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May 1st, 1:00 PM

## Paper Session III-A - A Commercial Launch System for Large Payloads

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# **Expanding the Commercial Space Arena: The Western Pacific Rim States as Competitors-Markets**

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## **Introduction**

Space commerce over the past decade has become a field in transition as comsat markets exponentially expand with prospect for further growth in other areas also very positive. As part of this change process, new competitors are stepping forward. The Russian Federation successor state to the former Soviet Union's space program represents one facet of that new challenge. Its competitiveness grows directly from its historic status as one of the two first space powers. A more intriguing situation is developing in the Western Pacific Rim states, there space-related activities span the spectrum from fairly comprehensive space programs to states just emerging into the space applications arena. This paper explores these changes and discusses their implications for the United States commercial space effort.

## **Changing Perceptions**

Until the 1960's commercial space activities were practically speaking nonexistent but that changed rapidly once relatively assured access to space became possible. The early efforts concentrated upon comsats those successes were dominated by Intelsat and by extension, the United States through Comsat. Over time, the US dominance over Intelsat has declined as other participants asserted their interests, but the US retains its premier status as a space practitioner. By the 1980's however, the Europeans (who had begun also in the 1960's) entered the field in a more significant fashion especially after the Ariane 4 achieved flight status. The Soviet bloc countries were not commercially significant given the military-political situation at that time, e.g. the Cold War. The Western Pacific Rim region (ranging from Japan to Australia) was at that time defined chiefly in terms of its market potential, enormous but unexploited, rather than as an independent space actor. That perception, however, is now shifting for several reasons which we will briefly discuss, then focus upon the current and future competitive situation in the region. The focus as we must emphasize is upon their potential rather than with few exceptions actual competitiveness, reflecting trends ongoing as we write (Johnson-Freese and Handberg, in press).

Within the region, there exists a bifurcated system regarding space activities (Handberg and Johnson-Freese, in press). Japan and the People's Republic of China (PRC) stand apart although differences exist even there; the rest of the participants stand a level below. The Japanese and the PRC for somewhat different reasons embarked upon development of relatively comprehensive space programs, spanning the spectrum from launch vehicles to satellites. For reasons of international prestige and national security, the PRC's efforts have been much more narrowly focused but better supported than the Japanese. This commitment reflected the ability as a command economy to commit whatever resources the leadership deemed necessary in order to achieve their political goals. Japanese efforts paralleled this initiative without the overt military overtones which meant that its political intensity level is significantly less as are budgets (controlling for cost of living differentials). In effect, their space effort has marched to a different drummer than the more politically and national security conscious Chinese program. The Japanese space effort also embodies the political agenda of confirming their high status within the international world order but their greater focus is upon economic strength generally of which

space activities are comparatively minor part (Johnson-Freese, **1993**). Regardless of why, as a result, both programs stand at a level above the rest in the region and are moving closer to the more advanced space players (who are receding budgetarily speaking at least back toward their level). China at the recent International Astronautical Federation meeting announced an extremely ambitious space effort.

The remaining space participants in the region are characterized as “niche” players. Lacking the technology base and/or experience in the field, these states have begun incremental steps toward becoming active participants. Among the available choices are enterprises engaged in value added processing of space-derived information collected by others and production of system components necessary to complete satellites, ground stations or launch vehicles. This participation has been perceived by some as the prelude toward more intense and sophisticated involvement. Thus, even among the niche players, there exists a diversity of views concerning each state’s long term objectives. Some including Singapore model themselves at least subconsciously upon the Canadian prototype in which specific areas of space-related activity are identified and pursued over long time intervals. Canadian participation in the current Space Shuttle program (the Canadarm) and the ongoing space station project is built around technologies allowing manipulation of large objects - the Space Station Remote Manipulation System. Such specialized activities facilitate a nation or its technically qualified companies and bureaus participating in space activities which otherwise would be inaccessible. The downside with pursuing such a narrow pathway is that a niche player can become quickly technologically obsolescent, the margins of viability can be tight. This often reflects these societies’ lack of larger resource bases - their budgets are tight and focused with difficulty coping with dramatic change. Canada, for example, has problems funding the next phase, the Special Purpose Dexterous Manipulator. Recent advances in comsats have dramatically expanded service options and thus, opened up new markets. The technology, however, assumes an information processing technology base that many societies lack or else lag behind.

