Disaster on the Launchpad
Implications for SpaceX and the Industry

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Earlier yesterday morning, a SpaceX Falcon 9 rocket exploded on the launch pad while preparing to undergo a standard static fire test for the launch of **Spacecom's** Amos-6 communications satellite. The rocket and the satellite were completely destroyed and the launch pad appears to have suffered extensive damage.

While the cause of the explosion is not yet known, video evidence would seem to suggest a failure with the pad's fuel handling system or the rocket's second-stage oxygen storage tank, as SpaceX had not yet commenced the static fire test.

For SpaceX, the reputational injury of suffering two catastrophic failures in a little over a year may prove more damaging than any discrete financial loss. That said, the implications for Spacecom may be even worse yet, and the "ripple effect" is likely to impact the industry both far-and-wide:

Falcon 9 Explosion on Launch Pad

Source: USLaunchReport.com

- **Spacecom options narrow.** Already-squeezed by the premature loss of its Amos-5 satellite in December 2015, Spacecom was eagerly (desperately) awaiting the launch of Amos-6 to provide the company with much-needed incremental capacity and the ability to diversify its customer/geographic exposure. Adding further significance to the launch, Beijing-based **Xinwei Technology Group** agreed on August 24 to buy Spacecom for $285 million, conditional on the successful launch of Amos-6.

  Insurance proceeds should enable Spacecom to fully-recover the ~$200 million it paid to **IAI** for the Amos-6 satellite, but Spacecom remains fully-exposed to the business/revenue disruption caused by the loss of the satellite. Should Xinwei choose to abandon its acquisition bid, Spacecom will face the difficult choice of: (1) seeking an alternative buyer, or (2) biding its time for another three years while awaiting the launch of a replacement satellite.

- **Facebook looks to other options.** In October 2015, **Facebook**, in partnership with **Eutelsat**, agreed to lease the entire African Ka-Band payload on Amos-6 for $95 million over five years, pursuant to Facebook's internet.org initiative to deliver affordable internet access to the developing world. The destruction of the Amos-6 satellite effectively unwinds the effort with ramifications for all-involved:
  - **Eutelsat:** Eutelsat issued a press release indicating a potential €45-50 million revenue loss over the next three years with a mitigated impact on EBITDA due to lower costs. The company affirmed its current financial objectives and indicated it will explore other options to serve impacted customers prior to the launch of its African HTS satellite in 2019

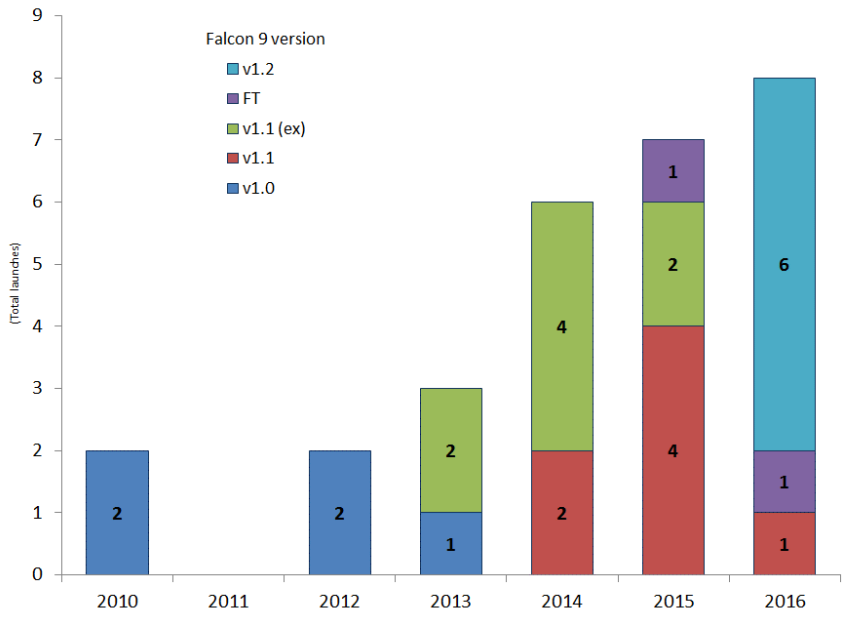
- **Hughes/EchoStar:** Earlier this year, Eutelsat/Facebook selected Hughes as the gateway/terminal provider for the African broadband project using the company's JUPITER system and re-conditioned user terminals. Assuming the deployment of three gateways, two data centers and the 500k terminals (at $100 apiece), the project likely represented a revenue opportunity of ~$100 million to Hughes.
- **Facebook:** Should it choose to push forward with its satellite broadband effort, Facebook could potentially partner with one of the handful of satellite operators launching HTS capacity into the African market, including **Intelsat** (IS-33e, IS-35e), **Yahsat** (Al Yah 3), or **Avanti** (Hylas 4). However, these operators are unlikely to sell capacity at the ~$100 per Mbps/month reflected by the Spacecom deal (two-thirds below going market rates), which may preclude the economic viability of the project. Alternatively, Facebook may choose to accelerate the rollout of its Aquila solar drone program, which completed its first successful flight on June 28.

- **Launch insurers dodge a bullet.** While the Amos-6 satellite was mounted atop a rocket, the launch insurance policy was not yet in effect because SpaceX had not yet triggered an intentional ignition. Consequently, the reported $285 million payout will be paid by IAI's "marine cargo transit" policy, which covers the transportation and handling of the satellite up until the point of launch.

  Notably, prior to March 2016, SpaceX did not mount satellites onto the rocket until after the static fire test was complete. Beginning with the SES 9 launch, however, SpaceX modified its testing procedure in a bid to save cost and time. We strongly suspect SpaceX will be forced to revert to its legacy procedures which would have prevented the destruction of the Amos-6 satellite.

