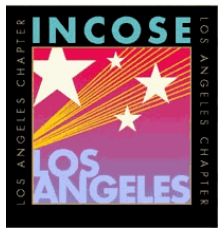




DIRECTV On Demand and Effective Systems Engineering

Deanna R. Kidd

- Education
 - BS Mechanical Engineering, UCLA
 - MS Mechanical Engineering, CSULB
- Employment Background
 - Northrop Corporation: Stress Analyst
 - Lockheed Martin “Skunk Works”: Stress Analyst
 - Hughes Space and Communications: Systems Engineer
 - DIRECTV: Technical Director, Broadcast Systems Engineering (current position)
- Professional Memberships
 - INCOSE
 - SWE



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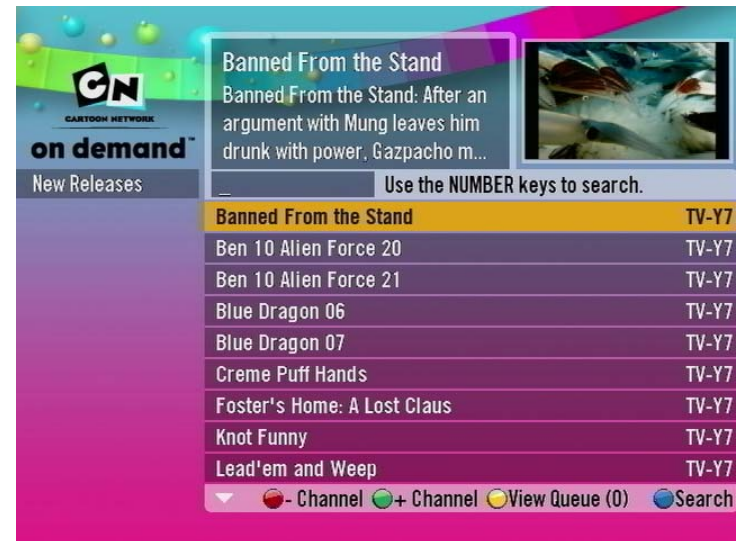
Introduction

- DIRECTV is a provider of satellite delivered television. DIRECTV On Demand is a new service that delivers video movies and shows to a customer's digital video recorder (DVR) through an active Internet connection.
- On Demand set up the infrastructure for DIRECTV to process and deliver all kinds of digital files via the Internet, and by satellite.
- The whole system of content ingest, processing, encoding, and delivery is basically new, yet the service was launched on DVRs already in customer's homes.
- This presentation discusses how Systems Engineering helped DIRECTV develop, test, and implement a new video delivery service on time and within budget.



DIRECTV On Demand

- A free service launched to customers in early 2008.
- Currently, there are 72 Home Page channels designed by the content providers.
- 7000 Standard Definition titles at end of 2008.
- 300 High Definition titles with 1080p coming soon.





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DIRECTV On Demand

- Integrated Home Page channels in the same Program Guide used for satellite channels.

The screenshot shows the DIRECTV On Demand program guide interface. At the top left is the DIRECTV logo. To its right is the text "tbs On Demand" and "guide". Below this is a header bar with "Wed 5:01p", "5:00p", and "No Rating". A small photo of three people is in the top right corner. The main content area has a blue background with the text: "Television's top-rated comedy network offers movies, specials, and original comedy series available anytime!". Below this is a list of channels with their On Demand options:

