Using Ada in Interactive Digital Television Systems

Thierry Lelégard
Canal+ Technologies
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Agenda

- Who are we?
- What is Digital Television?
- Why using Ada?
- How do we use Ada?
- Future Directions
Part I

Who Are We?

Some advertising...
(Don’t worry, it won’t be long)
Who Are We?

- Canal+ Group
- Canal+ Technologies
- Canal+ Technologies Customers
- Canal+ Technologies Partners
Canal+ Group
www.canalplus.fr

• **Largest Pay-TV Group in Europe**
  – 14,000,000 subscribers
  – 10 countries: France, Spain, Italy (Telepiu), Belgium, Netherlands, Northern Europe, Poland, etc.

• **Analog and Digital TV Operators**
  – Premium channels
  – Satellite operators
  – Cable operators

• **Film Industry**
  – Partially finance most French movies
  – Own Universal Studios (Hollywood, USA)
Canal+ Technologies
www.canalplus-technologies.com

- Subsidiary of the Canal+ Group
  - Based in Paris (France), 580 people (incl. 450 in R&D)
  - Cupertino (CA, USA), 50 people
  - New office in Beijing (China)

- Provide End-to-End Solutions for Digital Television Operators
  - Set-top box software
  - Broadcast center (a.k.a. « head-end ») systems
  - Integration services
Canal+ Technologies
Customers

• 20 Customers (Digital TV Operators)
  – Both inside and outside the Canal+ Group

• In 13 Countries
  – Europe, UK, USA, Japan, India, Malaysia, China, etc.

• 7,000,000 Digital Set-Top Boxes
Canal+ Technologies Partners

- **Multiple Set-Top Box Providers**
  - 26 different providers (Philips, Sony, Pioneer, Nokia, etc.)

- **Multiple Broadcast Media**
  - Satellite, Cable, Terrestrial

- **Multiple MPEG Equipment Providers**
  - Philips, Divicom/Harmonic, Tandberg, Thomson, etc.

- **Multiple Computer Systems Providers**
  - Compaq (OpenVMS), Sun Microsystems (Solaris)
Part II

What is Digital Television?

Some technical background...
What is Digital Television?

- Analog Television
- Digital Television
- Digital Television System Overview
- Digital Television Standards
- Interactive Services
- Conditional Access System
- Set-Top Box Overview
Analog Television

- **One Frequency = One TV Channel**
  - Poor bandwidth usage

- **Noisy Signal**
  - Poor image quality
  - Especially NTSC!

- **No or Poor Data Service**
  - Teletext at best
Digital Television

- **Compressed Pictures and Sound**
- **One Frequency = Several TV Channels**
  - Depends on medium bandwidth (typ. 24 to 38 Mb/s)
  - Depends on compression (typ. 4 to 6 Mb/s per channel)
  - Typically 6 to 10 channels (a.k.a. « services ») per frequency

- **Digital Picture Encoding**
  - Better image quality

- **High-Level Data Services**
  - Downloadable applications
  - Interactive services
Digital TV System Overview

Broadcast Center ("Head-End")

- Audio / Video
- MPEG Encoder
- Data

Business systems
TV Service providers
Internet
Banks, bookmakers, etc...

MPEG MUX

Satellite
Terrestrial
Cable

Uplink
(Any of the above)

Home
Set Top Box

TCP/IP over PSTN
PSTN + X25

Back-Channel
(Any of the above)

TCP/IP over Cable

The "REAL" Difference in Interactive Television
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Digital Television Standards

• **MPEG 2 (Motion Pictures Experts Group)**
  – International standard
  – Defines the audio/video encoding and compression
  – Defines the structure of the bitstream

• **DVB (Digital Video Broadcasting)**
  – European standard
  – Defines the Service Information (DVB-SI)

• **Application-Level Standards**
  – MHEG 5, DVB-MHP, DVB-HTML, etc.
Interactive Services

• **Basic Services**
  – Program guide, weather forecast, job advertising, games

• **Advanced Interactive Services**
  – Tele-banking, home shopping, home betting, network games, interactive advertising

• **Internet Services**
  – Full Internet or specialized services (e-mail, selected web sites)

• **Forthcoming services**
  – Hard disk based recording and time shifting in set-top box
Conditional Access

• Head-End side:
  – TV content scrambling
  – Broadcast specific access rights to subscribers

• Set-Top Box Side:
  – Conditional descrambling

• Subscription and Pay-Per-View

• Secured Transactions

Guarantee Operator’s Revenue
Set-Top Box Overview

- Conditional Access
- Smartcard

Audio Video H/W

Java Applications

MVM (Java)

Vendor Firmware

- Flash Resident Downloadable
- Downloaded

Antenna or cable

MPEG stream

Phone or cable modem

TCP/IP (or X25)

Canal+

STB Vendor

The "REAL" Difference in Interactive Television

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Part III

Ada in Digital Television

Ada, at last!
Ada in Digital Television

- Ada Matches Television Head-End Requirements
- Application Characteristics
- Where Ada is Used / not Used
- Current Issues and New Directions
- Ada 95 Benefits
- GNAT Compiler
- Future?
Head-End Requirements

