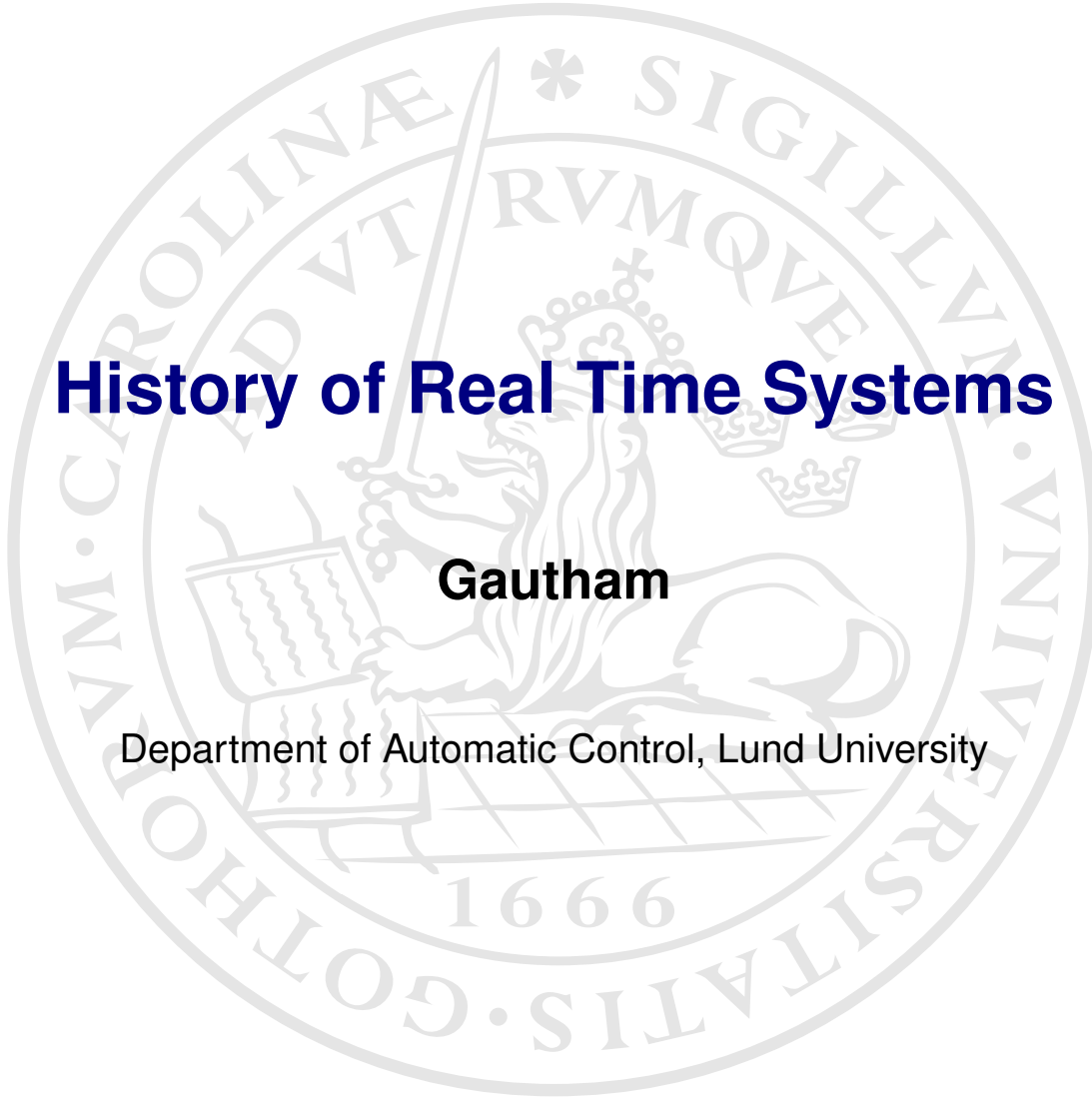


History of Real Time Systems

Gautham

Department of Automatic Control, Lund University

Overview

Introduction

1940s

1950s

1960s

RTOS

A look at RTSS

Cloud. The future?

