



5/01/2013

BESTBUY.COM'S CLOUD ARCHITECTURE

WHO WE ARE

- Best Buy is the **world's largest multi-channel consumer electronics retailer** with stores in the United States, Canada, China, Europe and Mexico.
- 11th **largest** online retailer
- More than **1.6 billion** visitors to our stores and BestBuy.com each year
- **Reward Zone** largest loyalty program in the U.S. – **more than 40 million active members**
- Provide customers with **outstanding choice, unbiased advice and unmatched support** for the tech needs



A UNIQUE CUSTOMER PROMISE

- **THE LATEST DEVICES AND SERVICES, ALL IN ONE PLACE**
- **IMPARTIAL & KNOWLEDGEABLE ADVICE**
- **COMPETITIVE PRICES**
- **THE ABILITY TO SHOP WHEN AND WHERE YOU WANT**
- **SUPPORT FOR THE LIFE OF YOUR PRODUCTS**



JOEL CRABB

- **Chief Architect, BestBuy.com**
- **Building BestBuy.com's Ecommerce Platform**
- **B.S. EE – Washington University in St. Louis**
- **M.S. NE – University of Wisconsin – Madison**
- **MBA – University of Minnesota – Carlson School**





ARCHITECTURE OVERVIEW

- **What's included**
 - Non-functional goals
 - Component system views
 - Real examples
 - Measurements and Volumes
- **What's not included**
 - Specific implementation details
 - Products and company names
 - Security information



TERMINOLOGY – HOME PAGE




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EXPLORE WINDOWS 8

Touch-screen laptops start at \$449.99, touch-screen all-in-one computers start at \$799.99. Plus free shipping.


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 TOUCH SCREEN




Save up to \$100 on Samsung Galaxy S III with 2-year agreement. Plus free shipping.
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SAVE \$20


Receive Double Reward Zone® Program Points with select Samsung tablets. Plus free shipping.
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LOW PRICE GUARANTEE
We'll match prices on qualifying products. [See details >](#)




FREE SHIPPING
on everything at BestBuy.com. [See details >](#) Exclusions apply.




May 1, 2013

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TERMINOLOGY – PRODUCT DETAIL PAGE




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[Best Buy](#) > [TV & Home Theater](#) > [TVs](#) > [All Flat-Panel TVs](#) > [Product Info](#) [Print](#) 



Insignia™ - 55" Class (54-5/8" Diag.) - LCD - 1080p - 120Hz - HDTV
Model: NS-55L260A13 | SKU: 4676582 | Customer Rating:  **4.3** (348 customer reviews)

 **LOW PRICE GUARANTEE**
ON SALE
\$599.99
Regular Price: \$799.99
You Save: \$200.00
FREE SHIPPING
[Add to Cart](#)
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May 1, 2013

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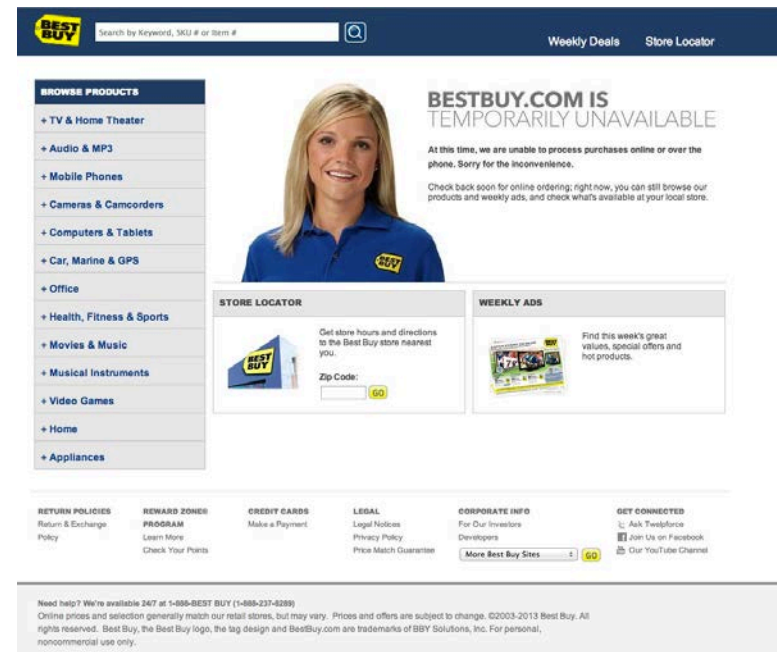
WHAT WE INHERITED