• Reliability
  – Television is a 24 h/d x 365 d/y business
  – System failure may result in significant loss of revenue
    (especially with « pay per view »)

• Very Short Development Cycle
  – 1 year max between initial idea and deployment on each project

• Openness
  – Many external systems
Ada Matches These Requirements

• Short Development Cycle
  – Rigorous language: Short debug time
  – Ada tasking: Short development time for parallel applications

• Reliability
  – Language safety
  – Ada run-time checks (essential after short testing time !)
Initial Choice (Early 90’s)

• Ada 83 - DEC Ada Compiler
  – Highly reliable compiler
  – Excellent generated code performance
  – Excellent integration with the operating system

• OpenVMS Clusters
  – Highly reliable operating system
  – Unique (at that time) clustering features

• DEC Rdb Database
  – Excellent performance
Application Characteristics

• « Soft » Real-Time
  – Cycle time > 10 ms, often > 1s

• Non-Constant Activity
  – Low average with very high peaks
  – Highly parallel applications
  – Up to 50 different applications on each system / cluster

• Commercial Products
  – No two identical system configurations
  – Type and volume of activity depends on the customer
  – System pricing constraints
Ada is Used in:

- **Broadcasting**
  - Short cycle time, constant activity

- **Telecommunication Servers**
  - Erratic activity (low average with very high peaks)

- **Data Processing**
  - Conditional access
  - Generation of data for set-top box applications

- **Database and Transactional Processing**
Ada Usage

- No Restricting Rules
- Unrestricted Use of:
  - Tasking
  - Genericity
  - Dynamic memory allocation (and deallocation !)
- Tend to No Longer Use Exceptions
  - Were used at the beginning
    ⇒ Poor diagnosis reporting for operators
  - Now use status-based reporting with Ada 95
Ada is not Used in:

- User Interface and Monitoring
  - Windows NT based
- Internet Applications
  - Too many interactions with existing non-Ada applications and API’s
- Set-Top Box Software

- GUI & Internet Developers ≠ Ada Developers
Current Issues

- **Non Portable Applications**
  - Needed to be « time-to-market » in 1996
  - Needed to use many low-level system-dependent features
  - ⇒ OpenVMS-dependent code

- **Future of Ada is Uncertain**
  - Exponential market growth ⇒
    Need to constantly hire new developers
  - Evolving technologies ⇒
    Need to constantly develop new applications
Choice of a New Language

• Ada 83 is Dying
  – DEC Ada no longer supported in near future

• Java ?
  – Pros: market acceptance, (almost) safe language
  – Cons: interpreted

• C++ ?
  – Pros: market acceptance
  – Cons: unsafe language

• Ada 95 ?
  – Pros: safe language
  – Cons: market reluctance
New Directions

• **New Language: Currently Ada 95**
  – GNAT compiler

• **Multi-Platform Development**
  – Need to use many low-level system-specific features
  – Need to write portable applications
  – \(\Rightarrow\) Development of a specialized system layer

• **Re-Engineering of Existing Applications**
  – Full object oriented development (in Ada 95)
  – UML design
  – Distribution using CORBA (OrbAda)
Applications Architecture

- Subs. A App. A1
- Subs. A App. A2
- Subsystem A Common Modules
- Managed Reuseable Components
- SNMP Application Management Layer
- Ada Reuseable Components
- Multiple O/S Support
- Subs. B App. B1
- Subsystem B Common Modules
- etc...
- etc...

Ada with's
Ada 95 Benefits

• Experience : Real Improvement from Ada 83
• Most Useful Features :
  – Controlled types
  – Tagged types
  – Hierarchical name space
• Nice Features :
  – Protected objects
  – Interfaces packages (annex B)
  – Elaboration control
  – Modular types
  – Readable « out » parameters (and other small but nice features)
Ada 95 Unsuitable Features

• Features which look promising but with practical flaws for our applications

• Streams
  – Implementation-dependent representation
  – User-defined ‘Read and ‘Write not enforceable

• Distributed Systems (Annex E)
  – Not interoperable (no equivalent of CORBA’s IIOP)
  – Ada-only
  – GNAT-only
GNAT Compiler

• **Used on all Platforms**
  – Main: OpenVMS clusters, Sun Solaris clusters
  – Side: Linux, Windows NT

• **Pros**
  – Exists on many (not to say all) platforms
  – Fast and efficient support from ACT

• **Cons**
  – Generated code performance
  – Difficult to use in large projects
Continue with Ada?

- Competitive Issues
  - Television is a very competitive market
  - Ada remains an expensive language
- Continuity of Ada Vendors
- Developer’s Culture
- Market Acceptance
  - Customers (TV operators) do not like Ada

We are willing to continue with Ada but we cannot afford to be the « Last of the Adaists »
Any Question?

or later: thierry.lelegard@canal-plus.fr