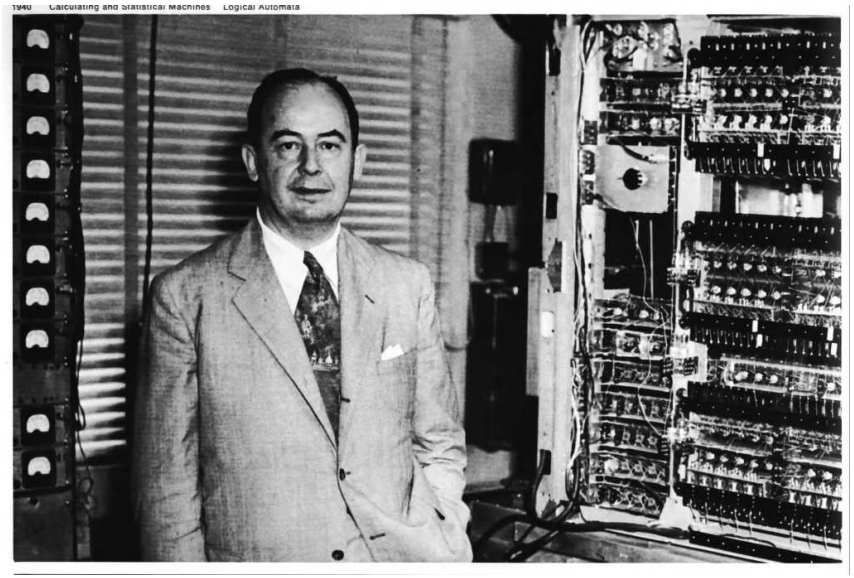
Real Time Systems

- Real Time Systems describes hardware and software systems subject to a ”real-time constraint”, for example from event to system response.
- Is one whose logical correctness depends on the correctness of its outputs as well as their timeliness.[1]
- Many contend that all computer systems are real-time. All systems have a response-time.

[1] **Historical Survey of Early Real-Time Computing Developments in the U.S..**

In the 1940s

- War effort pushed the boundary of technological process.
- Preparation of ballistics tables, aircraft systems, atomic weapons design, fire control, and logistics.
- Von Neumann, Bell labs and MIT were at the forefront.
- Gave rise to project Whirlwind in 1947. Pilot trainer/simulator.Ferrite Core memory - 10 μs access times.incorporated into SAGE air defense system.



In the 1950s

- The race to build faster and energy efficient computers and real-time systems.
- IBM had significant impact on research.
- Their Military Products Division worked on processing centers for SAGE and aiming for B-52 systems.
- The SemiAutomatic Ground Environment(SAGE) air defense system project
  - Maintain up-to-date picture of air and ground situation
  - Control modern weapons rapidly and accurately
  - Present pictures to Air Force
- A real time control, real-time communication and real-time information management system.

continued

- Other Projects include
  - IBM SABRE - Electronic reservation system for AA(American Airlines).
  - IBM Hardware - IBM 700 machine series
  - Project Stretch - All-transistor computer developed in 1954

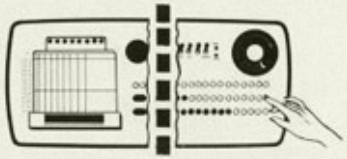
AMERICAN AIRLINES ELECTRONIC RESERVATIONS PROCESSING SYSTEM

How push-buttons-to-computers speed air travel reservations...

1. Passenger requests a seat reservation by telephone or in person from any of 1,100 American Airlines agent positions serving 61 cities.

2. Agent finds out which seats are available on all flights for the desired day by pressing inquiry buttons on her own desk console.

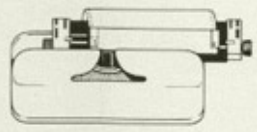
3. . . . which in turn over long-distance lines prompts the Computing Center in the New York area to search magnetic memory as to seats already reserved, others still available.



4. Seat availabilities flashed back to agent from Computing Center. Customer has complete and up-to-the-second choice from all seats open on all flights for destination and day desired.

