Human Performance in Degraded Modes

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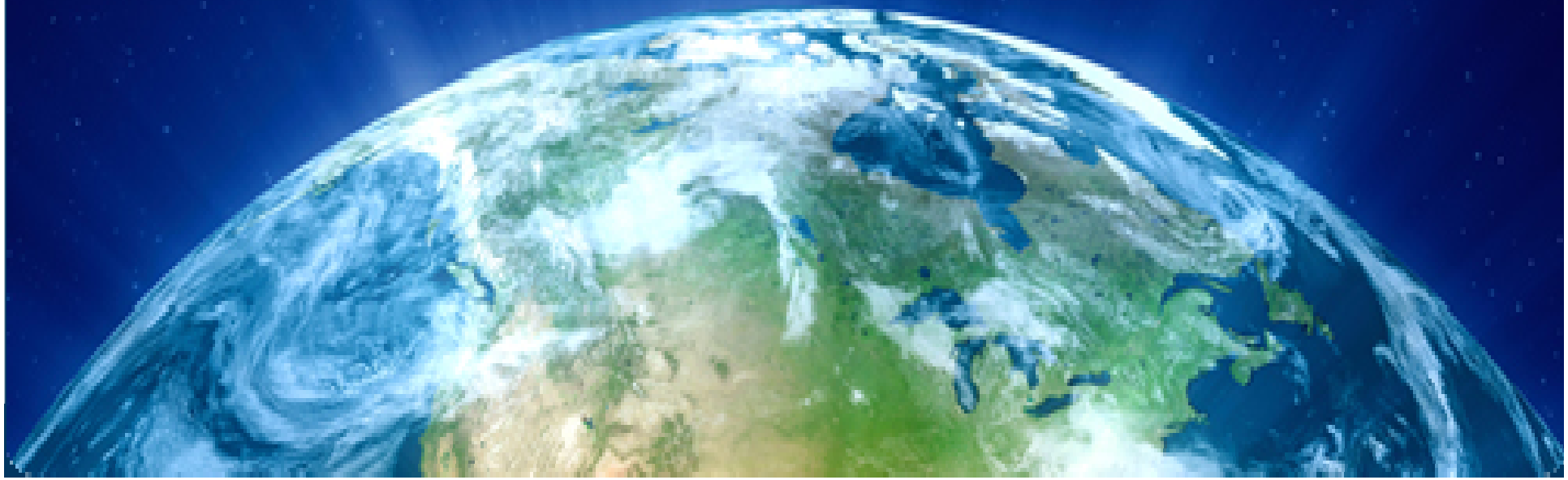
I Am A Software Engineer

