The Ariane 5 Flight 501 Failure

By James Theron

Background

- Developed by Arianespace to deliver payloads into to low Earth orbit.
- Was capable of carrying payloads larger and heavier than that of the Ariane 4.
- Spent 10 years in development costing a cumulative $7billion.
- 501 Flight was proposed to carry $500 million worth of satellite technology into orbit.

What happened during flight 501

- 39 Seconds after take off, the shuttle is at an altitude of around 3700m.
- The shuttle begins to shake wildly and spiral out of it’s intended course.
- The shuttle proceeds to activate it’s self-destruct function.

What went wrong?

- The inertial reference system (SRI) ran into and operand exception when converting the horizontal velocity from a 64-bit float to a 16-bit integer due to an overflow.
- The Software is unable to handle the overflow as it does not have the appropriate exception handling code.
- The exception is handled by the software's default exception handling software which results in the SRI shutting down.
- The backup SRI is running the same code and also shuts down for the same reason.
- The on board computer is longer guided by the SRI and can only be left to self destruct.

The poor decision making behind the scenes

- The software from the Ariane 4 is repurposed to use in the Ariane 5 in order to cut costs in avoiding further safety procedures.
- The software did not anticipate a high horizontal velocity since it was designed for the Ariane 4 which is a smaller shuttle.
- The development team does is not able to successfully adapt the software to the Ariane 5 and anticipate potential exceptions with proper exception handling software.

Conclusions

- Don’t undervalue the importance of rigorous software design.
- There’s no room for shortcuts in expensive aerospace projects.
- Always prepare for any potential mistakes as software isn’t necessarily perfect.

Potential Solutions

- Implementing proper exception handling software.
- Designing new software from the ground up instead of repurposing.
- Correctly adapting the Ariane 4 software for use in the Ariane 5.

References

Ariane 501 Inquiry Board, 1996. *Ariane 5 Flight 501 Failure*. [online] Available at: <https://www-users.math.umn.edu/~arnold/disasters/ariane5rep.html> [Accessed 28 March 2021].

Le Lann, G., 1996. *The Ariane 5 Flight 501 Failure - A Case Study in System Engineering for Computing Systems*. INRIA, pp.7, 8, 9.

Luton, J. and Schmitt, D., 1998. *The Ariane project*. Arianespace, p.1.