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TECHNOLOGY WHITE PAPER

# Mobile Smartloading

## Enabling smarter delivery of mobile video

The emergence of smartphones that bring mobile Internet access and video content to the masses is dramatically changing the mobile networking landscape. Mobile network data traffic is increasing rapidly and will likely to continue to do so in the coming years. The challenge for the media and telecom industries is to deliver high-quality mobile video content to consumers while avoiding network congestion and controlling investments in radio network capacity.

One approach for addressing this challenge is to push video content to mobile devices, taking advantage of the growing storage space offered on most of these devices. However, pushing content to mobile devices must be done intelligently to produce satisfactory results for end-users and control their use of bandwidth. If executed effectively, this approach promises to bring dramatic performance improvements for mobile service providers, enhance the experience for end-users, and open new service opportunities for mobile multimedia application providers.

Recognizing that service providers need solutions that will enable them to efficiently push content to mobile devices, Alcatel-Lucent is introducing Mobile Smartloading, a breakthrough mobile media technology developed based on innovative concepts from Alcatel-Lucent Bell Labs. Mobile Smartloading pushes content to individual end-user devices in a controlled and efficient fashion, enabling end-users to consume content offline and on demand.

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## Introduction: The mobile bandwidth challenge

Smartphones are becoming increasingly popular among wireless service provider customers. These customers typically use data services to a much greater degree than regular mobile customers. Their increasing use of data-intensive services, such as video download and streaming, is straining the capacity of service provider networks, a problem illustrated vividly by the well-publicized story of the London-based O2 network that recently became overwhelmed by an "explosion" of demand for data services.

The use of smartphones and bandwidth-intensive services like video is projected to grow rapidly over the next few years. This rapid growth will amplify the pressure on service provider networks. As a result, it is becoming increasingly clear that service providers cannot scale their networks to offer a simple "unlimited bandwidth" mobile data service. This type of service will lead to continuous increases in network capacity and costs, and, eventually, to dramatic access price increases for end-users.

## Infrastructure strategies used to deliver mobile video

Service providers need to develop strategies to build a sustainable infrastructure that can meet the growing need for mobile multimedia services while containing network costs. Several strategies are possible. These strategies are not mutually exclusive, as they have complementary cost-benefit trade-offs.

### Increasing the density of the mobile access and backhauling networks

Service providers are adding resources to their 3G networks. For example, AT&T recently announced that it would increase spending by US$2 billion on its wireless network in 2010. The company will need to add more base stations in highly populated locations and grow its data backhaul infrastructure accordingly. The challenge for AT&T is to generate enough additional revenues to offset its new network investments.

### Upgrading the mobile network with 4G/LTE

Service providers are moving to 4G networks that have significantly higher data capacity. While these infrastructure upgrades are necessary, they will take years to complete and require significant penetration of 4G terminals to be effective.

### Combining mobile and fixed wireless infrastructures

Service providers commonly redirect traffic away from costly network components. This approach lowers capital and operational expenses and enables service providers to free up resources by supporting users on the mobile network only when it represents the best or only option. A typical strategy is to offload data to Wi-Fi® and femto systems, thereby taking advantage of the increasing prevalence of wireless access points in urban areas. Leveraging domestic Wi-Fi access is becoming commonplace, but since coverage cannot be guaranteed, it represents a "best effort" strategy.

### Content caching

By caching popular content in the network close to the user, service providers can offload the mobile core and backhaul networks and lower transport costs. This approach is widely used in fixed networks, and can also be applied to mobile networks. It does not, however, address the resource bottleneck in the radio access network.

### Combining mobile and broadcasting infrastructures

Broadcasting networks provide an interesting alternative to using mobile networks to carry mass content in a fully scalable way, since the network cost depends solely on coverage and not on usage. This approach can be used only for content common to all users, such as that provided for live TV or push Video on Demand (VOD) services; it cannot be used for full on-demand video services.

### Combining online and real-time services with offline content push

Downloading gives service providers an alternative to using streaming to deliver content to mobile devices. With downloading, service providers can control the content delivery method and timing. They can also create efficient offerings that combine online, real-time services and offline content push capabilities.