- **Monolithic 10 year old architecture**
- **Minor UI changes took months**
- **10,000 line JSPs was normal**
- **Long standing defects**
- **Chaotic build and deployment**
- **Unsatisfied business customers**



CLOUD EXPERIMENTS - 2010

- Created a browse-only site to cover outages
 - Always on cloud resident application
 - Elastically scaled and available in around 10 minutes
- Smaller web properties in cloud
(myrewardzone.bestbuy.com)
- Test environments in cloud



CLOUD RE-ARCHITECTURE

- In 2011 we began planning a new Ecommerce Platform
- Our traffic profile features an approximately 7X peak around Thanksgiving
- Majority of traffic is browse and search
- Re-architect browse tier to cloud for elasticity, scalability and reliability
- Served ~25% of traffic in 2012



OVERARCHING CONCEPTS

- **Split Traffic**
 - Browse is > 90% of traffic
 - Commerce is most important traffic
- **Cache everywhere**
- **Increase use of Content Delivery Network**
- **System Isolation**



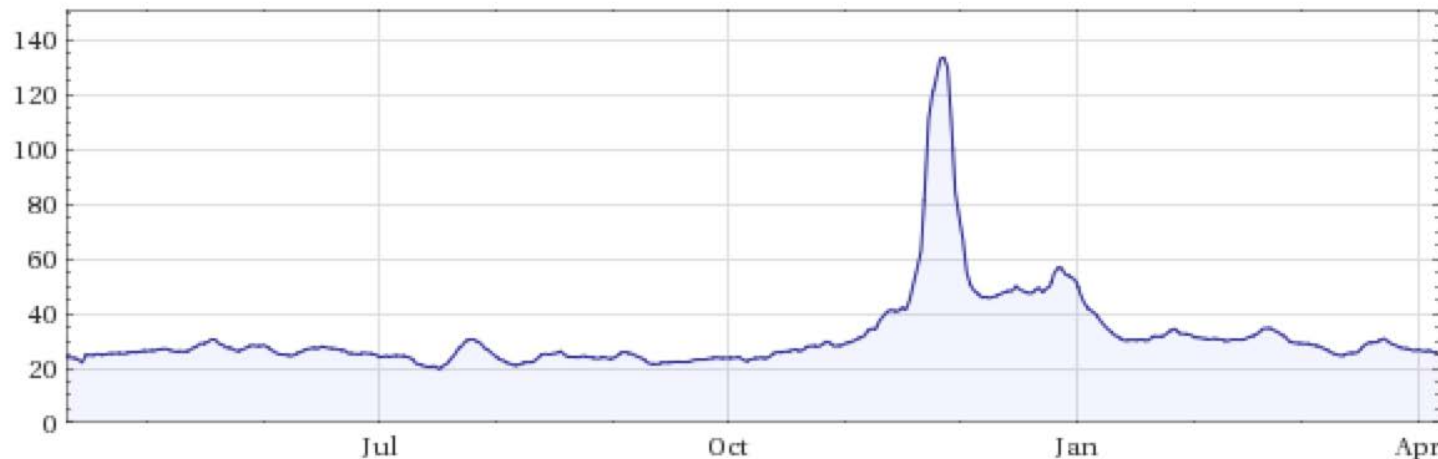
STAKEHOLDER REQUIREMENTS

- **Scalability**
- **Flexibility**
- **Reliability**



SCALABILITY GOALS

- Near-Infinite
 - Bursts
- 7X traffic spikes
 - Bursts > 50,000 rps
 - #3 in eCommerce traffic during holiday



(from Apr 10, 2012 to Apr 7, 2013) (in millions of hits per day)

(7-day moving averages)



