Official Guide to Notification Systems for Operators, Device Makers and Developers

Understanding how next-generation notification systems can increase service engagement and revenues

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Introduction

As more and more information and entertainment services compete for people's limited time and attention span, online services must increase their relevance to retain existing users and attract new subscribers. The perceived value of a service often depends on how quickly people using that service receive new information. Making sure people see and know about things as they happen is a transformative experience. Real-time notifications about activities and people are essential to capturing users' attention and spiking their interest and are a critical factor in determining the continued success of a service.

The dramatic growth of devices and applications has a downside though. It's increasing the number and sources of notifications, creating a fragmented and inconsistent experience for users, network complexity for operators and a maze of notification protocols for device makers and developers to navigate.

Operators, device makers and developers can simplify, secure and optimize the users' end-to-end notification experience with a centralized notification system that supports all major applications, devices and delivery mechanisms. Eliminating application-specific silos with a single notification system speeds the rollout of new services, creates new revenue opportunities, and consolidates and secures metadata for business intelligence, advertising and other revenue-generating opportunities.

Notification Overview

At the most basic level, notifications are tools or systems that cause people to engage and take action. They take a variety of forms – from a simple door bell, phone ring or clock alarm to an e-mail appointment reminder. Notifications are an intrinsic part of modern, fast-paced lifestyles, enabling people to track hectic schedules, remember important dates or keep up with breaking news.

In the same way, device applications and network services require notifications to fit into busy lives. People simply don't have the time to continuously check all their favorite sites to keep up with the glut of information they must consume on a daily basis, or stay abreast of the activities of friends and coworkers. Notifications simplify life by letting end-users know what their friends are doing, who wants to connect with them or when their favorite store is having a sale.

Notification Technologies

A variety of techniques are used to initiate notifications when new information or data is available. Polling and push are the most widely used notification technologies.

Polling

Polling is a relatively simple approach in which a client, running on a mobile device or desktop, queries a selected application server or channel – sports, news, stock ticker, weather, etc. – at designated intervals to check for new data or messages. When new data is available, the client receives a response (notification) and must analyze the response to determine what, if anything, has changed. Polling, however, has a number of drawbacks. With this approach, applications are constantly reaching out, checking servers for updates. It's comparable to checking a clock continuously, looking at the time rather than waiting for the wake up alarm to sound. When a user is running multiple applications, frequent polling creates an unusually large drain on battery life and consumes network resources. And, because the length of polling cycles is preconfigured – for example, every 10 minutes – update notifications can't be delivered in real-time. Decreasing the length of the cycle increases the drain on the client device's battery. In fact, poorly implemented applications, which poll continuously, can seriously impact a mobile operator's network.

Push

With the push model, clients usually subscribe to information channels or applications such as social network sites, photo services, dating sites, coupon services or news outlets and specify the types of information they want to receive. The system that listens for changes – for example, a friend's Facebook status update or the availability of new coupons – automatically sends or "pushes" the new information to the client device. In the push model, the client has a direct channel to the application server, so it receives notifications in real or near real-time. When a notification is used by the application to pull more content, it is typically known as a push-to-pull notification. In contrast to polling, push delivers information and updates much faster and has less of an impact on the device's battery.

Notification Delivery

As devices, applications and consumer behavior have evolved, the methods or tools used to deliver notifications have also changed. The earliest technologies employed email, short message service (SMS) and, to a lesser degree, multimedia messaging service (MMS) to deliver updates. With more recent technologies, the client has a direct channel opened to the application server, so it receives notifications very quickly and efficiently over the existing Internet protocol (IP) infrastructure. Table 1 lists many of the notification systems currently in use.

