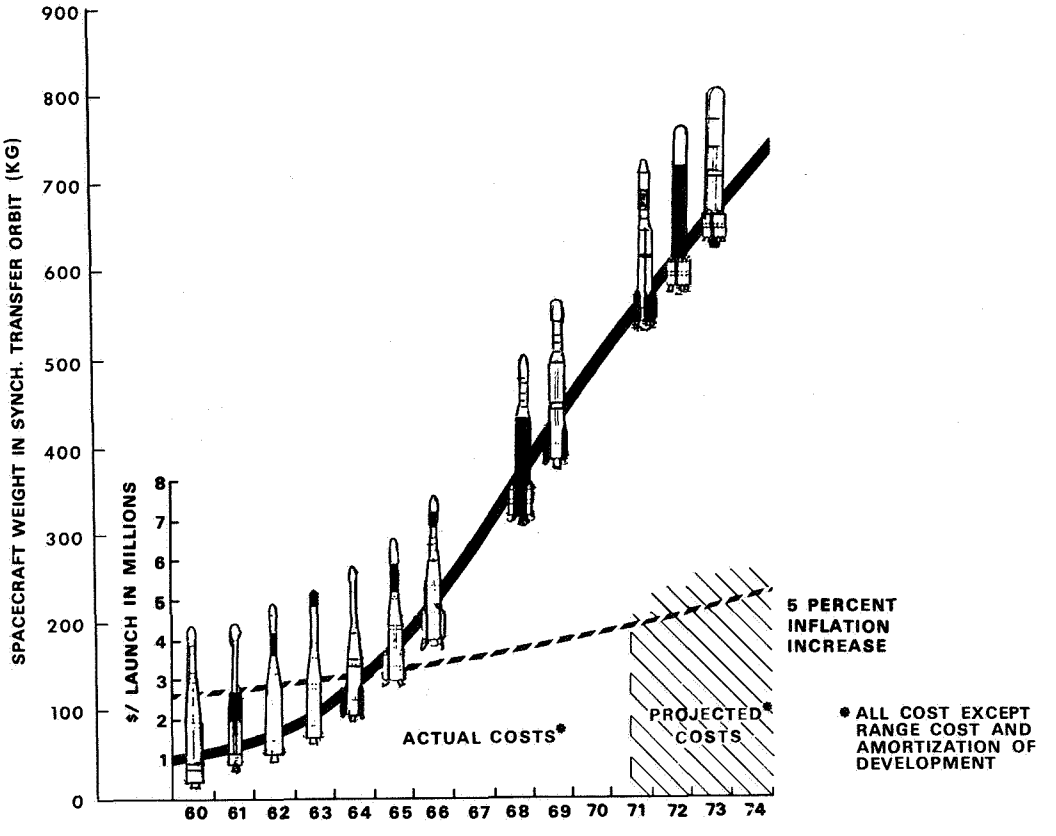

Figure 1. Delta performance and cost history.

Now I would like to highlight Delta's activities of the past 12 months.

In November 1971 we were preparing to ship the last two vehicles of the 1965-68 design and were in the design and early manufacturing phase of extensive vehicle configuration changes. The baseline vehicle as the year began was the long-tank Thor first stage, introduced in 1968, the 1.65-meter (65 in) diameter second stage with radio guidance introduced in 1965, and the FW-4 or T-364-3 third stages, 1965 and 1968 respectively (Figure 2). The initial change was the incorporation of the (UBT) Universal Boat Tail section of the Thor. The UBT is basically a structural beefup of the aft end of the first stage to permit carrying as many as nine thrust augmentation solids. The first UBT was flown on the TD-1A mission.

Next was the first flight of the T-364-4 third stage, which is a lengthened version of the 1.13-meter (37 in) Surveyor spherical motor. The -4 was introduced on the Atlas Centaur Pioneer F flight as the Delta project provided third stage. The launch of ERTS-1 was the first use of nine solids. It was also the first flight of the new higher-performing second stage engine, which was originally developed for the Titan-III Transtage vehicle. More important, however, it was the maiden flight of the Delta Inertial Guidance system, DIGS, which will be discussed in detail in the next presentation. These changes increased