May 1, 2013

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FLEXIBILITY GOALS

Low cost of change

Fast concepts to site

Daily releases

Multiple versions

One day of work vs. 2 months

RELIABILITY GOALS

- **100% availability**
- **Zero defects**
- **~ 2s response times**

- **Achieved 100% cloud uptime during Holiday**



CLOUD DOMAIN

- **Browse and Search traffic**
- **Non-transactional**
- **Non-persistent**
- **Non-sensitive data**

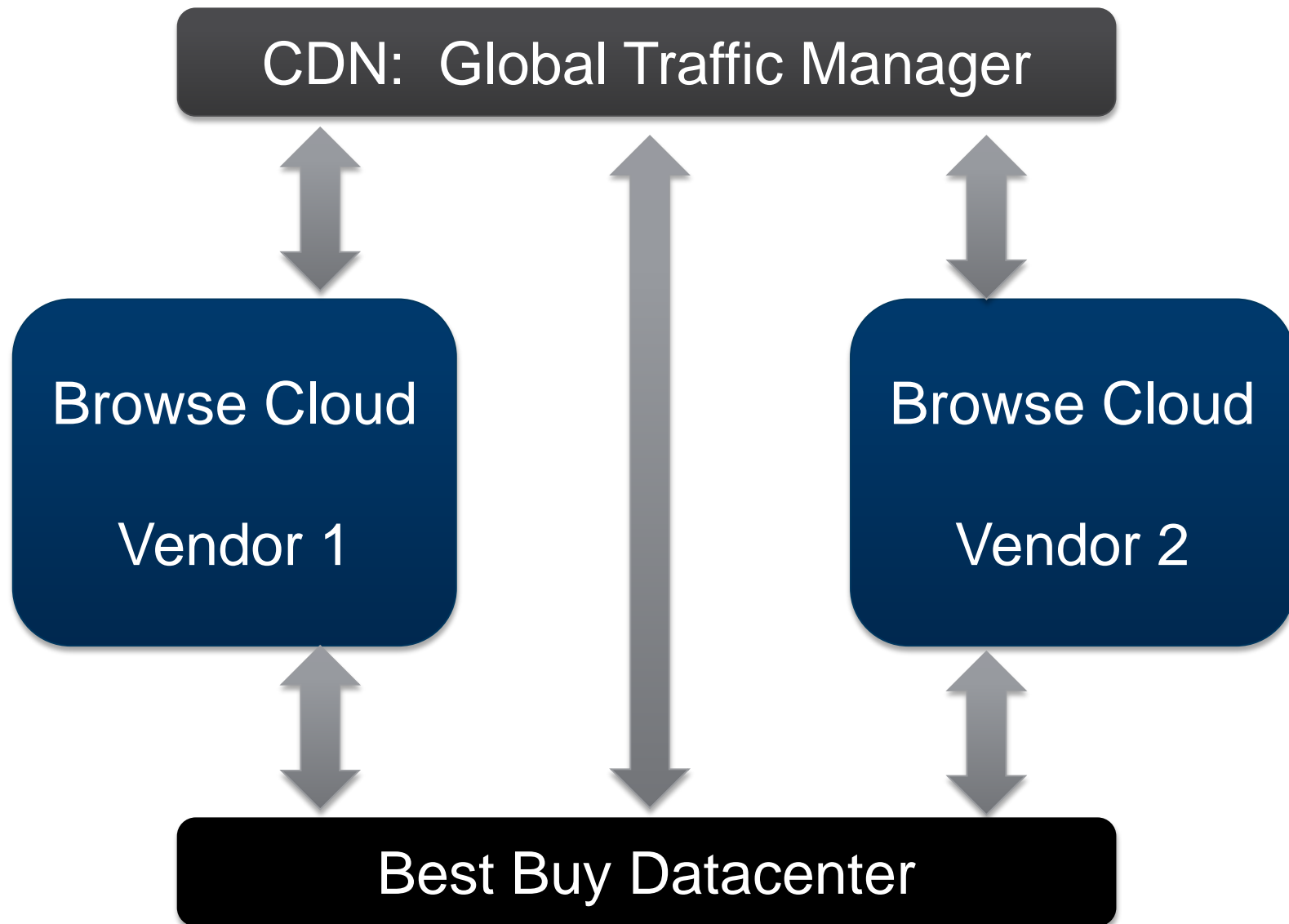


CLOUD ARCHITECTURE CONCEPTS

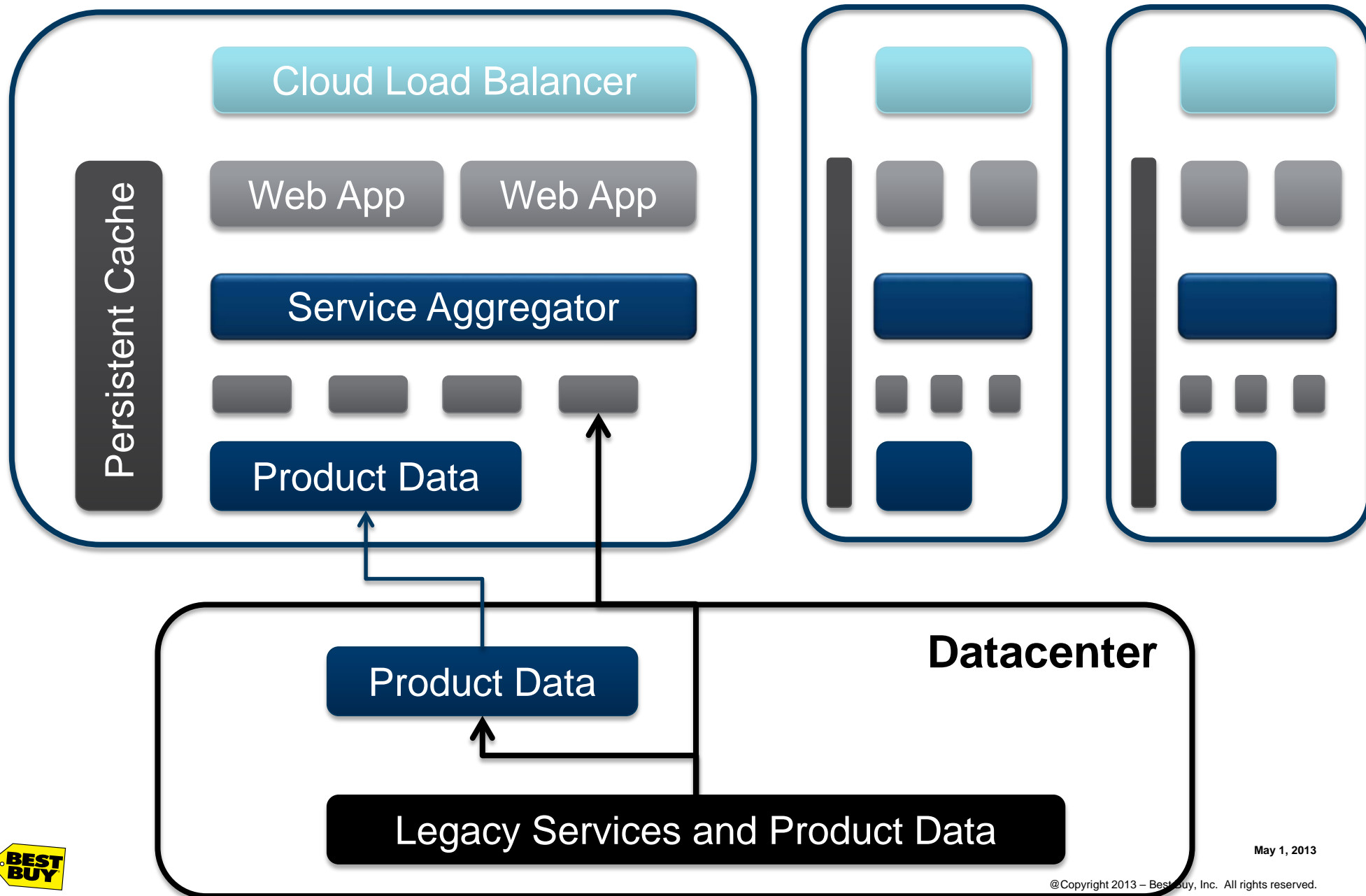
- **Clouds fail, plan for it**
 - Multiple availability zones
 - Multiple regions
 - Multiple vendors
- **Datacenter connections fail, plan for it**
 - Serve pages completely from cloud
 - Browse-only fallback mode