- **Launch manifest:** Having carried out seven launches in 2015, SpaceX was targeting an unprecedented 18 launches in 2016, implying a cycle time of less than two per launch through the balance of the year. With this goal clearly unachievable, the manifest may need to compress even further in 2017 for SpaceX to begin clearing its bloated launch manifest.

Falcon 9 Flight History



Source: Quilty Analytics, Inc.

Near-Term SpaceX Launch Manifest

Date	Launch Vehicle	Payload	Customer	Launch Site
09/03/16	Falcon 9	Amos 6	Spacecom	Cape Canaveral
09/19/16	Falcon 9	Iridium 1-10	Iridium	Vandenberg
Oct'16	Falcon 9	Formosat 5 & Sherpa	NSPO/Spaceflight	Vandenberg
Oct'16	Falcon 9	SES 10	SES	Cape Canaveral
11/11/16	Falcon 9	CRS 10	NASA	Cape Canaveral
Nov'16	Falcon Heavy	Demo Flight	N/A	Kennedy Space Center
Dec'16	Falcon 9	Iridium Next 11-20	Iridium	Vandenberg
4Q16	Falcon 9	EchoStar 23	EchoStar	Cape Canaveral
4Q16	Falcon 9	SES 11/EchoStar 105	SES/EchoStar	Cape Canaveral
4Q16	Falcon 9	Koreasat 5A	KT Corp.	Cape Canaveral
02/01/17	Falcon 9	CRS-11	NASA	Cape Canaveral
06/01/17	Falcon 9	CRS-12	NASA	Cape Canaveral
TBD	Falcon Heavy	STP-2	USAF	Kennedy Space Center

Source: spaceflightnow.com and Quilty Analytics.:

- **Return-to-flight:** The fact that the rocket exploded on the launch pad (vs. inflight) should help to expedite the launch investigation, as investigators will be able to physically inspect the damage rather than relying on telemetry data to forensically diagnose the root cause of the failure. That said, a pad explosion implies a destroyed launch pad and a major reconstruction project. How long will it take for the Falcon to fly again? While impossible to predict, some key points to keep in mind include:
    - **Rocket root cause:** If the accident investigation reveals that internal tankage or plumbing on the Falcon caused the failure, we would anticipate a six-month stand-down for SpaceX to redesign, test, qualify any necessary fixes.
    - **Ground root cause:** If, alternatively, the ground system proves to be the root cause, any necessary changes can be incorporated into the rebuilt launch pad, with no attendant "hold" on rocket launches.
    - **Rebuilding the launch pad.** Given the exceedingly rare nature of launch pad explosions (Cape Canaveral last-experienced a launch pad failure in April 1960, when a Titan D rocket exploded on SLC-11), it is difficult to estimate how long it will take to repair the damage on SLC-40. While not a perfect analogy, the October 2014 explosion of an Antares rocket several hundred feet above the launch pad resulted in extensive damage that took just over a year and $15 million to repair.
    - **Shift to pad 39A?** While awaiting repairs to SLC-40, SpaceX could potentially shift launch operations to pad 39A, which SpaceX acquired in 2014 (20-year lease) and is currently undergoing final modifications to support the launch of both the Falcon Heavy and the Falcon 9. It is currently unclear when the pad will be ready to support launches and whether any modifications will be needed as a result of the SLC-40 accident investigation.

- **KSC Launch Pad 39A**

Source: NASA.

- **Vandenberg good to go?** In addition to Cape Canaveral, SpaceX operates a redundant west coast launch site to support launches to polar and sun-synchronous orbits. **Iridium** is currently scheduled to launch from Vandenberg on September 19, but this launch will undoubtedly be delayed until SpaceX can determine the root cause of the AMOS-6 failure. If the SLC-40 ground system is implicated, SpaceX may need to incorporate these changes into the Vandenberg pad.

- **Iridium waiting game continues.** As mentioned above, Iridium was next in line on the SpaceX launch manifest, but will now likely see its launch bumped back by several months depending on the root cause of the failure. If pad-related, the delay might range from 2-4 months. If rocket-related, a 4-6 month delay seems more likely. These delays will likely cause Iridium to miss its (self-imposed) deadline of bringing the NEXT constellation fully online by the end of 2017 but should have a minimal impact on revenues (essentially, delayed revenue recognition of new services such as Certus and **Aireon**). That said, the Aireon service should still be fully-operational well-before ADS-B equipage mandate comes into force on January 1, 2020.

- **Falcon Heavy:** Already running four years behind schedule, SpaceX's heavy lift rocket is likely to incur yet another delay. SpaceX had been targeting a maiden launch in November, but a push-out to early-2017 now appears likely. Two early customers (**ViaSat** and **Inmarsat**) had previously booked backup launches, but additional defections (**ArabSat**, **Eutelsat**, **Telesat**) could be possible.

CONCLUSION: There is a good reason that companies within the Satellite & Space industry do not generally root for the failure of competitors...catastrophic events generally cannot be isolated, and the industry suffers as a whole. Due to crowded launch manifests, SpaceX's launch competitors (**Arianespace**, **ILS**, **ULA**) typically find it difficult to steal launch customers. Likewise, satellite operators such as **Intelsat** and **SES** may have gained some market advantage in Africa, but both companies are manifested with SpaceX (Intelsat on a Falcon Heavy, TBD) and will likely suffer delays of their upcoming satellite launches.

Finally, for SpaceX, which has consistently pushed the envelope of rocket development (3D printed engines, reusable rockets, densified propellants, etc.) and achieved rapid success, this latest failure is yet another reminder that "rockets are tricky" and quality control is paramount when playing with explosives.

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