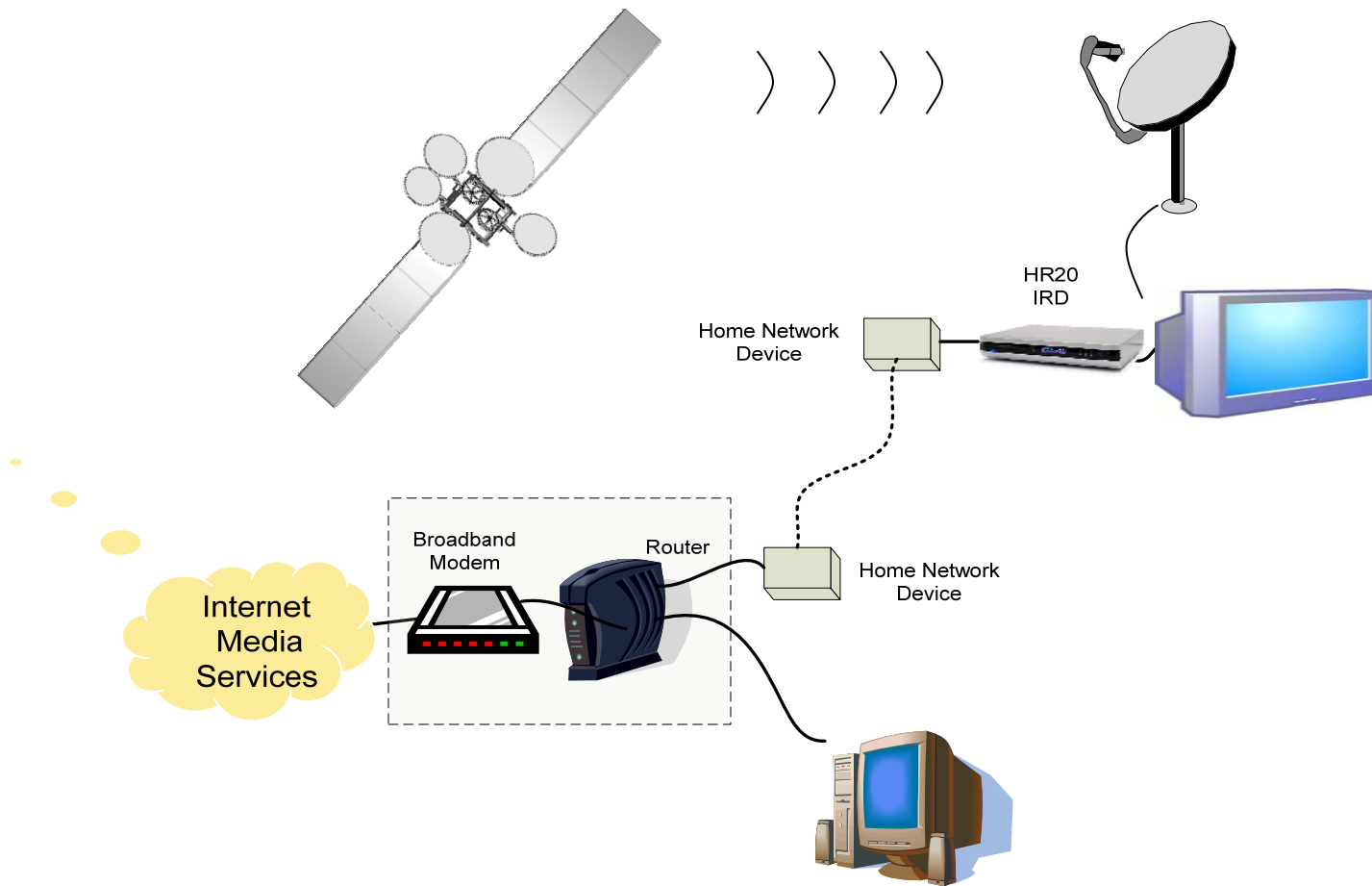
Channel	On Demand Option
1247 TBS	< tbs On Demand VOD >
1248 FX	< FX On Demand VOD >
1249 COME...	< Comedy Central On Demand VOD >
1250 FOXR...	< Fox Reality on Demand VOD >
1254 AMC	< AMC On Demand VOD >
1256 TCM	< TCM On Demand VOD >

At the bottom right, there are navigation icons: a red circle with "- 12hrs", a green circle with "+ 12hrs", and a yellow circle with "Guide Options".



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A New Model for DIRECTV Customers





System Challenges to Development

- To adapt our system to the existing multicast world of video on demand (VOD) content being delivered by program providers to cable companies today.
- Make no changes to DIRECTV's existing conditional access systems.
- Make no changes to DIRECTV's existing transport formats.
- Adapt program guide to deliver program information for VOD content within the same Program Guide being used for satellite TV.
- Make the service as seamless as possible to the look and feel of current satellite TV .
- Have the ability to deliver our DOD files by satellite to a customer's DVR.
- Bring the Customer Service and Home Installation Services into the new world of broadband delivered content.
- Automate the system as much as possible.



System Solutions

- Using the system requirements, new subsystems were created.
- A new Work Flow System developed that receives and process content files into specified formats.
- A new Traffic system
- Modified our Program Guide System
- A new Content Delivery System.
- Modified Digital Video Recorder



How System Engineering Helped Make the Project a Success?

- Initial system description
- System architecture diagram
- An overall System Specification
- White papers
- Weekly system meetings
- Up to date list of specification
- System testing
- Change control
- Enterprise roll out planning



So What's New About That?

