An Open Source Analysis of China’s Anti-satellite Testing in Space

Brian Weeden
Technical Advisor
Secure World Foundation
Overview

• What was launched from Xichang Satellite Launch Center in May 2013?
  – From which launch pad?
  – How high did it go?
  – What rocket was used?

• Summary of what’s known about Chinese ASAT testing in space since the mid-2000s

• **Not covered today**: history of American and Russian ASAT testing in space & compares to what China is doing (see full report)
• May 13, 2013, a rocket was launched from Xichang Satellite Launch Center

• Chinese government
  – “Chinese Academy of Sciences has conducted a high altitude scientific exploration test”
  – Sounding rocket, reached 10,000 km height
  – Released barium cloud to observe upper atmosphere

• US government
  – “…the launch appeared to be on a ballistic trajectory nearly to [GEO]. We tracked several objects during the flight…and no objects associated with this launch remain in space”

• Beltway rumors
  – Was the test of a new ASAT weapon that could reach to GEO
Launch trajectory from the NOTAM (Source Spaceflight101.com) Image © 2013 Google Earth.
Image of the May 13 launch from Xichang taken from Hong Kong (Image credit Wah!)
QUESTION 1: FROM WHICH LAUNCH PAD?
Launch Complex 2 (LC-2)

Possible to turn around the pad for a sounding rocket launch in 12 days?
Example of lightning masts

Lightning masts at Cape Canaveral Pad 39B. Image credit Wikimedia Commons (source)
Lightning masts at Xichang (circled in red). Image © 2013 Google Earth.
Northwest unknown pad

- Built to support mobile rocket launches, beginning some time in mid-2005

*Historical imagery of the northwest pad at Xichang. Images © 2005, 2006, 2012, & 2013 Google Earth*
Southeast unknown pad

November 15, 2006

April 30, 2012

Historical imagery of the southeast pad at Xichang. Images © 2006, 2012 Google Earth
Digitalglobe image of Xichang, April 3, 2013

Imagery of Xichang from April 3, 2013, showing a TEL on the southeast pad. Image © 2013 DigitalGlobe. All rights reserved.
Comparison to an IRBM TEL

TEL on SE launch pad at Xichang
April 3, 2013

DF-21C TEL elevated for launch.
(Image credit Air Power Australia)

WS2500 TEL
QUESTION 2: HOW HIGH DID IT GO?
U.S. officials:
• “…the launch appeared to be on a ballistic trajectory nearly to [GEO]*
• “[objects from the launch] re-entered the Earth’s atmosphere above the Indian Ocean”

*assumed to be 30,000 km for this analysis

The boundaries of the Indian Ocean. Image credit Wikimedia Commons
The ground track of a rocket from Xichang to the Equator for a non-rotating Earth indicated by Point A and a rotating Earth indicated by Point B (source: David Wright). Image © 2013 Google Earth.

**Flight time for a notional SLV to 10,000 km:** 2.2 hours

**Flight time for a notional SLV to 30,000 km:** 6.7 hours
QUESTION 3: WHAT ROCKET WAS USED?
Potential candidates

• Based on the satellite imagery and launch pads, rocket needs to be of a mobile nature

• DF-21C IRBM
  – Estimated max horizontal range of 2,500 km or 1,250 km straight up
  – Not a possibility for May 2013 launch

• DF-31 ICBM
  – Estimated max horizontal range of 12,000 km or 6,000 km straight up
  – Possible to reach 10,000 km but not ~30,000 km
Mystery rocket program?

• After the 2007 Chinese ASAT test, there was much speculation about the heritage of the rocket used in that test as part of the SC-19 ASAT system

• Most of the speculation centered around the KT-1
  – Shown publicly at some Chinese trade shows, marketed as a “commercial” launcher

• Proposed heritage was DF-21C -> KT-1 -> SC-19
  – Didn’t quite fit
  – Also claims that the SC-19 borrowed from the DF-31
China’s rocket program

• Currently centralized in two state-owned corporations who are competitors

• Chinese Aerospace Science and Technology Corporation (CASC), First Academy of Launch Vehicle Technology (CALT)
  – Long March family of SLVs
  – Silo-based DF-4 and DF-4 ICBMs
  – DF-31/DF-31A ICBMs

