Superbird Memories

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A year ago, I retired from SSL (Space Systems/Loral) after nearly 45 years designing and manufacturing communications spacecraft. I am still working and hope to influence the course of satellite communications for years to come, but as I reflect back on my career up to now, Superbird was by far the most important program – for my personal growth, for Ford Aerospace/SSL, and for the industry as a whole. I don't think any of us appreciated it at the time, but this program had a profound impact on the course of our industry, a legacy that continues today. I am honored to be able to share some of the program history, as well as some of my personal memories.

My Memories

In 1985, the Japanese government licensed the founding partners of the SKY Perfect JSAT Corporation (founded in 2008) - JSAT Corporation and the Space Communications Corporation (SCC) - to provide communications service by satellite and in 1986 they purchased spacecraft from Hughes Aircraft and Ford Aerospace, respectively. SCC chose the opportunity to define the world's most powerful commercial spacecraft and to include the first purely commercial Ka-Band payload.

Superbird's design was based on work codenamed "Supersat" performed in the early 80's at Ford Aerospace. The reason for the Supersat name: the previously unheard of 3 kW power level. At the time, I was the Director of the Ford Aerospace Advanced Systems organization, and in that capacity, I led the Supersat R&D team. Although most of my experience up until that time had been on the Intelsat V program, much of the Supersat design was borrowed from the technologically ambitions INSAT program. The design was intended to be very flexible (and it has proven to be) but the original focus was a satellite to be built and operated by Ford Motor Company. Fordsat, as it was called, was eventually cancelled, but the design lived on and, along with

my friend Ming Louie, we made several marketing trips to Japan in 1985 to try to sell the design to SCC. I'll never forget our first trip, when we were also accompanied by Ed Hunter, who later became the Superbird Systems Engineering Manager. Since Ed was very experienced with traveling to Japan I asked him for advice on where to eat when we arrived at our hotel in Tokyo. Imagine my disappointment when he led us to McDonald's! Ming and I left him to find a sushi bar.

Throughout 1985, the pace of activities picked up and we all began to feel that the program was going to be real. Up until January 1986, the Supersat studies had focused on Shuttle compatibility. The design featured a complex perigee stage to mount the spacecraft in the Shuttle and begin it on its journey from LEO. And, then, on 28 January, 1986 we all experienced the Challenger disaster. Well before any official findings were made, I realized that we needed to eliminate the Shuttle as a potential launch vehicle and that this was in fact, an opportunity. Eliminating the need for launching from the Shuttle resulted in significant cost and schedule savings. There was another effect: the Shuttle pricing rules favored short, squatty spacecraft, whereas the fairing of all expendable launch vehicles favored tall, skinny spacecraft. Optimizing for one launch vehicle resulted in a compromise design that was extremely sub-optimized on the other. The communications satellite industry would have evolved much differently had the shuttle stayed in the equation.

About that time, Bob Berry, the General Manager of the Ford Aerospace Space Systems Division, gave me a call one Saturday morning – could I come in to work to talk to him about something important? A couple hours later, I met with him and as soon as I sat down, he said *"We have a problem. SCC wants to have the SUPERBRD satellite in a much shorter period of time, but everyone in the factory keeps telling me that it will take at least 43 months. We want you to try to do much better than that – do you think that you can deliver the satellite in 29 months?"* I gulped, since I had had no experience as a program manager, and responded *"I don't know, but I do know that we can do a lot of things faster than the way we do them today."* Without hesitation, he said *"Good, you are now the Program Manager and I am going to see that you have the best team in the company to do the job."* I had a lot to think of that day as I rode my bicycle home.

Ultimately Ford Aerospace accepted the challenge to design, build, and launch the largest and most powerful communications satellite ever, in the shortest schedule ever, 29 months! The program was on track to deliver in about 31 or 32 months, until the disappointment of a TWTA parts problem; all of the TWTAs had to be reworked at the last minute. We brought technicians up from the TWTA suppler, Hughes Electron Dynamic Division in Los Angeles, to make the repairs with the TWTAs still mounted in the spacecraft. Superbird-A was delivered in 35 months, which at the time was a disappointment to all of us, but the experience put in place the tools and processes to routinely deliver much more complex satellites in 29 months today.

I want to highlight the most important event in the difficult contract negotiations (key SCC participants were Takeshi Hashimoto, Junji Inoue, and Takao Ueda). After two weeks of back and forth negotiations, Inoue-san told us "We have a deal, but first we have one more demand." We all froze, because we could not imagine what that would be. Imagine our surprise when he said "We want to raise the price of the spacecraft by $2 M, but there is only one condition".

The condition was that the $2 M had to be spent on the employees who worked on the program, and who we would be asking to make extraordinary sacrifices to make the program a success. We had never received a request like that before, and at first we could not say yes; there were some legal questions and the first response from Ford Motor Company was "This is in violation of our policies". My thanks to Mr. Berry, who lobbied very hard with Ford to accept

this requirement. The Superbird Employee Recognition program became the model for many of our employee programs going forward, and I give it 100% of the credit for establishing the culture of "Can Do" that has had a lot to do with SSL's (Loral bought Ford Aerospace from Ford Motor Company about the time of the Superbird-A launch) success in the commercial satellite marketplace. The figure below was the official program poster given to every Space Systems Division employee at the time of the contract award and the announcement of the Employee Recognition Program. The cluster of 7 stars is a tribute to the Challenger 7, including my good friend, Greg Jarvis.