## Pushing content to mobile devices: Benefits and challenges

The increasing storage capacity available in mobile devices is making downloading a more and more attractive option for service providers and users alike.

Service providers can control downloads to ensure that they use their bandwidth in an optimal way. For instance, they can relieve peak-hour pressure on the mobile network by giving downloads lower priority than live streaming within the network and by scheduling downloads so that they occur during off-peak hours.

End-users can also benefit from controlled downloading. For example, they can download high-quality content such as high bit rate HD video whenever network bandwidth is available. Download speeds are greater when more bandwidth is available but once content is stored on an end-user device, it is always available for consumption, even when the network is congested or inaccessible. In addition, the quality of experience (QoE) for downloaded content is always the same regardless of location and network quality.

It is important to note that end-users cannot rely exclusively on controlled downloads to access media content. Some use cases require real-time streaming; services that impose download-only restrictions could cause frustration among end-users.

The challenge for service providers is to combine controlled download and real-time streaming services while accounting for service-specific profiles, content offerings and pricing.

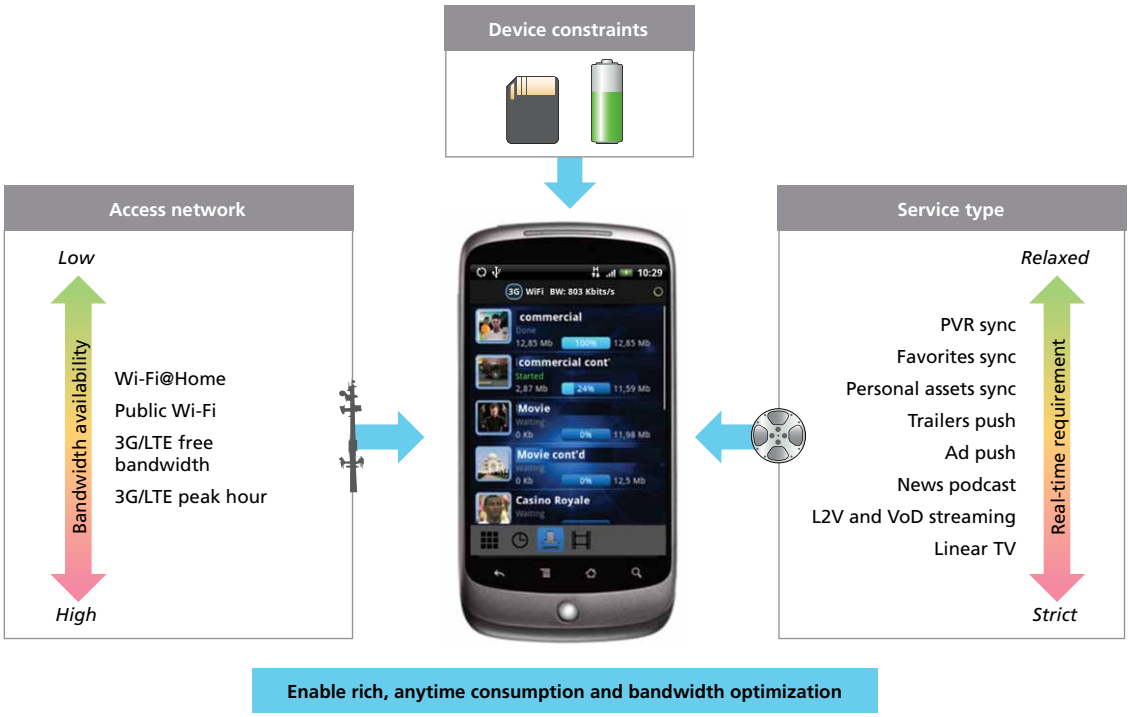
## Smart content download: Mobile Smartloading

Mobile Smartloading offers an alternative content delivery mechanism for mobile devices. This mechanism pushes content to individual mobile devices in a controlled fashion, enabling it to be stored on these devices for future consumption by end-users.

Mobile Smartloading enables traffic offloading by seamlessly and opportunistically pushing personalized and targeted content onto individual end-user devices. Whenever possible, Mobile Smartloading uses network quiet periods and chooses alternative, cost-effective fixed wireless networks (for example, Wi-Fi or femto systems) instead of 3G networks.