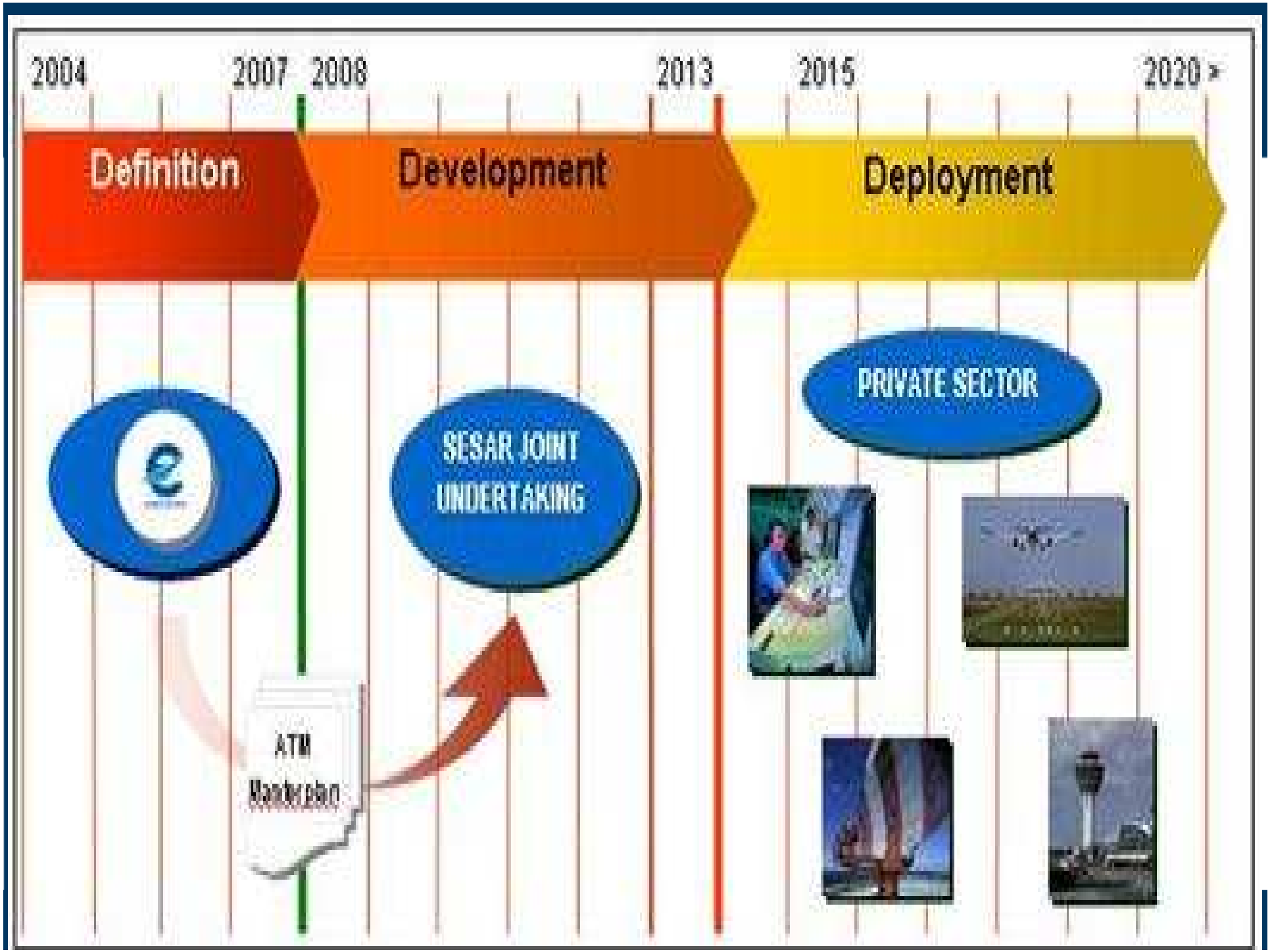
I am not the best person to tell anyone
how to do things right…

Key Message

- To make things go right…
- We need to change the balance.
- Look less at human performance of ATCOs.
- Increase focus on performance of engineers.

NextGEN Implementation Plan 2013




2004
2007
2008
2013
2015
2020 >
Definition
Development
Deployment
SESAR JOINT UNDERTAKING
PRIVATE SECTOR
ATM Masterplan

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Aging, Complex Critical Infrastructures...

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Reliability in Cloud Infrastructures

- **Two months, 1 million users:** October 2009 T-Mobile's Sidekick users lost contacts, calendars, photos when Microsoft subsidiary Danger suffered a server failure.
- **Permanent data loss, over 6,300 users:** 1-4th July 2010, Evernote hardware failure, loss of data.
- **Four days, 35,000 users:** February 2011 Gmail accounts and Google Apps customers lost all the data in the accounts. Google had to resort to restoring backups from tapes, in an operation lasting 4 days.
- **Several hours, service-wide:** 6,11 and 15 August 2008, Google's enterprise e-mail system, Apps Premier Edition, outage affected nearly all users for 2 hours; some were affected for 24 hours.
- **30 minutes, service-wide:** September 2011, Google Docs, Google Docs List and Google went offline for 30 minutes, affecting all its users.
- **72 hours, as big as 70m users:** Millions of Blackberry users across Europe, Middle East and Africa suffered outage for 3 days in October 2011. Speculation is that most of global customer base (70m users) were affected at some point during 72 hours.

ANSPs in Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Germany, Hungary, Ireland, Luxembourg, Malta, Norway, Portugal, Slovenia, Spain, Turkey, UK.

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Aim is to Provoke Discussion...

- Recent trends in ATM Engineering.
- Increasing complexity in software networks:
  - Leads to more complex failure modes.
- Increasing use of COTS products:
  - Leads to new security threats (after break).
- Increasing use of sub-contractors.