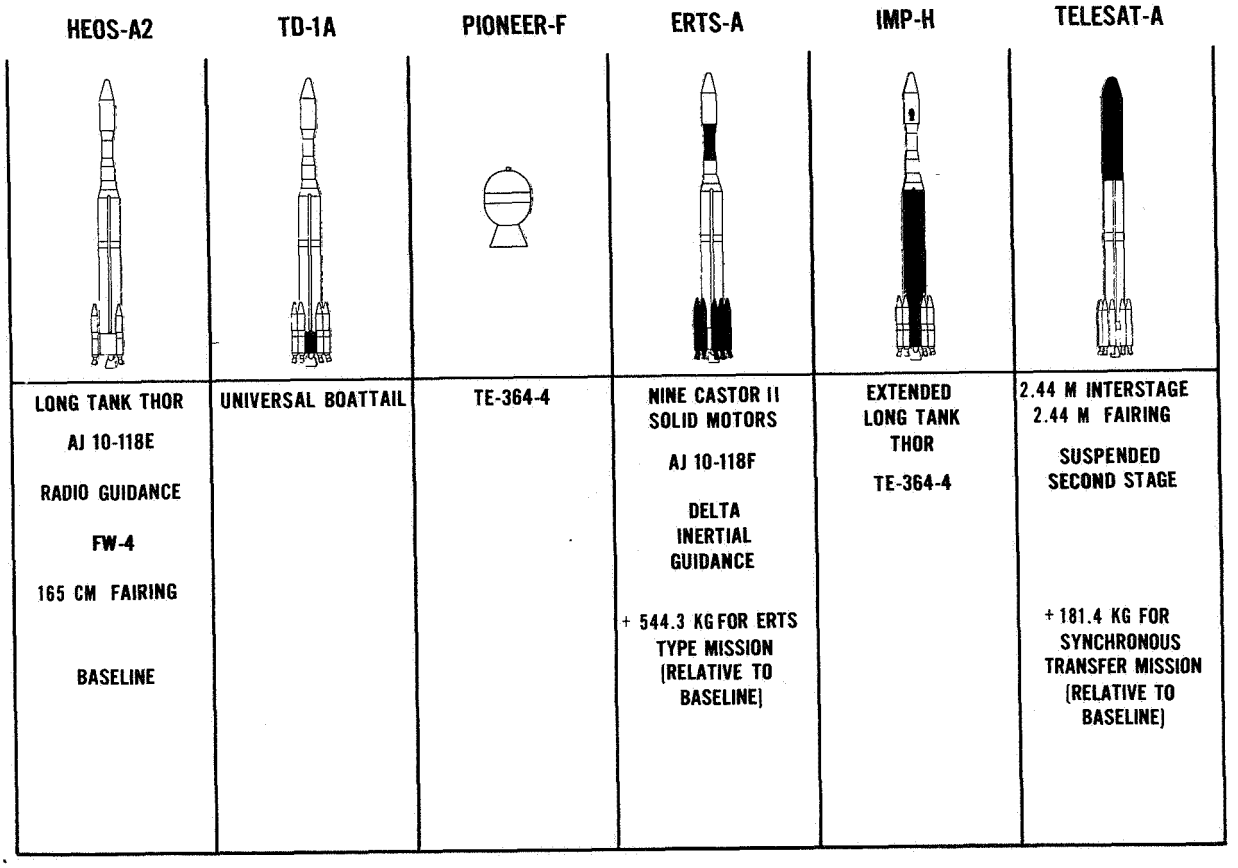

Figure 2. Delta improvement schedule, 1972.

the allowable spacecraft weight in an ERTS type orbit by about 545 kilograms (1200 lb) relative to the baseline vehicle.

Next was the launch of IMP-H, which was the first flight of the extended long-tank first stage. This is basically 3.1 meter (10 ft) extension of the propellant tanks, and features a revolutionary isogrid construction of the tank walls. IMP-H was also the first Delta use of the -4 third stage. Capping the 1972 introductions was delivery of the first 2.4-meter (8ft) diameter second stage, with an improved first-to-second stage separation system, and the 2.4 meter diameter all-metal fairing. The combined improvements have increased the allowable spacecraft weight for a synchornous transfer mission by about 180 kilograms (400 lb) relative to the baseline vehicle.

Reviewing briefly the launch record for 1972 (Figure 3), the year started with two launches for the European Space Research Organization. HEOS A-2 was placed in a near-nominal, highly elliptical orbit. It is an IMP-type particles and field satellite. TD-1A, an astronomical observatory, achieved a very accurate circular orbit. The ERTS-A launch vehicle, with its three major changes previously noted, and scores of minor improvements, performed flawlessly. All aspects of the IMP-H launch, with its significant innovations, and the ITOS-D launch, were completely successful. And finally, we are one day from the scheduled launch of Delta-92, our first straight eight vehicle. Surely, 1972 has been a year of spectacular achievement for NASA's busiest launch vehicle.

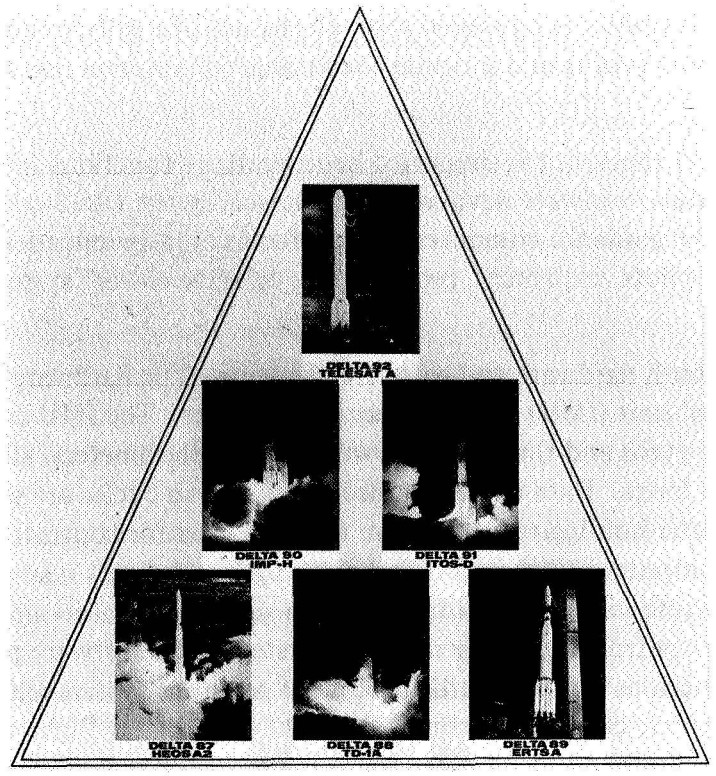

Figure 3. Delta launches – 1972.