A Global Missile Launch Surveillance System for Strategic Stability

Panel Discussion

S. Chandrashekar
Professor Indian Institute of Management Bangalore
J.R.D.Tata Visiting Professor National Institute of Advanced Studies (NIAS)

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Assumptions

I will adopt the viewpoint of an independent Indian analyst looking objectively at the problem that India faces.

The two major concerns that relate to strategic stability for India are two of India’s neighbours – Pakistan and China.

Though the inclusion of China may not qualify as the problems of South Asia, in discussing nuclear stability from an Indian perspective one cannot ignore the role of China.

In my presentation today while I will not ignore the reality of Indian Pakistani and Chinese missiles I am going to ignore a number of things.

I will use a magic wand and wish away all the major political problems that one can visualise in setting up an international missile launch surveillance system. We will assume that we have the go ahead and have to look at what kind of a system we should propose.

Dr. Forden has already done a lot of work – I am going to only embellish and add a little bit to it largely from an Indian viewpoint. It will be a technical view. We could of course touch upon the political issues during the discussions.
THE TRAJECTORY OF A MISSILE

Time of powered flight above a certain altitude critical for surveillance system
Pakistan missile launch record – by missile type - ~ end 2006

No. of launches

Type of Missile

- Ghauri
- Shaheen 1
- Ghaznavi
- Abdali
- Shaheen 2
Pakistan Launch History

27 Ballistic missile launches. 4 to 6 per year to be expected
The Abdali Missile

Strategic or tactical?
Solid propellant
Single stage
85 to 95 km range with a 500 kg payload
The Ghaznavi Missile

Tactical or strategic?

Bigger missile – solid rocket
Nuclear warhead capable
The Shaheen 1

Very similar in dimensions and performance to the Ghaznavi. There could be issues of separation and discrimination between the Ghaznavi and the Shaheen 1.
The Shaheen 2

Two stage Solid rocket
The Ghauri Missile

Liquid missile
RFNA / UDMH
Single stage
Pakistan Missiles – some relevant parameters

<table>
<thead>
<tr>
<th>Missile</th>
<th>Time of burnout</th>
<th>Thrust time above 5 km</th>
<th>Burnout altitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdali</td>
<td>42 seconds</td>
<td>16 seconds</td>
<td>13 km</td>
</tr>
<tr>
<td>Ghaznavi</td>
<td>37 seconds</td>
<td>18 seconds</td>
<td>19 km</td>
</tr>
<tr>
<td>Shaheen 1</td>
<td>53 seconds</td>
<td>30 seconds</td>
<td>27 km</td>
</tr>
<tr>
<td>Shaheen 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1</td>
<td>31 seconds</td>
<td>9 seconds</td>
<td>11 km</td>
</tr>
<tr>
<td>Stage 2</td>
<td>73 seconds</td>
<td>73 seconds</td>
<td>62 km</td>
</tr>
<tr>
<td>Total</td>
<td>104 seconds</td>
<td>&gt; 82 seconds</td>
<td>&gt; 62 km</td>
</tr>
<tr>
<td>Ghauri</td>
<td>73 seconds</td>
<td>47 seconds</td>
<td>43 km</td>
</tr>
</tbody>
</table>
Implications for design

We can see from this analysis that missile surveillance especially for the very short range Pakistani missiles poses some special problems.

These problems were not important in the US – USSR context since the distance separating the two sides was of the order of thousands of kilometers and the flight times and boost times were correspondingly large.

In the case of India and Pakistan we can see that the time of thrusting at altitudes of more than 5 km for some Pakistani missiles is between 16 and 30 seconds. This does not give the sensor enough time to detect and estimate the trajectory unless it is specially designed.

To be able to estimate the trajectory reasonably accurately the number of observations should be large. Sampling of the plume at 1 second or 4 second intervals may not be adequate.

A wide field of view that constantly looks at the total earth disc may be necessary. A 3 axis stabilised satellite without a stepper motor that stares all the time at the earth may be needed in case we do not miss the launch.

Since more frequent observations may be needed it may be a good idea to include a second higher resolution instrument especially if you are looking at South Asia.
<table>
<thead>
<tr>
<th>Missile</th>
<th>Time of flight in seconds</th>
<th>Range km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payload kg</td>
<td>500 700 1000</td>
<td>500 700 1000</td>
</tr>
<tr>
<td>Abdali</td>
<td>176 sec</td>
<td>95 km</td>
</tr>
<tr>
<td>Ghaznavi</td>
<td>301 sec 267 sec</td>
<td>347 km  269 km</td>
</tr>
<tr>
<td>Shaheen 1</td>
<td>375 sec 343 sec</td>
<td>495 km  410 km</td>
</tr>
<tr>
<td>Shaheen 2</td>
<td>583 sec 506 sec</td>
<td>1136 km 852 km</td>
</tr>
<tr>
<td>Ghauri</td>
<td>528 sec 497 sec</td>
<td>928 km  818 km</td>
</tr>
</tbody>
</table>
Data distribution may have to be in real-time.

We can see from the table that the total time available for decision-making ranges from a minimum of 3 minutes for the shorter range missiles to a maximum of about 10 minutes.

This would mean that the data dissemination cannot wait for a suitable time before an independent assessment can be made. Data must be made available in real time.

During test launches also the surveillance system can ensure an independent monitoring of the launch so as to make sure that no escalation occurs in case of any problems with the test launches.

Special organisational arrangements may be needed - by the international organisation - political will.
Some Questions

The availability of the Detector arrays with the required performances. Mercuric cadmium telluride detectors operating in the infrared bands – configured as a focal plane array – is one area of critical technology. US and maybe France have capabilities – will they be available. Do not know about Russia, Israel, China.

The field of view or area of coverage should be large – wide field of view optics butting of the detector arrays maybe multiple optical payloads. VHRR experience but design fundamentally different.

The design of the optics could also be critical. One metre – maybe larger - focal length mirrors – special lenses, filters could also be areas of concern. Many remote sensing satellites operate at high resolutions – but they operate largely in the visible and at low orbits. Some stretch of capabilities may be needed.

If the detector requires onboard cooling (most probably it will) this would complicate the design. But again can be done.

International cooperation can also reduce cost. Would France, Russia, China, India and maybe Japan cooperate. Million dollar question.

System may need complementary ground based capabilities. Can such facilities be located across the world at suitable locations to complement satellite surveillance.

Cruise Missiles may be the alternative probable route – no role for space surveillance?