- No new systems engineering techniques were developed. However, implementation of system engineering methods was key to the success of the project.
- This presentation explains how the project utilized system engineering to overcome a multitude of challenges.



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The Initial System Description Starting Off On the Right Foot

- The project started off with a high level system description document.
 - Introduced the concept of the service.
 - Described the elements of a possible architecture.
 - Was the result of meetings and brainstorming sessions, but authored by one knowledgeable individual who was passionate about the project.
 - Was never revised or updated after the initial write-up.
- Why was this important:
 - It gave members of the team an idea of what the overall goal of the project was about.
 - It outlined a possible architecture.
 - It became the source for the first pass at a systems specification.



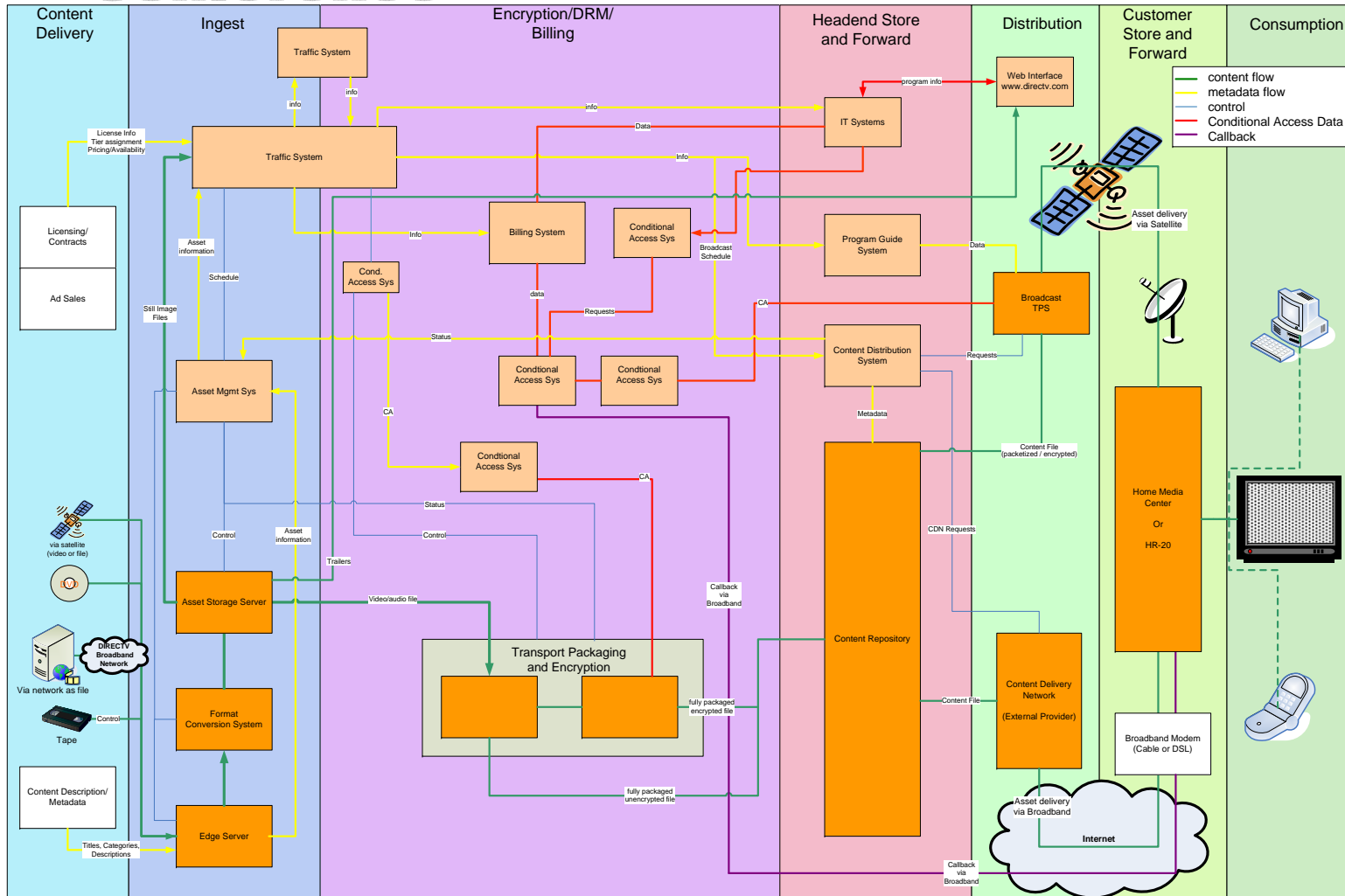
The Most Important Thing: The System Architecture Diagram

- The one element of system engineering that had the most impact was the system architecture diagram.
 - Continually kept up-to-date, widely available, and widely used.
 - Very detailed...showed major components within subsystem and the relationship between them all on one page.
- Why was this so important:
 - It tied all the subsystems together from tip to tail.
 - Showed each subsystem their place within the whole.
 - Clearly defined interfaces and where an Interface Control Document (ICD) should exist.
 - Gave all team members an understanding of the overall system.
 - Gave names to and showed what systems were new and what existed and would be modified.