CLOUD ARCHITECTURE CONCEPTS



CLOUD ARCHITECTURE



FRONT END APPLICATION

- **HTML**
- **Javascript**
- **CSS**
- **Templating framework**
- **JSON Data Contract with Service Layer**
- **No Java/JSP in front end**
- **No MVC framework**



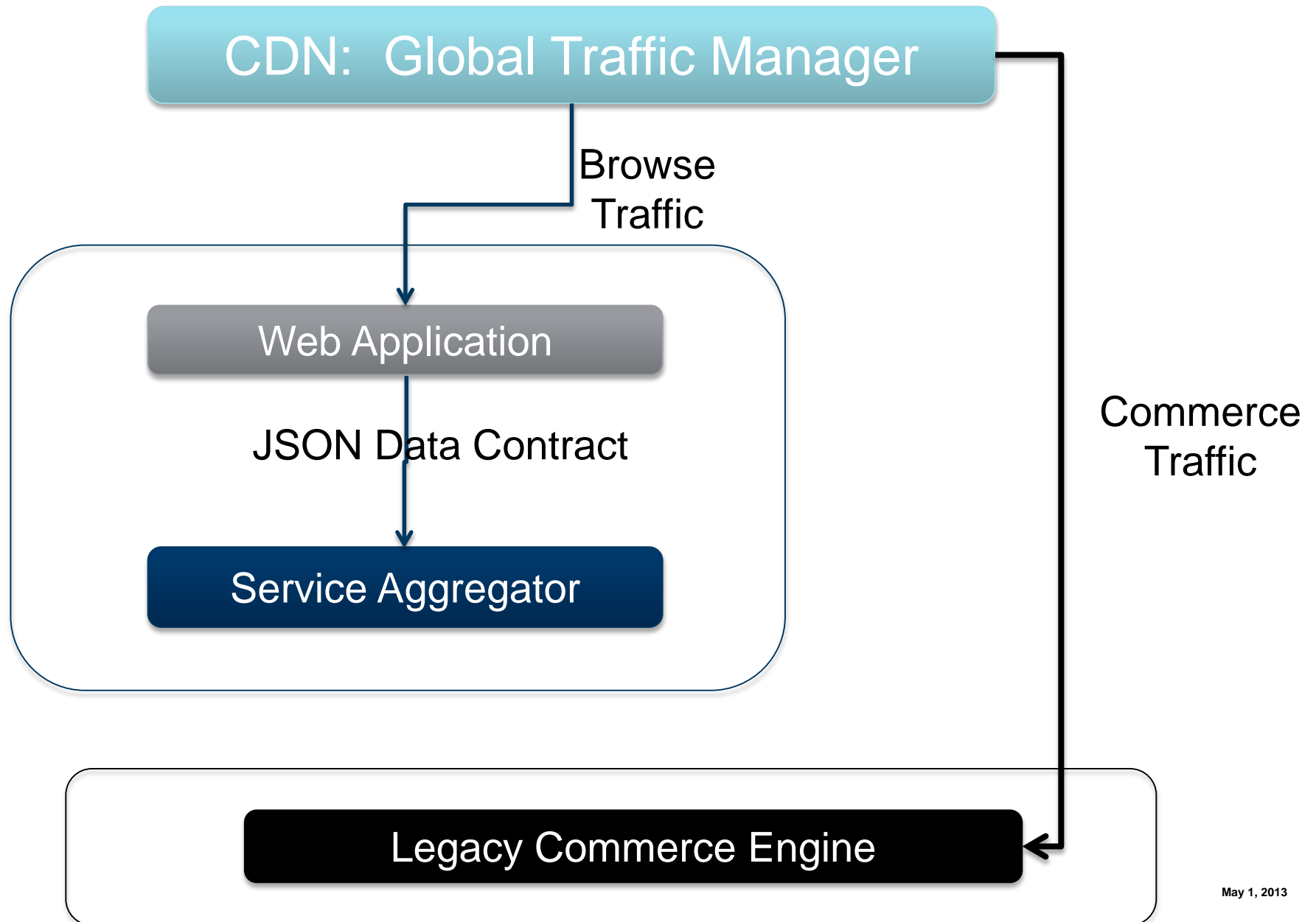


FRONT END FLEXIBILITY

Decoupling from back end allows freedom to iterate and deploy independent of back end.

