



Adaptive Information Security for the Cloud

The aftermath of mystery flight MH370: what can adaptive software engineers do?

A "Geek of the Week" talk based on

Yijun Yu, "The Aftermath of Mystery Flight MH370: What Can Engineers Do?". In: Proceedings of the IEEE. upcoming, 2015.

Sept. 9, 2015 @ Engineering Adaptive Software workshop, Shonan, Japan

Internet of Flying Things need Engineering Adaptive Software Systems

Last year will be remembered as a **dark** year in aviation history



Number Of Fatalties (Civil Aircraft with 19 or More Passengers)





QZ8501 (162)



Germanwings 4U9525 (150)



MH17 (298)



MH370 (239)

Microsoft Research

Bad weather, reported by flights nearby

Predicting wind speeds using Azure (The Internet of Flying Things)

PHYSICAL

QZ8501



Mandate two persons inside the cockpit...

AG (Cockpit_{door} (pilot₁ | pilot₂) or (pilot₁ | crew))





Germanwings 4U9525

Conflicts at Ukraine:

Rerouted the civilian flights to avoid war zones

















July 31, 2015



September 3, 2015

MH370: Reunion wing debris 'certainly' from missing flight



If we'd used the cloud, we might know where MH370 is now









Airplanes as Internet of Flying Things

- Change blackbox to live streaming boxes
- Verify the plane like you verify a bitcoin
- Simulate the physics of flights from the ground

SATELLITES

- Is SatCom feasible to locate a flight over the ocean ?
 - ~100K flights operating in Sky
 - Cloud computing can handle that computing needs
 - Transmitting FDR requires substantial amount of bandwidth
 - There is no mast in Indian Ocean
 - According to Prof. Mischa Dohler it was not possible

MISCHA'S VISION OF 5G NETWORK "THE TACTILE INTERNET"

https://youtu.be/ASphNkMOq-U

- Transmitting physical touches
- distance (Sender, Recipient) / c > 50ms
- Smoother transmission requires faster feedback
- Interpolating frames of feedback with simulated movement, proactively (before it actually receives the signals)



SEARCHING FOR ALIENS

Habitable Zone Line Up

Sub-Neptune-size

Super-Earth-size

Kepler-22b 2.4 R_⊕ Kepler-69c 1.7 R_⊕ Kepler-62e 1.6 R_⊕

e Kep 1.

Kepler-62f 1.4 R_⊕ Earth 1.0 R_⊕

SATCOM

- Ka band of frequency, 26.5~40GHz
 E.g., Inmarsat 4A F4, Kepler Space telescope
- Bandwidth is 4.3 Mbps
- Divide it up by 100K flights, you get merely 430bps, or 53.5 bytes per second

INTERPOLATION

 Interpolating simulating computation with the physical transmissions, one gets

430 bps = 25.8 K bpm = 1.55 M bph

 That's more than enough for sending hourly locations of every flight !!! "The Aftermath of Mystery Flight MH370: What Can Engineers Do?"

Part 1. It is feasible to implement Internet of Flying Things

Part 2. What is challenging to EASSy?

"The Aftermath of Mystery Flight MH370: What Engineers Can't Do w/o EASSy?"





Solve the right problem?





Solve the problem right?





How **safe** and **secure** it is to fly in the sky?

Nuseibeh, B. "Securing the Skies: In Requirements We Trust". IEEE Computer, 42(9):64-72.



CYBER INTERLEAVE PHYSICAL



Boundaries need to be filled with data knowledge elicited simulated verified

DISTRIBUTE HIGH VARIABILITY MODEL



ANOTHER MISSING OBJECT



EXPLANATION ACROSS THE KNOWLEDGE BOUNDARY

https://www.youtube.com/watch?v=EDehBet2Tpg

WE NEED CONTROL WITH THE RIGHT-LEVEL OF KNOWLEDGE



WE NEED KNOWLEDGE FOR EXPLANATION: TRUST

- When a self-adaptation decision was made, how can it link to users' awareness ?
 - Causal Dependencies and Traceability Links
 - Causal Context => Decisions => Effect Context

Armstrong Nhlabatsi, Thein Tun, Niamul Khan, Yijun Yu, Arosha K. Bandara, Khaled M. Khan, Bashar Nuseibeh. "Why can't I do that?": Tracing Adaptive Security Decisions, EAI Endorsed Transactions on Self-Adaptive Systems 15(1), doi:10.4108/sas.1.1.e2, 2015.

TAKE HOME

- Internet of Flying Things appeals to engineers to prevent the tragic of another MH370.
- Challenge: How can knowledge used in MAPE-K loops be elicited, simulated, verified, and explained to ensure Performance, Privacy, Security, and Trust.
- Checking John's Top-10 challenges, it matches all of them, in an increasing order of difficulty. The most difficult one is "R10. Full Adaptation".