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DIRECTV On Demand System Architecture (Simplified)



February 7, 2009

On Demand & Effective Sys Engr



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System Specification

- The System Specification was the next most important systems engineering tool.
 - The document covered all the major requirements for each area in the system.
 - No boiler plate document but based on the initial system description. The first draft was reviewed line by line by the project team (all subsystem leads, business owners, experts, and others) in a requirements review meeting. The resulting document became the overall System Specification.
- Why was this important:
 - Documented all the higher level requirements.
 - Clearly defined the responsibilities of each subsystem area. Defined what not how.
 - Kept the subsystems on the right path.
 - Basis for the System Test Plan.
 - Kept requirements that were developed in later phases from getting lost.



Weekly Systems Meetings

- The systems meeting included all the main players involved from the beginning.
 - All involved engineering subsystem leads.
 - Business owners.
 - Integrated Technologies (IT) (website, business systems)
 - Operations (a new Operations group was formed)
 - User Interface designers
- Meeting kept focused by system lead
 - Meeting was 2 hr/week
 - Issues list kept discussion and actions on specific topics.
- Later in the development, we added other areas
 - Customer Service
 - Home Services (installation and supply chain)
 - An enterprise integrator (facilitate roll out to the enterprise)



System Review and System Testing

- Only one system review was held - intermediate to a PDR and CDR.
- Subsystem testing was done in a pilot lab environment.
- Three levels of system testing:
 - Alpha testing: System testing to a select group of employees and testers involved with the project.
 - Beta testing run by the enterprise integration team. Testers were employees chosen from many areas in the enterprise. Most were not technical.
 - Anonymous DIRECTV customers that volunteered to test the service before it went to the public. They downloaded a software image to their DVR using a special code. This gave them access to the service. Their feedback and comments were posted to a well known website called DBS Talk. DBS Talk is a website for devotees of satellite TV.



Conclusion- A New Method for DIRECTV To Deliver Content

- Developed a system that used the best of satellite – delivery of one to all, and the best of Internet – delivery of one to few.
 - Satellite delivery of program guide, trailers, and popular movies.
 - Internet delivery of the video movies and programs (unless very popular).
- On time and on schedule using basic system engineering tools.



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Back-up Charts



White Papers

- White Papers were written to explain complex concepts.
 - Mostly written by the system engineer to help others understand complex ideas we were going to implement.
 - It would often be the only documentation explaining these concepts.
 - Without the white paper, the concepts would only be gleaned by piecing together subsystem detailed requirements.
- Why were the White Papers important:
 - It gave team members the ability to explain to others complex ideas, and to understand the system better.
 - Documents important concepts.



Document Repository and Change Control

- Maintained an up-to-date list of specifications, ICDs, and white papers. They were kept on a web based common repository used by engineering. Only those involved with the program were given access.
- Change control was started after the project was well into development to control unnecessary and uncoordinated changes.
 - If the change involved one subsystem only and they agreed to the change, no change form need be submitted.
 - If a change involved more than one subsystem or a subsystem did not agree with the change, then the change board was involved.
 - Change board was the system engineer, main engineering authority (my boss), affected subsystem leads, and the business owners.
 - Once the project went into beta testing, the change board was disbanded.



Risk Management

- Risk management was confined to a risk list:
 - Concerns
 - Causes
 - Mitigation
 - Likelihood + Consequence = Risk Level
- First draft was reviewed in a system meeting with the project leads.
- Although it was hard to get some of the project leads to seriously consider the risk list, it paid off in the long run as the project matured. It gave awareness to concerns that would not have been raised until too late otherwise.



Launching the Service

- The weekly systems meeting morphed into an enterprise launch meeting.
- Produced a written enterprise launch plan in outline style. This became the roadmap that was followed to launch.
- The Marketing group decided to do a soft launch which involved no advertising or promotion.