Existing Notification Systems	Description
Email	Early email clients polled periodically to see if users had new mail, using standards like POP3, and delivery usually took 10 to 15 minutes. Newer versions like corporate email (via Microsoft Exchange and BlackBerry to mobile devices) and consumer email offerings through email providers like Gmail have significantly improved delivery times.
Short Message Service (SMS)	SMS is the most widely used and successful mobile application, both text SMS to a consumers inbox (potentially with links to launch a mobile browser) and binary SMS (directed to specific mobile applications installed on a traditional feature phone).
Multimedia Messaging Service (MMS)	MMS was intended to replace SMS, but consumer uptake has been slow. It is used primarily to send embedded pictures between mobile devices.
Cloud to Device Messaging (C2DM)	Google created C2DM to help developers send data from servers to their applications running on devices with Android v2.2 or later releases. The service provides a mechanism that servers can use to tell mobile applications to contact the server directly to fetch updated application or user data. C2DM handles all aspects of message queuing and delivery to the target application running on the target device.
Apple Push Notification Service (APNS)	Apple uses a protocol similar to C2DM to propagate push notifications to iOS devices (iPhones, iPads and iPods), running applications registered to receive those notifications.
RIM BlackBerry Push Service (BBPS)	The BlackBerry push service implements the push access protocol (PAP), which defines how content developers push applications messages to its mobile devices. As with other push technologies, the BlackBerry does not poll servers to look for updates; it waits for the update to arrive and notifies the user when it does.
Microsoft Windows Phone 7 Notification Protocol	Microsoft Windows notification protocol was designed to minimize the drain on battery life caused by frequent web service polling. It implements a push notification service rather than polling to create a dedicated, persistent channel for third-party developers to send information and updates to a Windows Phone application from their web services.
Extensible Messaging and Presence Protocol (XMPP)	The XMPP protocol was designed to support near real-time instant messaging. In contrast to most instant messaging protocols, XMPP employs an open systems approach of development and application; anyone can implement an XMPP service and interoperate with other organizations' implementations.
HTML WebSockets	WebSockets is a technology that enables HTML5-compliant browsers to communicate via bi-directional, full-duplex communications channels over a single transmission control protocol (TCP) socket to *appropriately* configured application servers. The WebSocket API is being standardized by the W3C, and the WebSocket protocol is being

Existing Notification Systems	Description
	standardized by the IETF. Once a web application uses WebSockets, the browser looking at the webpage can receive notifications in real-time from the application server. Web applications no longer need to "poll" for changes and can implement new features like pop-up notifications to enhance their service.
Session Initiation Protocol (SIP) Subscribe/Notify Event	SIP is the main protocol used in standards-based voice over Internet protocol (VoIP) applications. Next-generation core networks like IP multimedia subsystem (IMS) and existing instant messaging platforms like Google Talk utilize SIP. One of the key extensions within the SIP protocol is the event notification extension, RFC3265, which defines the SIP subscribe/notify primitives and how they can be used by a SIP user-agent client with a SIP service to subscribe and be subsequently notified of changes to the underlying services data model. As IMS networks are rolled out by operators around the world, SIP notifications increasingly will take on the more generic role of providing notifications of key events to subscribers using SIP-enabled handsets.

Table 1. Existing Notification Mechanisms

Technical Issues and Challenges

The number of devices – smartphones, game consoles, tablets, TVs and even refrigerators – connecting to the Internet over fixed and mobile networks are multiplying at an unprecedented pace. In response, operators, device makers and application developers are expanding their business models to deliver multi-screen user experiences. Enabling this expanding array of services and applications is creating a host of challenges that necessitate a shift from service-specific notification systems, many of which were designed specifically for the desktop, to advanced notification systems that are optimized for the mobile experience.

Mobile Battery Life

Mobile devices have morphed from phones to hand-held computers, supporting an increasing assortment of features and applications. As the demands on the devices increase, the battery life suffers. An application like global positioning system (GPS), for instance, can drain a battery in just five hours. Running multiple applications simultaneously consumes power at an even faster pace, and even casual smartphone usage such as browsing the web for several hours can empty the battery before the end of the day. Notifications also impact battery life because the device either has to "wake up" – come out of sleep/power saving mode – periodically to check application servers for messages and updates or stay connected, which, if not implemented via a mobile-optimized mechanism, seriously affects battery life.