One of the products of the Employee Recognition Program was Superbird Magazine, a video produced every three months for the employees working on the program. You can view the first edition here:

https://www.youtube.com/watch?v=zXV4fbQVFOo

The quarterly editions of the magazine profiled the program successes as they happened, but also the failures. One edition ended with the implosion of the engineering model propellant tank (this was very controversial, but I insisted that it was important that all employees see the difficulty of the problems we had to overcome); I think that every employee in the company was waiting for the next edition to find out how we solved this problem.

Importance of the Superbird Program – the Superbird Legacy

Mr. Berry kept his promise to assign a great team to the Superbird Program. The core team members included Bob Owiesny, the Bus Manager, Dan Collins, the Payload Manager, and Ed Hunter, the Systems Engineering Manager. I had all the support that I needed from the Finance and Legal organizations (including approval for the first FAX machine in the company for overnight communications back-and-forth to Japan!). We all learned that it took a lot of cooperation to execute a difficult space program; no one could succeed unless all of the people that they worked with succeeded as well. We also cemented the customer attitude that has served to differentiate Ford Aerospace/SSL over the years – SSL cannot succeed unless its customers succeed. This was actually a hard lesson to learn, but profitability in our business is a function of long term relationships that depend on working together to create "win-win" situations.

As a side note: the Superbird Program Office was the first group within Ford Motor Company to take the "Doing Business with Japanese Companies" week long course at the Ford Training Center in Detroit, Michigan (Ford Motor Company had an important relationship with Mazda and at the time, it was exploring joint venture opportunities with Nissan). We learned that what I am describing here is an example of the differences between Japanese and American cultural norms. In simulations of real world negotiations at many workshops, the Japanese workshop participants always ended up with the customer getting more than the supplier, but in such a way that the value of the program was increased (the American expression is "a bigger pie"), and the benefit to the supplier was always greater than the starting point for the negotiations. On the other hand, American workshop participants always ended up with the supplier and the customer getting almost the same benefit, but the size of the pie was always smaller, such that neither side got as much as in the Japanese simulations.

No one could have predicted at the time of Superbird that all future SSL programs would trace their heritage pack to Superbird. Ford Aerospace at the time was a technology leader, but tiny compared to Hughes Aircraft (now part of Boeing) and RCA (now part of Lockheed Martin). Shortly after the award of Superbird-A and B, Ford Aerospace was awarded the 9 satellite Intelsat VII program and Superbird and Intelsat VII defined the Ford Aerospace/SSL Product Line spacecraft, the 1300 (named after the dry mass of Superbird-A and B, 1300 kg). Last summer, twenty six years after the delivery of Superbird-A, SSL celebrated the delivery of the 100^{th} 1300 spacecraft - NBNCo-1 (Sky Muster); designed to provide Internet access to every last person in the Australian Outback. Gary Selick, a member of the original Superbird Program Office, and I were invited to speak at the employee ceremony in the parking lot and everyone who stopped me to talk said that it reminded them of the famous Superbird Tent Party in the Parking Lot; that party was the capstone of the Employee Recognition Program first proposed by Inoue-san.

The 1300 program is the most successful and longest lived product line satellite program in history. Over the years, the capability has been carefully expanded, and the 1300 has been the world leader in moving from 3 to 8 and then to 20 kW. Every component has been incrementally improved so that today the only component recognizable from the first Superbird is the sun sensor. During most of the time since the original Superbird Program, I was responsible for Product Development and I liked to say that every satellite would be about 2% better (higher capacity, lighter weight, greater flexibility; whatever parameter you want to measure). As a result, the incremental risk on each new program was quite small, but after 26 years, the improvement has been 1.02^{100} = 7 times. And there are about 20 more 1300 spacecraft in manufacturing backlog, representing an improvement of

Party celebrating the delivery of Sky Muster, the 100th 1300 spacecraft in August, 2015. That's me (Superbird Program Manager), Larry Rubin, Gary Selick (Superbird Program Office), John Celli, Matteo Genna, and Greg Bossert (Sky Muster Program Manager) cutting the Superbird cake on the left and the Sky Muster cake on the right.

1.02^{120} = 11 times. These figures are of course only approximations, but the formula of small incremental improvements has worked, and continues to work, very well. Since 1997 there have been 3 generations of power and avionics equipment, each of which has been more reliable than the previous generation, and every new product insertion has been successful. Three satellites in the SSL backlog today, JCSAT-14, 15 and 16, will continue this proud legacy of almost 30 years.