Others as Taiwan and South Korea define their preliminary space-related activities as a prelude to a much more inclusive participation level. Similar to the Japanese and Chinese, their goals are more ambitious - usually involving establishment of some form of light sat launch capability to allow exploration of more advanced space capabilities. Plus the potential military applications are obvious and relevant for these societies. In a world in which the old political verities of the Cold War are gone along with expectations of US protection against aggression, pursuit of self protection becomes a rational goal.

The point is that perceptions of the Western Pacific Rim states regarding commercial space activities have generally labeled them as potential markets rather than as serious competitors. Markets often difficult to penetrate due to political and cultural differences but still markets. The aspirations and achievements briefly alluded to above mean that these states are striving to become more proactive rather than simply passive participants acted upon by others. This is especially true as competition in space commerce intensifies. For example, the United States lost its dominance (actually monopoly for many years) over the launch market in the early nineties - recapturing that momentum has proven more difficult than many assumed. Restructuring the industry and making governmental processes supportive of commercial space activity has taken time while new competitors have emerged. Satellite applications have become

the major source for United States success but rising nationalism with increased pressures upon buyers to buy domestic products further intensifies the competitive pressures. Western Pacific Rim space participants are making this a much more competitive process as they pursue their national aspirations which can conflict with those pursued by the United States.

One example of this more assertive approach can be seen in how countries in the region leverage their markets. China especially with its billion plus people and expanding market economy represents a situation in which international corporations penetrating the market have agreed to restrictions upon content for example regarding their comsats while more pragmatically technology transfers (with the limits of international security restrictions) are required as the price for admission. Informal quid pro quos occur as countries and their corporate players seek entry by trading access to their technology and out sourcing contracts. No longer can corporations engage in “slash and burn” strategies; that is, hit a market quickly and then get out. Instead, longer involvement is demanded with substantive results occurring for the market country beyond just access to some new technology as a user. There are too many players, real and potential, who offer access so that the price of admission goes higher: engaging in helping the market population achieve its goals. Players unable or unwilling to provide such “extras” will become less competitive. The payoff is that once market penetration occurs, the relationship is likely to be long term in nature given the financial and technology commitment required to implement new systems. These countries are not interested in merely selling access to their populations for no appreciable long term benefit. The intent is to eventually eliminate the middle player and become independent but that is down the road.

### **The Changing International Space Marketplace**

Because of its military applications, space technology has been heavily restricted regarding transfer between societies. With the Cold War’s end, those restrictions have been loosened although not abolished. This change opens up opportunities not previously available for space participants to work together in truly cooperative international ventures. For example, satellite components can be obtained from suppliers outside the corporation’s host state or satellite launches can use vehicles from different states. The Iridium satellite fleet, for example, is being launched on United States, Russian and Chinese flag carriers while others can be contracted for future launches.

The importance of this change is not merely that a diversity of participants are employed but rather it implies for new players such as those found along the Western Pacific Rim, opportunities exist that otherwise would not have previously occurred. These opportunities allow newer players experience with and exposure to space technologies inaccessible under the old regulatory regime. The established space players are caught in a dilemma - out sourcing component production may significantly reduce costs in the short run but at the same time increase the competitiveness of participants not presently competitive. The Japanese, for example Mitsubishi Electric, are using this strategy to upgrade their satellite industry. However, internationalization increases the pressures upon space enterprises to become more efficient and profit oriented so all avenues are pursued. Returning to domestic only purchase policies is one short-term option but such policies may not be viable given the competitive pressures. One sees conflicts within the US between launch companies and satellite builders, government space programs are no longer sufficient to support expanding commercial space activities. Instead, the

strategy becomes reaching out for other markets which demand greater flexibility and willingness to accommodate customer preferences especially in reference to prices. No longer do western space participants dictate the market, they remain critical players just no longer controlling.