The Threat Posed by New Operating Systems and Protocols

The advent of smartphone operating systems like Android and iOS, and new IP-based notification protocols like C2DM and APNS pose a serious threat to operator revenues as well their relationship with their customers. These new notification mechanisms have numerous advantages over traditional alerting tools like SMS and MMS. They are able to carry rich application data and service-specific metadata directly to smartphone applications as well as support WiFi only devices like tablets and TV set-top boxes, which normally don't support SMS or MMS. Another significant advantage is their ability to provide third-party developers with a simple application programming interface (API) that doesn't require virtual private network (VPN) access to bind into the operator's short message service centers (SMSCs).

Maintaining control over the end-to-end delivery of notifications and addressing the widest array of devices require solutions that are independent of third-party operating systems (OS). Service providers and, for that matter, device makers can't afford to be locked into a device-specific OS. To compete with the likes of Google and Apple, operators must provide their own rich, IP-based notification protocol so they can own the customer relationship, continue to generate notification revenues and attract new revenues from smartphone application developers.

Network Complexity

To ensure a consistent end-user experience, operators must have the ability to deliver notifications from any service or application to any device via any delivery mechanism. That's no small feat. It requires the ability to support an ever-increasing number of application-specific notification protocols as well as single APIs to enable applications from the developer community.

As the number of protocols grows and propriety device notification systems proliferate, service-specific notification silos – many of which perform the same function – develop within the network. This situation results in a 'siloed' (vertical) architecture that incurs additional costs and prevents cross-application synergies. The approach also inhibits the mining of metadata for business intelligence and targeted advertising since analytics are housed in multiple systems spread across disparate silos.

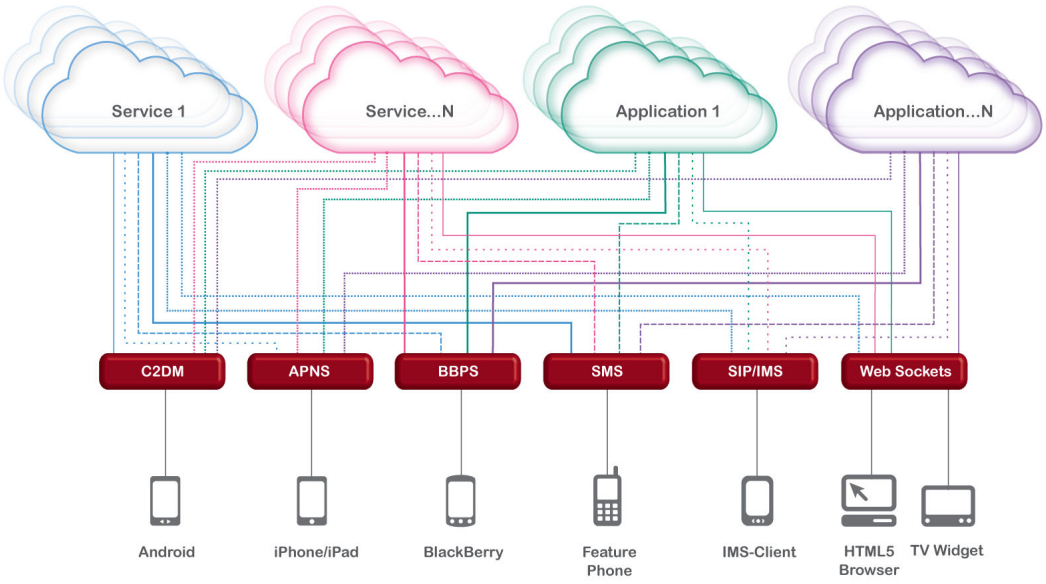

Figure 1. Complexity Created by Proliferation of New OSs, Services and Applications

Excessive Mobile Network Signaling

Consumers have become accustomed to an "always-on" lifestyle in which they stay connected to the network for long periods of time, consuming massive amounts of data and receiving frequent updates and messages. To minimize the battery drain created by this behavior, many device makers have implemented a fast dormancy state, which allows the mobile device to quickly signal the radio network controller (RNC) and release the connection so that it can return to the idle state faster. However, these rapid connects and disconnects boost signaling traffic, increasing control switching requirements and negatively impacting the network's overall performance.