5. Passenger selects most suitable flight for himself. Agent pushes "sell" button . . .

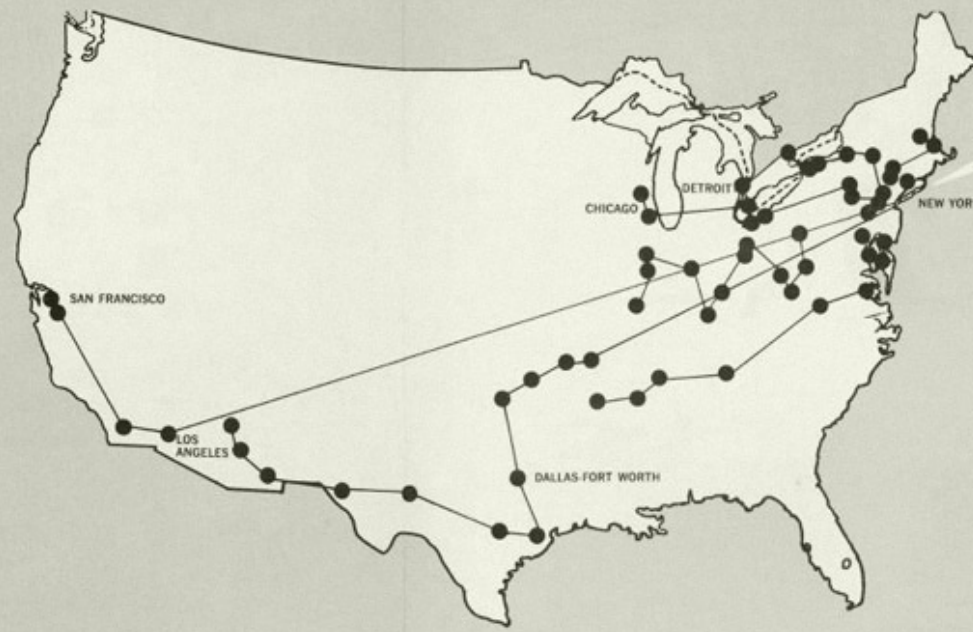
6. . . . and thus instructs the Computing Center to record sale.



7. Computer confirms sale by automatically printing out on agent's printer at console — flight number, date, number of passengers, departure point and departure and arrival times.

8. Agent in turn transmits additional information to computer's memory — typing on her console keyboard the passenger's name, telephone number and any other information such as car rental at passenger's destination, etc.

9. Computer automatically checks and confirms this additional data for completeness, and stores it in memory as part of the passenger's flight until completed, changed or cancelled.



Central Processing Unit

In addition to handling the passenger's reservation, this new IBM system also:

Answers requests for space from other airlines.

Advises agents to remind passengers to pick up tickets.

Maintains and processes passengers waiting lists for fully-booked flights.

Supplies fare quotations.

Supplies information on arrival and departure times.

Reminds agents to advise scheduled passengers of any flight changes.

Bell Laboratories

- Involved in the development of Naval gunfire-control system.
- Major involvement is real-time switching system.
- Stored Program Control(SPC) was a big breakthrough in real-time telephone communications.

in the 60s

- Significant non-military research split into computational and commercial interests.
- Industries like petroleum industry and chemical manufacturing used real-time control.
- IBM worked on NASA's real-time computer for manned space program.
- Project Mercury was used to compute spacecraft orbit go/no-go computation in 10 seconds. Project Gemini succeeded Project Mercury.
- Project Apollo was used for tracking of Apollo spacecraft.
- Its successor project space shuttle implemented pinpoint landing, data processing and very high flight rate.