Swapped in Hottest Deals carousel in December 2012 in one day.

FRONT END ARCHITECTURE



FRONT END: CDN USAGE

- **CDN = Content Delivery Network**
- **Base page caching**
- **Edge Side Includes (ESI)**
- **Image caching**
- **Traffic routing to multiple clouds and DC**
- **Overall ~ 80% of requests served by CDN**



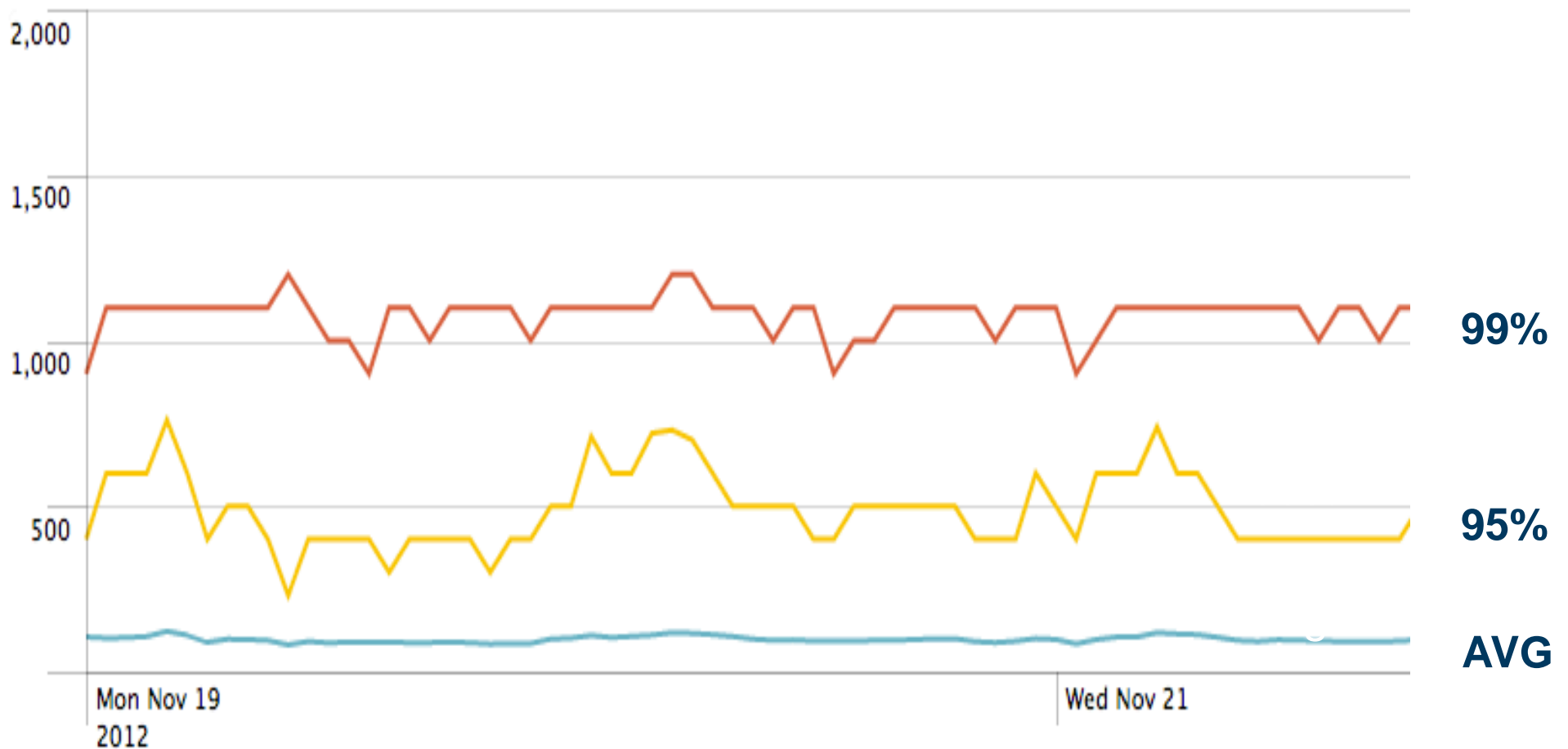
SERVICES TIER

- **Aggregation services**
 - Specific to each page
 - Gathers data from 30-50 services
 - Asynchronous
 - Smart caching
- **Granular services**
 - Specific related data
 - Reusable across views