In fact, many experts report that much of the network congestion is related to signaling traffic generated by smartphones as they move through cell sites, making constant queries to access social network tools, push email, and conduct other repetitive actions. This phenomenon has caused more problems than actual data bandwidth capacity problems on networks like AT&T and O2 during the initial iPhone rollout (Source: numerous media and analyst reports). A key consideration for operators, device makers and application developers, therefore, as they consider a notification solution, is choosing one that optimizes network resource usage in terms of data packet size, frequency of delivery and impact to the radio access network (RAN).

The NewBay Approach

NewBay's LifeCache Notifier, part of the LifeCache product suite, is a next-generation, centralized notification solution for operators, device makers and application developers. LifeCache Notifier is the first white-label notification system that delivers notifications from any application or service to any device over any delivery mechanism. It eliminates the complexity of supporting application-specific notification protocols and provides a simple API for third-party channels and services.

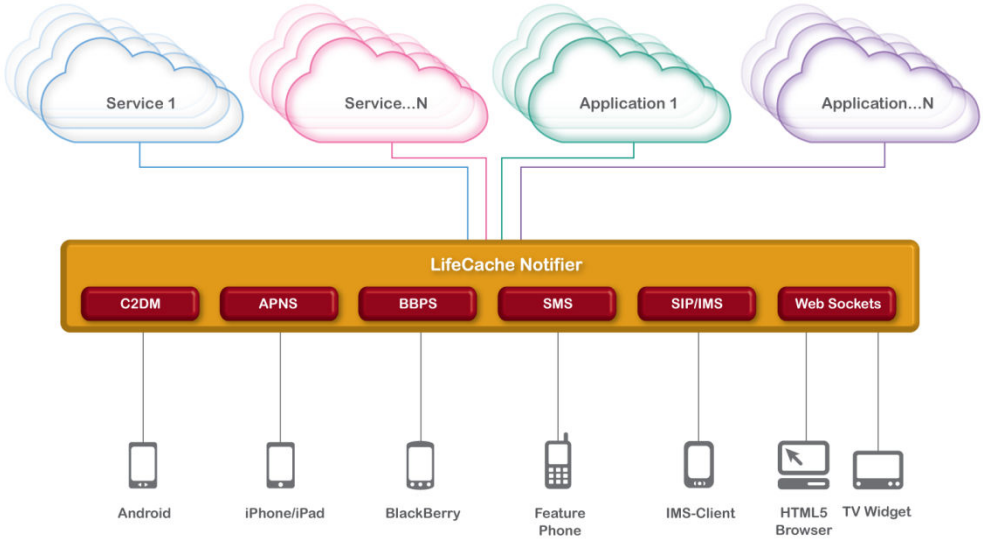

Figure 2. LifeCache Notifier Simplifies Notifications Across Devices, Services and Applications

Notifier integrates seamlessly with other LifeCache products - Photo and Video Album (PVA), Social Networking Gateway (SNG), Digital Vault (DV), Smart Address Book (SAB) and Message Minder (MM). Notifier also supports notifications from third-party sources such as advertisers and media channels, providing additional revenue opportunities.

LifeCache Notifier Architecture

LifeCache Notifier's architecture is designed to support hundreds of millions of connections and deliver billions of notifications. The service can be scaled to provide additional functionality and capacity with minimal additional investment. Scalability is achieved through a modular architecture with a distinct separation of functional concerns (loose coupling), well-defined product and service APIs and caching at all layers. As part of the LifeCache product suite, Notifier integrates seamlessly with other LifeCache products and services.

Notifier's Binary Push Protocol (BPP)

NewBay's IP-based BPP, the solution's preferred delivery mechanism, is optimized for mobile networks and is the most efficient means to move real-time notifications back and forth between server and client domains. With BPP's extensible specification, developers and providers can piggyback other protocols like XMPP, the instant messaging protocol, over BPP. Notifier's architecture supports "pluggable" gateways for notification delivery. In addition to NewBay's BPP protocol, Notifier supports other key notification protocols, including: C2DM, APNS, Microsoft Windows Phone 7 Notification Protocol, RIM's BlackBerry Push Service, SIP Subscribe/Notify Event, HTML5 WebSockets (through an extension to Notifier BPP), SMS, email and XMPP.