Key Message

- You outsource the service.
- You do not outsource the risk.

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What has this to do with Human Performance?

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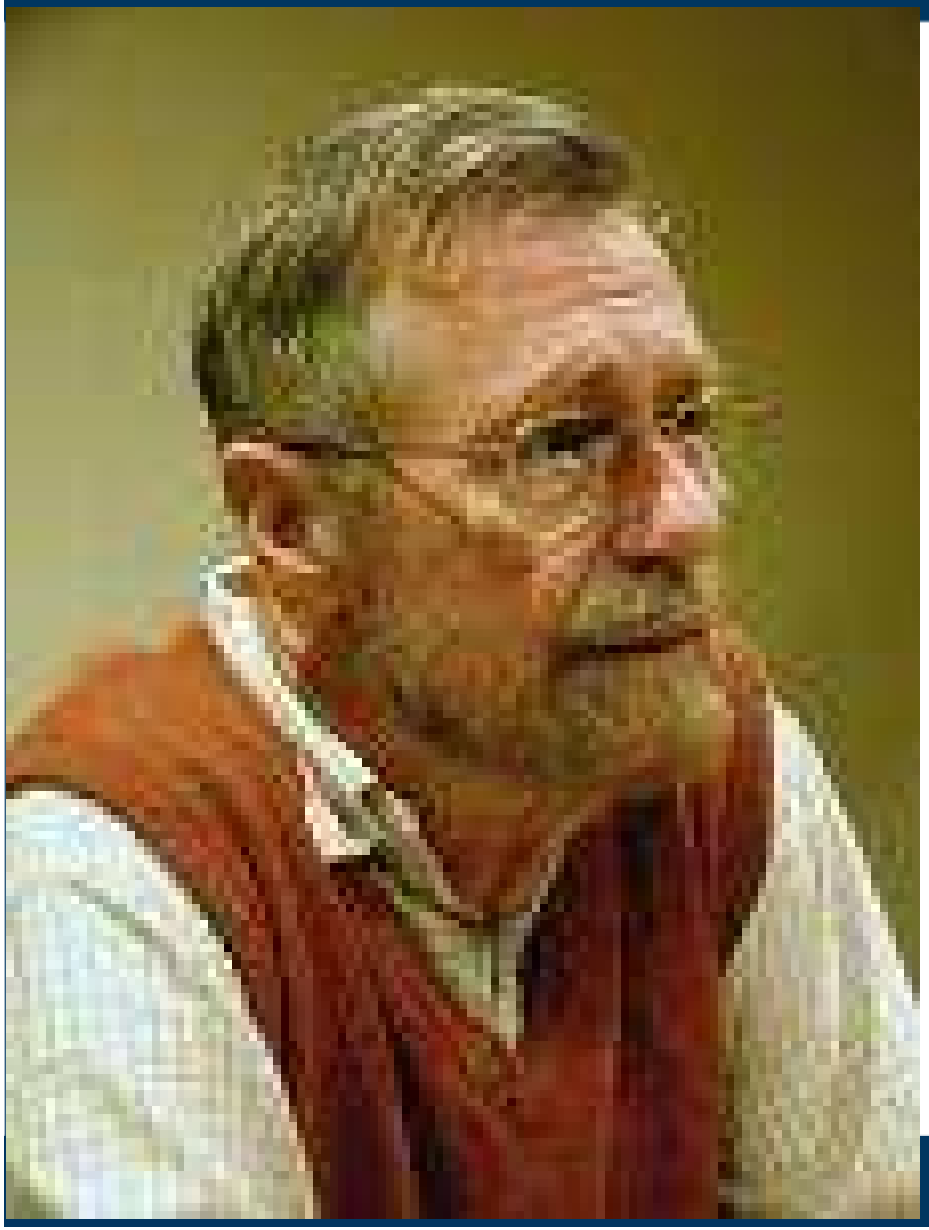
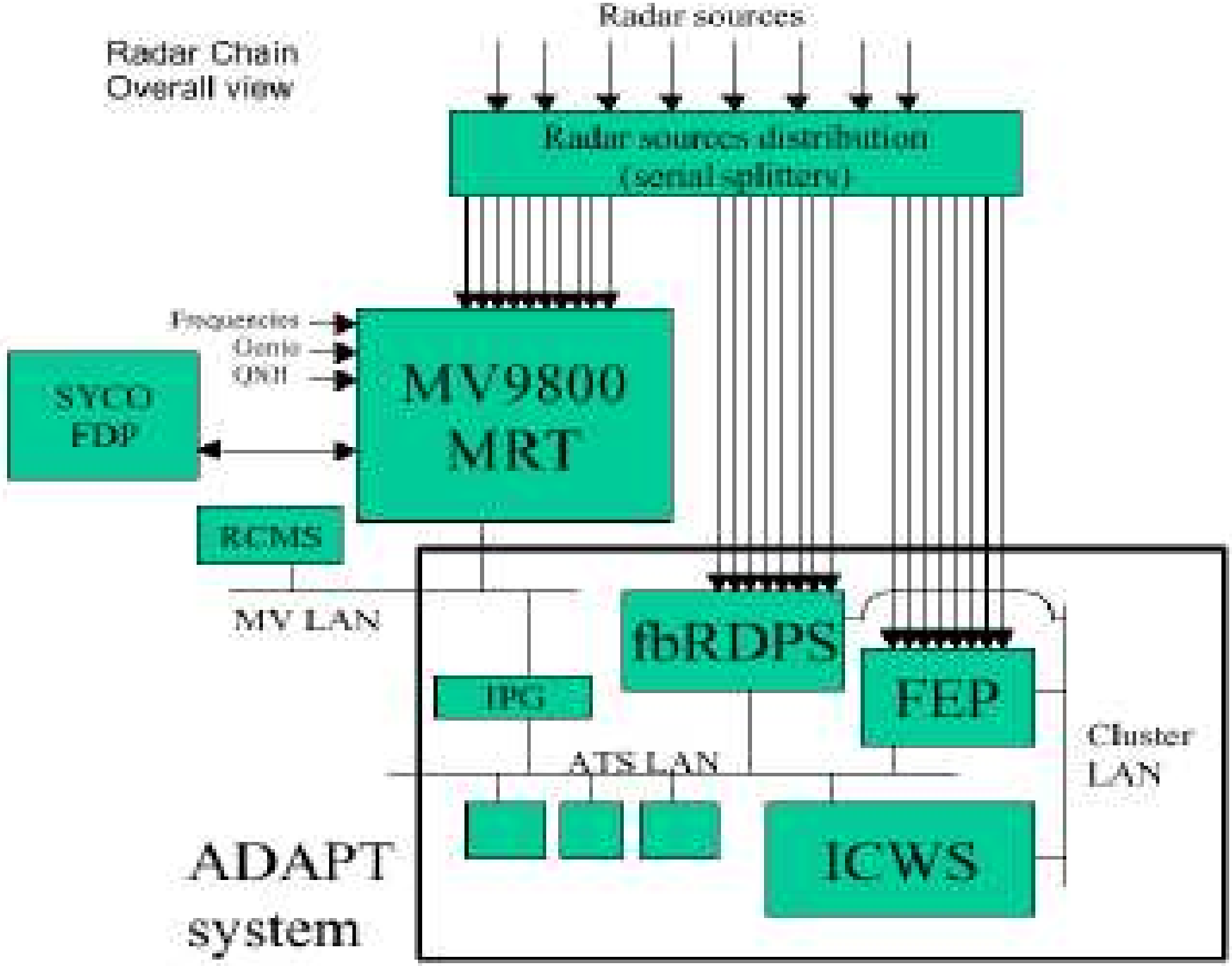