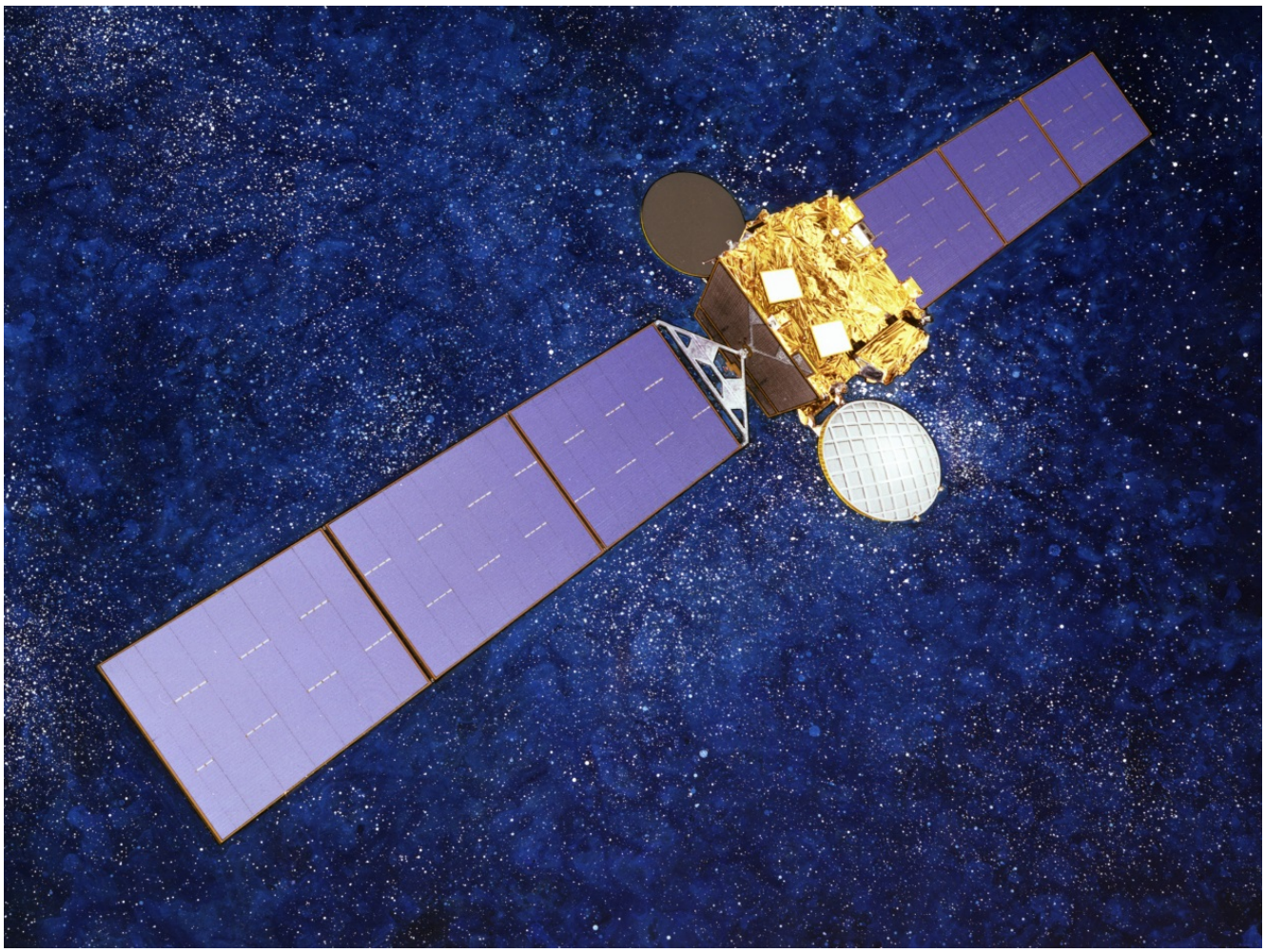
It is fitting that Sky Muster is a state-of-the-art High Throughput Ka Band satellite. SCC made the very brave decision in 1986 to make Superbird-A the first pure commercial spacecraft to feature a Ka-Band payload, based on the Ford Aerospace technology development work on the Japanese experimental CS (*Sakura)* spacecraft in the late 1970's (in addition to specifying the most powerful commercial satellite ever). The Japanese customers were not ready for Ka-Band at the time, but time has proven the wisdom of that decision.

Personal Note

I have told the story as I remember it of the start of the Superbird Program, and I have told the story of the legacy of Superbird – 120 spacecraft, including JCSAT-14, 15, and 16, and still counting. But my story would not be complete without thanking my many friends from SCC, as well as the friends that I made along the way at MELCO, MIC and Mitsubishi Shoji. I learned a great deal from our friendship and our work together; not a day goes by that I do not practice a few of my bicultural skills. Those personal relationships, and of course the time that I spent at the *geisha* concert in Kyoto, *hanami* in *Ueno Koen*, riding the *shinkansen* and enjoying the *onsen* at the *ryokan* at *Hakone* are a big part of my fond memories of my Ford Aerospace/SSL career.

Sushi, sashimi, yakitori, udon, tempura and *shabu shabu* remain among my favorite meals, and a hot bowl of *ramen* is the comfort food I look for on a cold day. I can promise you all that I will never, ever, visit McDonalds in Tokyo.

My hope is that those who follow us will get as much out of their careers and friendships as I, and my Japanese friends and colleagues have.



Superbird-A