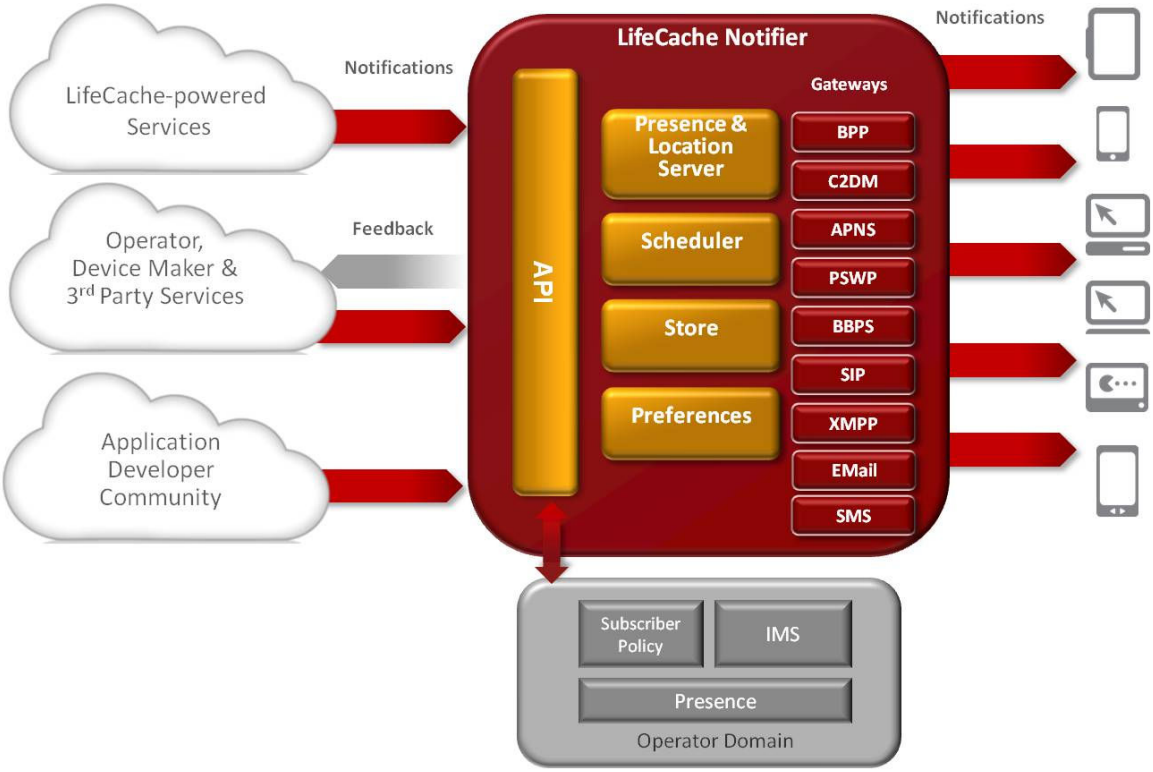

Figure 3. LifeCache Notifier Architecture

The BPP protocol provides a secure end-to-end connection between Notifier and the device. With NewBay's pluggable authentication module (ATP), users are authenticated on their handsets and verified when the mobile first connects to the service. When deployed in an operator environment, this secure channel stays on the operator's packet core network, guaranteeing the security of the communication. This is in contrast to C2DM and APNS protocols, which route all connections through an external infrastructure provided by Google or Apple.

Support Location-based Notification Services

LifeCache Notifier supports location-based notifications, allowing services to deliver location-aware notifications. For example, a coupon-based notification service provider can deliver alerts to people who are near the place where the coupon can be redeemed. Similarly, a single person can receive an alert when they are in the same establishment as someone who has mutual likes and interests – when both are subscribed and opted-in to the same online dating service.