SERVICES AGGREGATOR - PDP

- Target of 1000ms for 99% of requests

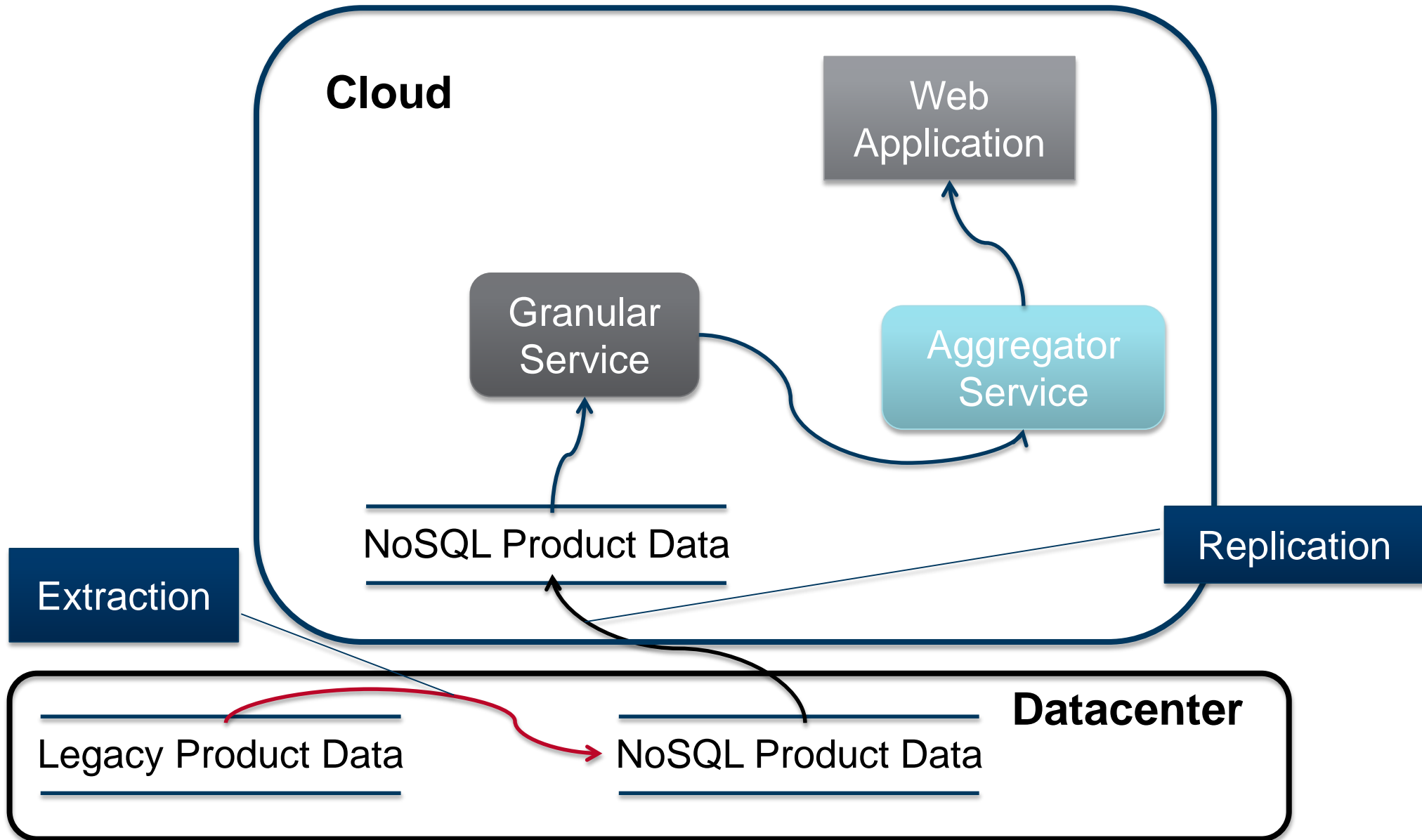


DATA TIER

- **NoSQL Product Catalog**
 - Schema flexibility
 - Simple REST API
 - Replication – Datacenter to Cloud
 - Pulled from legacy product catalog
 - Data available to all of Best Buy
 - Reliable and Scalable
 - ~ 20 applications using data since inception



DATA FLOW



BEST PRACTICES

- **Use a distributed service framework**
 - Netflix - Hystrix
 - LinkedIn – Rest.li
- **Understand velocity of change**
 - Front end is high velocity
 - *Lightweight*
 - *Disposable*
 - Back end is low velocity
 - *Heavyweight*
 - *Scalable*



BEST PRACTICES

- **Staged Deployments**
 - Started with Home Page
 - Ramped up traffic from 10 – 100% over weeks
 - Added Product Detail Pages in phases
- **Have a backup plan**
 - Legacy system left intact
 - Occasional rollback to fix defects
- **Automate Everything**
 - Consistently deploy 100s of cloud VMs
 - Easily create test environments



PROBLEMS ENCOUNTERED

- **Data replication is hard at scale**
- **Scaling takes time**
 - **Getting from 95% to 99% of calls to our expected SLAs took months**
- **Legacy data issues**
 - **Old data formats were difficult to use in redesigned UI**



WHAT YOU SEE

Old PDP ~ 4 - 20 seconds

This screenshot shows the old Best Buy PDP for a Panasonic 50" Class Plasma TV. The layout is cluttered with multiple sections. At the top, there's a navigation bar with links to Store Locator, Weekly Ad, Credit Cards, and Reward Zone. Below this is a search bar and a navigation menu with categories like PRODUCTS, SERVICES, SHOPS & DEALS, and GIFTS. A prominent banner for Windows 7 and a pre-order offer for a home premium upgrade is displayed. The