**HIGH END SPACE INVOLVEMENT**

Japan and the PRC stand head and shoulders above the region regarding the scope and intensity of their space-related activities. Therefore, we will begin by describing their activities in order to assess their future potential *vis a vie* the US. Their various activities from the perspective of an established space participant can be grouped into distinct categories: 1) established technologically and challenging the established players and 2) developmental and at the self help stage of involvement. The first category refers to activities that are already tested and proven, representing a significant commercial challenge to American space companies. The second contains developmental activities with some use for their national purposes but still secondary to established European and American players.

**Space Lift**

Both Japan and China operate major space lift competitors to the US and Europe including Russia. China with its Long March family of boosters is currently the strongest challenger with the Japanese beginning their push commercially. Table 1 describes the existing and projected launch vehicles for these two regional space powers plus comparative launchers from the US, Europe, and Russia (Caceres, January 13, 1997: 117-37). To put the table in context, the table is selective in that China and Japan total 10 ELVs while the rest of world totals at least 38 flight options, not including different configurations such as the Ariane 4 with its five different looks. Column 2 presents the maximum payload to orbit performance identified for the particular rocket family while column 3 presented a rough estimate of the cost for a launch.

**Table 1.  
Orbital Launch Capabilities**

	Country	Payload in lb.	Launch Cost \$
A.	PRC		
	Long March CZ-2C	<b>2,200</b>	\$20 m
	Long March CZ-2E	<b>7,430</b>	50 m
	Long March CZ-3A	<b>5,500</b>	45 m
	Long March CZ-3B	<b>9,900</b>	70 m
B.	Japan		
	M-5	<b>4,000</b>	<b>60</b> m
	H-2	<b>8,800</b>	190 m
	J-1	1,980	49 m
C.	Russia		
	Proton	12,100	<b>60</b> m
	Rocket	4,100	5-10 m
	Zenit 2	30,300	45 m
	Cosmos	3,100	10m
	soyuz	15,400	20 m
D.	Arianespace		

Ariane 4	9,965	65-110 m
Ariane 5	13,892	
E. United States		
Atlas 2	6,800	75-100 m
Delta 2	4,120	40-50 m
Taurus	3,100	20 m
Titan 4	12,700	350 m

China presents a full range of launch options for potential customers. Given cost of living differentials and the fact that until recently the Chinese economy was not market driven, their low quoted prices for launches pose a clear threat to Western launch companies. The temporary expedient has been establishing a quota system upon the number of launches that can be sold on the world market. That quota, however, has been renegotiated once already and several competitors have argued that the cost restrictions built into the quotas (prices must not be more than 10 percent below competitors) are not actually being enforced. The Chinese need for hard currency makes price cutting (“dumping” to competitors) a real temptation which is difficult to prevent. The same issues arise concerning the Russians but the Chinese were more aggressive earlier in seeking contracts through the Great Wall Corporation. What limits their competitiveness is not the artificial workings of international agreements but the fact that performance concerns negate the attractiveness of their cheaper prices. The Long March vehicles have experienced failures, intermixed with success, which have raised concerns about reliability and insurability. Payload owners can not afford to “fly naked,” that is, without insurance. This uncertainty is compounded by Chinese reluctance to allow outsiders full information as to why flight failures occurred. Customers become skittish under these circumstances. Old customers have stood firm but await evidence that the problems have been resolved while new contracts hang fire. Their anxieties have been compounded by the conflicting reports as to the number of deaths that occurred during one LM-3B flight failure - deaths minimized by the government despite the presence of outside observers. Assuming the causes are correctable, the PRC remains a strong competitive presence in the field. Ironically, its effect is most likely in the short term to impact Arianespace more than the US since they are presently the dominant presence in the field.

Japanese launch competition is only beginning seriously due to two factors, both fixable. First, the Japanese launch from Kagoshima and Tanegashima, spaceports hampered by launch restrictions which allow only two 45 day launch periods. Negotiations have begun with local fishing interests to expand these periods. The restriction’s existence reflects the comparative low priority space launches had within Japanese politics. With its greater potential now being recognized, the government is moving cautiously to reduce this obstacle.