Simplify the Network and Control the Notification Experience

Notifier features a single API that consolidates all service notifications through one fast and efficient connection. By centralizing notifications, Notifier simplifies the network architecture, eliminating costly and inefficient notification silos, and creates a central point for metadata mining to support business intelligence and revenue generation with targeted advertising and offers. And, by removing competition from the end-user notification experience, operators and device makers can keep valuable metadata confidential.

Create an End-to-end Subscriber Experience

LifeCache Notifier ensures a consistent, end-to-end user experience that encourages ongoing service engagement, which in turn drives messaging and voice traffic and increases service stickiness. Notifier activates real-time push notifications based on user-defined preferences and instantly converts the alerts into the correct format for the selected device. Using NewBay's solution, operators can track user activity – Web, WAP, mobile Internet, handset client, desktop and TV – to route notifications intelligently to the best device and channel for each customer. Alerts can be delivered to users as well as devices with the system's "find me" feature, which enables dynamic forwarding based on preferences and current connectivity. For example, if an end-user has just turned on the TV, a notification can be delivered to the mobile device and the TV simultaneously. And, Notifier's store-and-forward feature ensures that subscribers won't miss notifications; they're delivered even if a user is temporarily disconnected.

Optimize Notification Delivery

Enterprise and Web 2.0 solutions rely on heavyweight formats and inefficient push protocols that drain battery life and network bandwidth. Notifier is IP-based and mobile-optimized to reduce bandwidth requirements and conserve battery life. It supports configurable policies such as notification batching by service or across services with a time-of-day preference to minimize network impact and reduce battery drain. In tests, compared to protocols like C2DM and APNS, Notifier BPP generates 50 percent less network traffic due to its compressed message delivery. And, unlike protocols that tax the battery excessively when there are no alerts to send, BPP intelligently detects the network architecture and dynamically tunes connectivity options

on the device to allow longer periods of inactivity to preserve battery life. When compared to C2DM, BPP uses 60 percent less battery resource on average during periods of inactivity.

Monetize Metadata

NewBay's Notifier enables operators, device makers and developers to tap into new business opportunities and create a richer subscriber experience, using valuable user-content and notification metadata. With the system's support for analytics and business intelligence (BI), operators can mine metadata across virtually any application or device to understand where consumers spend their time and how they get there. That insight can be leveraged to feed the growing demand for real-time, direct advertising programs, improve customer care and spur new service innovation.

Future Use Cases

In addition to the applications cited in this paper, NewBay is considering a variety of new uses for its LifeCache Notifier that includes:

- **Location-aware 'to-do' list**: Notifies users when they are near a store that sells something on their to-do list such as a prescription or loaf of bread.

- **Saving energy**: Machine-to-machine notifications that can create a more energy-efficient household. For example, when the electric meter reaches a pre-defined threshold, it sends a machine-to-machine notification to other connected devices in the household to let them know they should switch into energy-saver mode.

- **Commuting aids**: Notifications that can be used to simplify a commuter's life such as providing alerts when the train or bus is running late or turning up the heat when a user is within several miles of his or her house.

- **Friends-based notifications**: Help users keep track of their friends and loved ones. For example, a user receives an alert when she's near a friend at a sporting event or concert or when her child is someplace he shouldn't be.

Summary

The mobile revolution is clearly underway, driven by an ever-increasing number of Internet-enabled services and applications and the growth in the variety of devices used to access them. The explosion of channels and applications is driving the competition to capture user's limited time and attention. Real-time notifications about activities and people, which engage users' attention and spike their interest, are critical to the success of deployed services.

Operators, device makers and developers can simplify, secure and optimize the users' end-to-end notification experience with a centralized notification system that supports all major applications, devices and delivery mechanisms. Eliminating application-specific silos with a single notification system speeds the rollout of new services, creates new revenue opportunities, and consolidates and secures metadata for business intelligence, advertising and other revenue-generating opportunities.

About NewBay

NewBay enables operators and device makers to deliver a lifetime of digital content experiences across any connected device such as mobile, PC, tablets and TV. The NewBay LifeCache white-label software platform powers cloud-based services for storing, sharing, accessing and organizing digital content. NewBay LifeCache enables customers to monetize a wide range of branded services such as social networking, photo and video albums, digital vault, notifications and converged messaging.