Edsger W Dijkstra (1930-2002)

Testing can prove the presence of errors, but not their absence.

Radar Chain
Overall view



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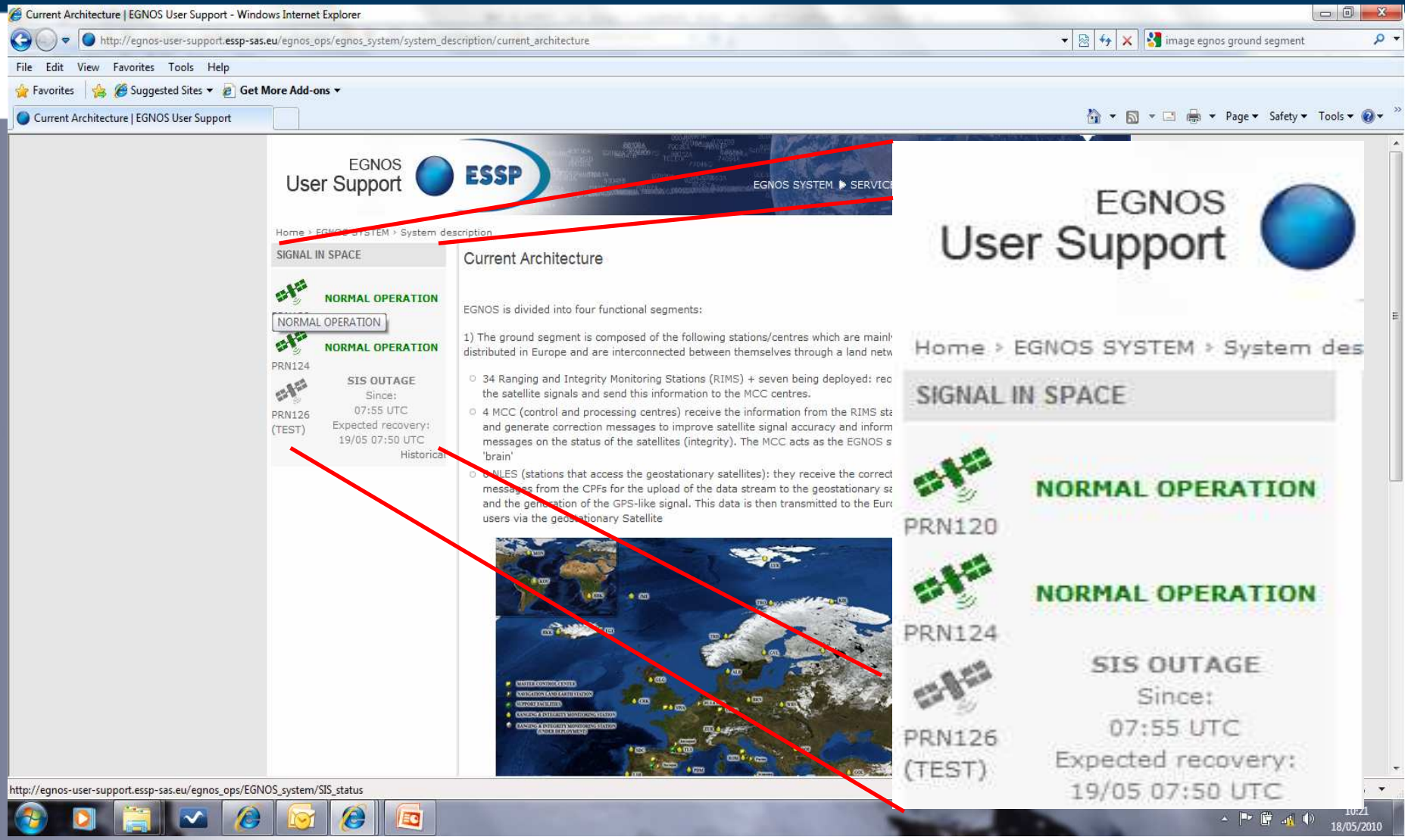
Space-Based Augmentation System

Safety of Life requirements

- ICAO SARPS high-level integrity requirements on Signal In Space

Typical Operation	Horizontal Alert Limit	Vertical Alert Limit	Integrity	Time to alert	Continuity	Availability
En-route	2 NM	N/A	$1x10^{-7}$ /h	15 s	$1x10^{-4}$ /h to $1x10^{-8}$ /h	0.999 to 0.99999
En-route (terminal)	1NM	N/A	$1x10^{-7}$ /h	15 s		
Innitial approach, NPA departure	0.3 NM	N/A	$1x10^{-7}$ /h	10 s		
APV-I	40.0 m	50 m	$1\text{-}2x10^{-7}$ /app (150s)	10 s	$1x10^{-6}$ /h in any 15s	
APV-II	40.0 m	20 m	$1\text{-}2x10^{-7}$ /app (150s)	6 s		
CAT I	40.0 m	15-10 m	$1\text{-}2x10^{-7}$ /app (150s)	6 s		

There Can Still Be Problems...