The second restriction is more difficult to remove or reduce, high costs. Referring back to Table 1, one can observe that the H-2 is very expensive. Only the Titan 4 is cost comparable, a vehicle used mostly to lift high priority military and intelligence payloads where price is not as strong a constraint. The H-2 is already undergoing an upgrade (the H-2A), whose objective is to significantly reduce costs (Davis, 1996). The H-2A, if the improvement program works, becomes a direct competitor to the Ariane 5 (which is undergoing a similar upgrade despite its first flight failure). The H-2, J-1 and M-5 will likely be primarily occupied with lifting Japanese national payloads initially but the clear intent is to move onto the world marketplace.

Both states are pursuing independent economically competitive launch options. Their domestic space programs have grown large enough to support such efforts. The difficulty is that the world space launch marketplace has become a much more competitive situation with all the major national players upgrading their launch systems. The US, for example, is engaged in upgrades through the EELV and X-33 programs plus efforts not related directly to these programs. Therefore, flight failures and excessively high costs make the task difficult as both have already discovered.

### **Satellite Applications**

The other major sector involves various types of satellite applications including comsats of different types, Earth-observation, scientific and weather. Here, the dominance of the traditional space powers becomes obvious. For example, a simple count identifies 31 comsats as serving the region satellites which are owned by regional members while only 4 of those were produced indigenously by either Japan or China. This is actually an undercount of the total number of satellites because international satellites were not counted. What is critical to observe is that the Europeans and Americans dominate the comsat field although the Europeans themselves feel threatened by the American companies' aggressiveness. As the world comsat market mushrooms into the MEO and LEO regions, the Western dominance becomes even clearer. This proliferation, however, benefits China and Japan in that their launchers are being used to place these new satellite fleets into orbit

When one moves away from the comsat market both Japan and China have been actively pursuing development of different satellite types. Japan's track record has been more impressive with in place weather satellites although most recently their Earth observing satellite, Adeos- 1, has encountered some problems. The Chinese have placed satellites in orbit but have encountered severe problems. Lifting a satellite into orbit may now be the easier part of the job - sustaining the satellite in the harsh space environment has proven more difficult. This reality is clear as even the more experienced satellite builders continually encounter unexpected or harsher than expected conditions. For example, solar storms have knocked out permanently or temporarily Intelsat and Canadian satellites over the past several years. Chinese satellites have failed in orbit fairly quickly but their flight experience will help conquer those problems.

Both are engaged in systematic developmental programs but the Japanese program has been more successful in meeting national needs.. Their program has benefited from exposure to Western satellite builders while domestic capabilities are expanding. Mitsubishi Electric, for example, has developed a standardized satellite bus, the first step to simplifying construction and lowering costs. The PRC's bootstrap program, reflecting its political isolation, has had less opportunity to benefit from such implicit technology transfer events, thus it lags behind in quality of performance. A society can reinvent the wheel but that inefficiency slows progress toward establishing a viable satellite applications program. The other limitation upon the PRC is simply the scarcity of human and technological capital (Handberg and Xinming, 1992), making innovation difficult. On balance over the long term, the Japanese are becoming more competitive but that is at least a decade out.

### **SEEKING ACCESS TO SPACE COMMERCE**

The rest of the Western Pacific region states are in what can be characterized loosely as "seeking access." These states are parlaying what technological and physical assets they possess

in the effort to gain access to space. A number of these states primarily Taiwan and South Korea are already subcontractors in various aspects of the aeronautical industry. Their efforts there indicate a technological and human skills base that can with effort be extended into space-related activities. Taiwan with their projected launch of the Rocsat are moving closer to creation of a domestic satellite industry. The objective is learning from this government program and transferring that knowledge into the industrial sector - similar to several NASA satellite applications programs. South Korea with its Komsat is engaged in a similar effort plus has already become a telemetry command subcontractor for other comsat companies.