• Chinese Aerospace Science and Industry Corporation (CASIC)
  – Responsible for nearly all of China’s tactical ballistic missiles
  – DF-21 IRBMs
Kuaizhou: China’s “quick vessel” to space

- September 25, 2013 launch from Jiuquan Satellite Launch Center
- Kuaizhou “Quick Vessel” solid-rocket SLV
- Part of China’s “Operationally Responsive Space” program
Behind the scenes

Image of the Kuaizhou launch taken from an access road near the launch site. (Source)
Is it authentic?

Kuaizhou Launch pad

Shenzhou Launch pad

Fence
Ground truth

Google Earth imagery of Jiuquan Kuaizhou Launch pad

Fence along access road

Shenzhou Launch pad

Kuaizhou Launch pad

Access road

Image NASA
Image © 2013 DigitalGlobe
A plausible heritage

• From Chinese blogger kktt: “CASIC wanted to develop a new business in solid rocket SLVs by leveraging its expertise with solid rocket missiles”
  – KT-1: four-stage SLV 13.6 meters in length and 1.4 meters in diameter, tested twice unsuccessfully
  – KT-2: 1.7 meter diameter, never tested
  – KT-409: 1.4 meter diameter, four-stage rocket (three solid with a liquid upper stage), launched from a WS2500 TEL (same as the DF-21C)
  – Kuaizhou: 1.7 meter diameter, four-stage rocket (three solid with a liquid upper stage)

Was the May 2013 Xichang launch that of a Kuaizhou on a ballistic trajectory?
## Known SC-19 testing to date

<table>
<thead>
<tr>
<th>Date of Test</th>
<th>Target Object</th>
<th>Interceptor Object</th>
<th>Interceptor Type</th>
<th>Amount of Trackable Debris Created</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/5/2005</td>
<td>None known</td>
<td>SC-19</td>
<td>direct ascent</td>
<td>0</td>
<td>Likely rocket test</td>
</tr>
<tr>
<td>2/6/2006</td>
<td>None known</td>
<td>SC-19</td>
<td>direct ascent</td>
<td>0</td>
<td>Likely flyby of an unknown orbital target</td>
</tr>
<tr>
<td>1/11/2007</td>
<td>FengYun 1C</td>
<td>SC-19</td>
<td>direct ascent</td>
<td>3,280</td>
<td>Successful intercept and destruction of an orbital target</td>
</tr>
<tr>
<td>1/11/2010</td>
<td>CSS-X-11 (ballistic)</td>
<td>SC-19</td>
<td>direct ascent</td>
<td>0</td>
<td>Successful intercept and destruction of a suborbital target</td>
</tr>
<tr>
<td>1/27/2013</td>
<td>Unknown (ballistic)</td>
<td>SC-19</td>
<td>direct ascent</td>
<td>0</td>
<td>Successful intercept and destruction of a suborbital target</td>
</tr>
</tbody>
</table>

**Total Amount of Trackable Debris**: 3,280
Summary of findings for new ASAT

- Most likely candidate launch pad for the May 2013 launch was one of the mobile pads identified by the lightning masts
- A TEL was imaged on the SE pad six weeks before launch
- The TEL appears to be similar to the WS2500 TEL used for the DF-21C
- If objects from the launch landed in Indian Ocean, then they had to have gone much higher than 10,000 km
- Existing ballistic missiles do not have the power to reach 10,000 km, let alone “nearly to GEO”
- Likely heritage from DF-21C and related to SC-19 and Kuaizhou
Unanswered questions

• Has the SC-19 finished testing, and does that mean it is now “operational”?
• If the May 2013 launch was a scientific experiment, when will the data/results be published and where?
• Is the rocket used in May 2013 the Kuaizhou or derived from it?
• Was the May 2013 launch the first in a series of new tests of a new system?
• Is there a plan to test this new system with an actual intercept?
• Is this new system reusing the same KKV from the SC-19?
• What threat does this system pose to satellite systems in HEO/MEO/GEO?
Thank You
Questions?

Brian Weeden
bweeden@swfound.org