main product section features a large image of the Panasonic Viera TV, its specifications (50" Class Plasma, 1080p, 600Hz, 3D, HDTV), and a customer rating of 4.3 stars. To the right of the product image, there's a 'Our Price' of \$1,499.99 and a 'FREE ADD TO CART' button. Below the price, there's a 'PROTECT YOUR PRODUCT' section with a 'BUY BACK PROGRAM' and a 'FREE SHIPPING' offer. The bottom section includes a 'Customer Rating' of 4.3 stars, a 'Share this product' button, and a 'Perfect Match Promise' section. The overall design is busy with many elements competing for attention.

New PDP ~ 2.5 seconds

This screenshot shows the new Best Buy PDP for an LG 47" Class LCD HDTV. The layout is clean and modern, focusing on the product and key information. At the top, there's a navigation bar with links to Store Locator, Weekly Deals, Credit Cards, and Reward Zone. Below this is a search bar and a navigation menu with categories like PRODUCTS, SERVICES, SHOPS & DEALS, and GIFTS. A prominent banner for 'Store Pickup Plus' is displayed. The main product section features a large image of the LG LCD HDTV, its specifications (47" Class, 1080p, 120Hz, LCD HDTV), and a customer rating of 4.6 stars. To the right of the product image, there's a 'Save \$300.00' offer, a 'Price' of \$699.99, and a 'Reg. Price' of \$999.99. Below the price, there's a 'FREE ADD TO CART' button. The bottom section includes a 'Product Availability' section with 'Delivery: Most Areas' and 'Store Pickup: Available', a 'Special Offers' section with 'See all (3) special offers', and a 'Financing Offers' section with 'See all (2) financing offers'. The overall design is clean and easy to navigate, with a clear focus on the product and its key features.