RTOS

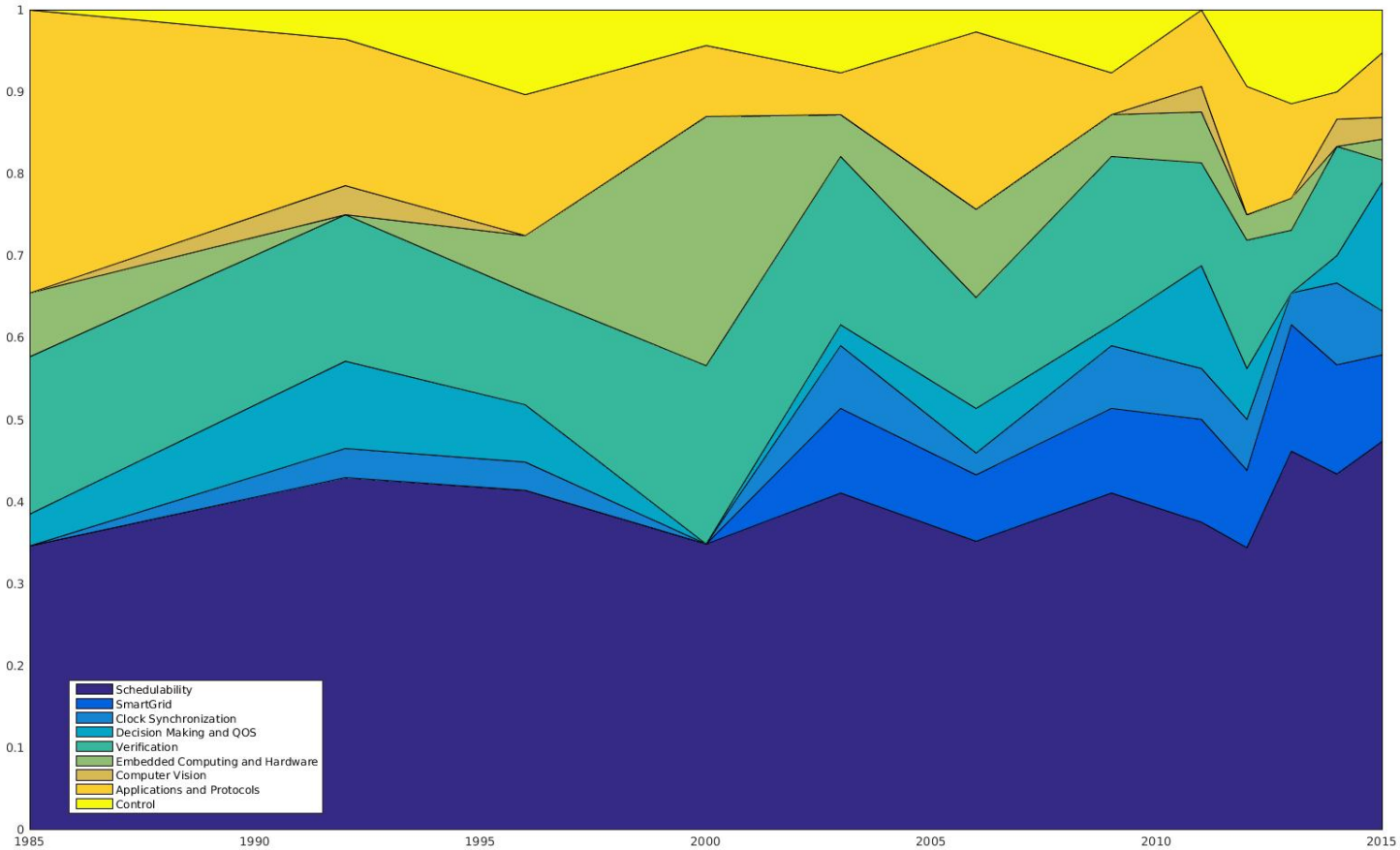
- IBM's first RTOS, the Basic Executive was developed in 1962. Minimum function, it had interrupt handling and I/O driver support. Succeeded by Executive II in 1963.
- Executive II provided disk residence for user and system programs.
- The third RTOS, FORTRAN Executive, Build the foundation for future high-level languages in real-time system.

A look at RTSS

Year	Submitted	Accepted	Percentage Accepted
1986	68	30	44.1
1992	120	34	28.3
1997	99	30	30.3
1998	182	45	24.7
2000	103	28	27.2
2002	106	30	28.3
2004	187	43	22.7
2006	173	42	25.7
2008	187	44	23.5
2010	142	36	25.4
2012	157	35	22.3
2013	160	36	22.5
2015	151	34	22.5

Table: RTSS Statistics

continued


1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1985
1990
1995
2000
2005
2010
2015
Schedulability
SmartGrid
Clock Synchronization
Decision Making and QOS
Verification
Embedded Computing and Hardware
Computer Vision
Applications and Protocols
Control

Cloud Control

- Applying control concepts to the cloud is the next big thing.
- Some notable research done at the Department of Automatic Control in Lund.
- Autonomous cloud is a major research area in the WASP project.
- Brownout control, server startup optimization and energy reduction are major challenges.

2

Thank you.

[2] **Chris Watterston**.