NewBay is delivering highly successful commercial services for operators and device makers worldwide. Customers include T-Mobile, Telefónica O2, Orange, U.S. Cellular, AT&T, Telstra, Verizon, and LG Electronics. NewBay LifeCache is processing millions of messages daily and stores billions of media for live operator and device maker services.

NewBay is based in Dublin, Ireland; Seattle, USA; London, UK; Dusseldorf, Germany; Sydney, Australia and Seoul, South Korea. NewBay was founded in 2002 and is privately held. Investors include Balderton Capital and Fidelity Growth Partners.

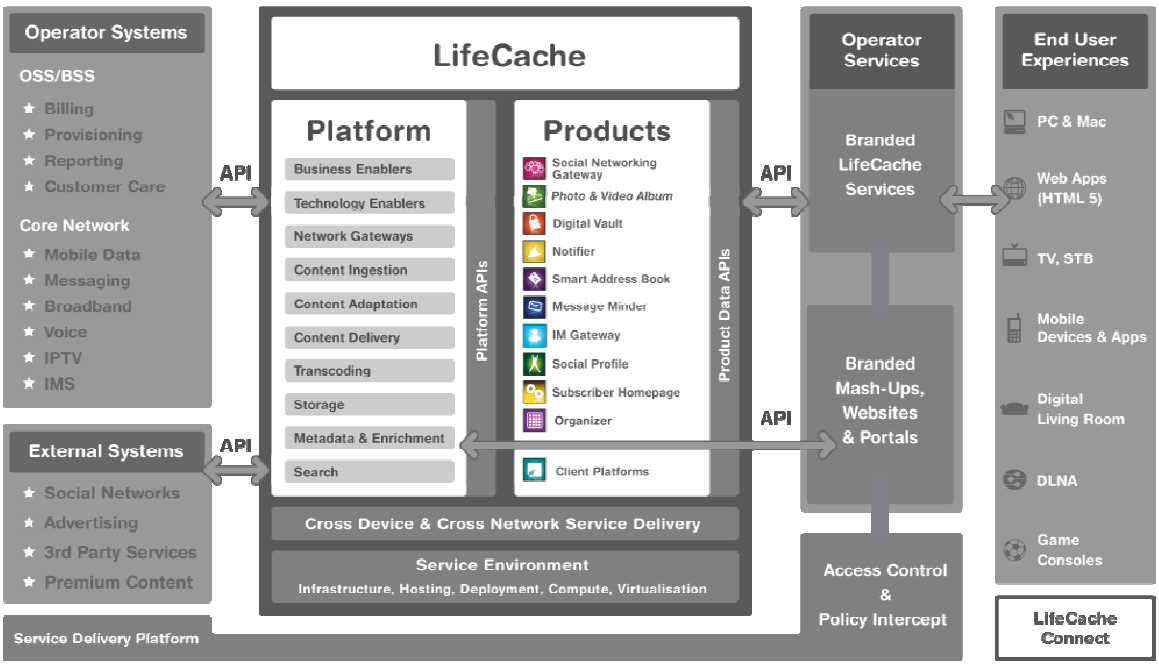

Figure 4. NewBay LifeCache Architecture

Acronyms

API	Application programming interface
APNS	Apple push notification service
ATP	Authentication, tokens and provisioning
BPP	Binary push protocol
C2DM	Cloud to device messaging
IP	Internet protocol
IMS	IP multimedia subsystem
LTE	Long term evolution
MMS	Multimedia messaging service
OS	Operating system
PAP	Push application protocol
PVA	Photo and video album
RAN	Radio access network
RNC	Radio network controller
SAB	Smart address book
SIP	Session initiation protocol
SMS	Short message service
SMSC	Short message service center
SNG	Social networking gateway
TCP	Transmission control protocol
VoIP	Voice over Internet protocol
VPN	Virtual private network
XMPP	Extensible messaging and presence protocol

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