Thailand's space program is largely military driven except that several consortia have been set up (with Laos in one instance) to operate DBS satellites in the Asia-Pacific region. A Thai space agency exists on paper but the scope of its activities remains limited. Vietnam has begun acquiring its own domestic comsat, partially in reaction to its neighbors' activities.

Australia has been the most puzzling player in the region. A reasonably robust space effort (in conjunction with the UK and the US) was allowed for domestic political reasons to run down. Having lost their momentum, the Australians are now attempting to revive their participation by touting their geographic location in order to entice the Japanese primarily to establish a spaceport. The Japanese have been testing components of their HOPE space plane at Woomera. Domestic comsats are already in orbit but recapturing sufficient technological expertise to be competitive has proven harder than imagined. The Philippines and Indonesia represent two societies for which space applications are particularly essential. Being multiple island nations with large diverse and isolated populations, comsats become a major device for integrating the islands together despite the lack of a communications infrastructure. Therefore, both have pursued development of comsat capabilities. Indonesia has especially found this an important component in their drive to create a sense of national self-identity using their national language specifically created to bridge diverse often antagonistic cultures. Both societies have consequently made heavy investments in earth stations and other communications technologies. They are not directly striving for independent space capabilities instead the exploitation of those assets for a greater social good is the objective. For example, linking to the Internet through satellite has become a goal for Indonesia.

Hong Kong and Singapore likewise are moving to exploit space technologies in similar ways although Singapore's participation is more intense. Hong Kong operates as a financial center, investing in comsat technologies, exploiting its ties to the PRC. Integration of Hong Kong into the PRC means that its status as an independent will end, the ultimate form of its future participation will be bounded by PRC policies. Singapore being an independent Chinese city state has found its ties to the PRC useful in creating economic opportunities but its small size limits its leverage. Its intensive involvement comes in Singapore's concerted effort to upgrade and expand its scientific personnel. One immediate payoff has been creation of a remote sensing center, the Center for Remote Imaging, Sensing and Processing, whose purpose is to further process the received imagery to enhance its economic value for potential customers. Such activities demand sophisticated computer and imagery processing skills which most smaller states lack.

This mix of activities indicates that these states are now convinced that space related applications and technologies can contribute to their national economic competitiveness. Exactly how that potential is to be tapped remains the great unknown which has led to proposals for an



Asia Space Agency - shadowing the development of the successful ESA. The difficulty that stymied earlier efforts at such an organization were the political differences which placed China and Japan in opposite political quarters. Some of those differences have muted with the demise of the Cold War but the relative imbalance between the dominant regional space participants and the rest of the region makes cooperation tricky. The lesser feel submerged by the larger. ESA also had differences in comparative size and commitment but there were sufficient relatively equal players initially to balance off differences. A region wide organization, therefore, appears unlikely in the immediate future but remains one possibility for integrating this diversity of states.

#### CONCLUSION

This brief overview projects a region characterized by significant gradients in degree of involvement in space-related activities. Aside from Japan and the PRC, most of the region is still characterized by its market potential for outside especially Western players. Currently, the Asia Pacific market represents the hottest growth area for comsats despite an escalating crisis regarding availability of orbital slots. Despite deficits in technology and personnel, societies desire involvement but the process remains long and arduous for most. Manufacturing Earth stations and their related equipment is likely the field of immediate involvement. These states remain largely consumers rather than producers. The exceptions are clearly Japan and the PRC. Both still represent significant markets due to their population size (both) and economic strength (Japan). Their existing launch programs pose significant commercial threats to the US although Japan remains the more distant threat. The PRC is currently the most competitive but concerns about Long March reliability may cancel out price advantages. Satellite applications lag compared to the US but here the Japanese are positioning themselves for greater prominence in the field. The old stereotype of the region as strictly a marketing opportunity is no longer accurate although their desires outrun performance at this point. For US space participants, there is no way to prevent that gap from closing; therefore, the push must be to improve not only technical performance in space but provide responsive service to meet market needs. That will be the real test as the number of providers escalate, differentiating the winners and the losers will be on the basis of this extra dimension. Failure to see that is a recipe for disaster.

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