April 2010

- $2.1 Billion upgrade by Dec 2010:
  - En Route Automation Modernization.
- Faults lead to ‘missing’ flight plans;
  - Other aircraft change identity in flight;
  - Again cannot transfer flight data to Atlanta etc.
  - Undermines ATCO confidence in system;
  - ‘fallback’ original 20 year old IBM system
  - IBM contract expired, uses Jovial – rarely used.
- Test deployment to Salt Lake City:
  - FAA spend $14 million, still not working.
  - Salt Lake City simple compared to Chicago...

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Dublin Airport (More Later…)

- Common failure modes:
  - Permanent; Transient; Recurrent…
- What happens when a problem goes away?
- How much do you spend to find bug?
- This will get worse – huge HF issues…

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US Examples…

- Atlanta FDPS System software bug;
  - Switch data rate configuration error (again).
- Use of fallback system in Salt Lake City:
  - Cascading failure cannot cope with demand.
- ATCOs enter flight data manually;
  - Cannot cope with backlog, knock-on delays.
- 12 hours to diagnose problem;
  - 6 more to catch up with backlog eg New York.

More US Examples…

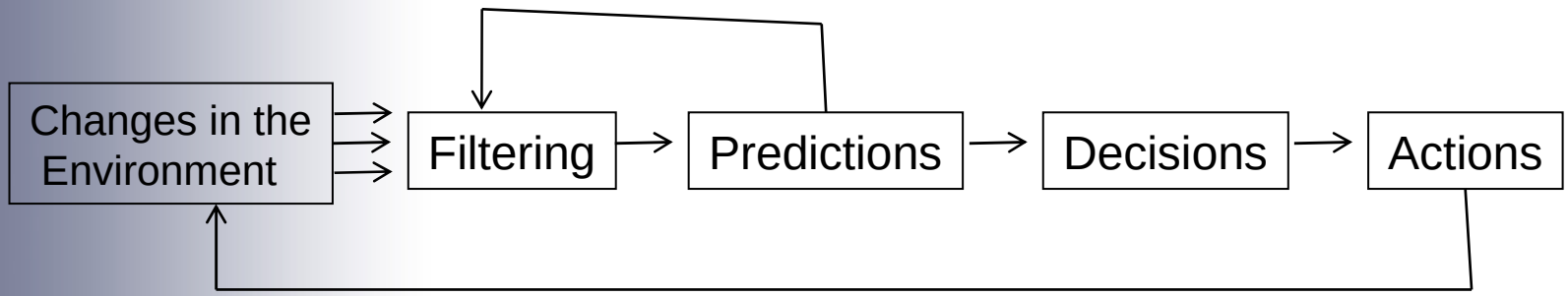
- Fault stems from Salt Lake City:
  - hardware fault on router circuit board;
  - Network interface affects comms with Atlanta;
  - Also affects comms with 21 regional radar centers.
- Network owned/operated by Harris Corp...
  - “We are working with the FAA to diagnose problem and explain the failure of backup systems...”
  - 5 hours to diagnose, 12+ to restore support;
  - ATCOs enter flight plans manually (workload);
  - Effects exacerbated by bad weather eg Chicago

Media and Politicians

- “Sisters Sharon Walker and Sheila James were taking their elderly mother to see their sister in St. Louis. Their 09.30 flight was delayed until 16:00...”

- “Sen. Charles Schumer said the country’s aviation system is ‘in shambles’...’the FAA needs to upgrade the system, these technical glitches that cause cascading chaos across the country are going to become a very regular occurrence...’”

Situation Awareness in Engineering



Moral Hazards

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How Can We Make Things Go Right?

- Increase HF focus on Systems Engineering:
  - Shift patterns (upgrades day or night?);
  - Rostering (fixed or flexible?);
  - Sub-contractors (who owns the risk?);
  - Regulators (Another talk!);
  - Competency in engineering…
  - Diminishing role of ATCOs, rise of Engineers?
  - Pay and incentive structures changing.
- Most ANSPs lack strategic view…
  - There is very little guidance on human performance issues in future ATM…

The Future: SESAR Delivery Manager

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Any Questions?