Figure 1 shows the key use cases supported by Mobile Smartloading, highlighting its consideration of access network bandwidth availability, subscriber preferences, device constraints and service types.

**Figure 1: Mobile Smartloading use cases**




Properly used, Mobile Smartloading reduces peak-time bandwidth demand by enabling more end-users to play content already stored locally instead of consuming streaming bandwidth. It offers further benefits to the network by controlling the amount of download bandwidth used when new content is requested.

## Features

Mobile Smartloading is a common service that can be used by any application that needs to push content — for example, videos or program grid-related metadata — to a mobile device. It provides the following key features:

- *Open application interface* —Any multimedia service can subscribe to Mobile Smartloading and publish content to be pushed to a device.
- *Scheduled downloads* — With Mobile Smartloading, downloads can be scheduled according to user- or application-defined criteria. For example, downloads can be initiated immediately, at a scheduled off-peak hour, or as soon as possible but with low priority.
- *Network overload detection* — Mobile Smartloading can detect network overload in real time and automatically suspend and reschedule downloads to less-congested periods.
- *Automatic network selection* — When alternative networks are available, Mobile Smartloading automatically selects the most appropriate, lowest-cost transport network.

## Architecture

The Mobile Smartloading architecture includes two main functional subsystems: a network-resident Mobile Smartloading control server and a Mobile Smartloading client that runs in the background on the mobile device.

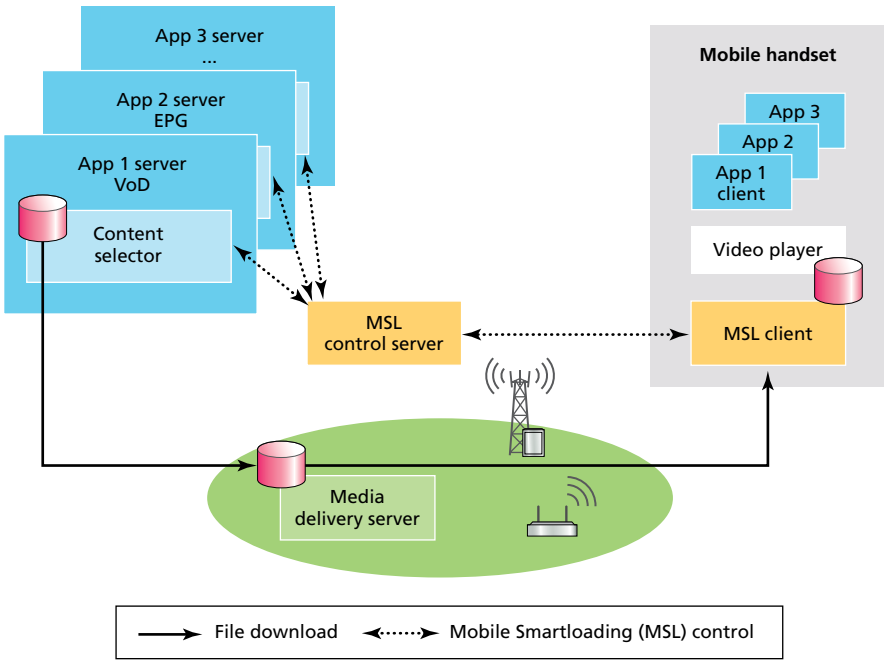
Mobile Smartloading interfaces with two external components:

- A centralized or distributed content repository (such as a Content Delivery Network), which is used to store and serve the physical media for downloading.
- Applications, which are responsible for selecting and delivering appropriate content to mobile devices.

  These applications can address a variety of download-specific use cases. For example, one application could control the timing of VOD content downloads. Another application could download a live TV program guide every night to ensure that the end-user can instantaneously access it on demand the following day. A third application could be an opt-in service that downloads articles, podcasts or videos from a newspaper, broadcaster or radio station at off-peak hours, ensuring that end-users always have access to their preferred content — even if they are commuting in an environment without mobile network access, such as a subway or airplane.

Figure 2 shows the Mobile Smartloading architecture.

**Figure 2: Mobile Smartloading architecture**




### *MSL control server*

The Mobile Smartloading control server centralizes all content delivery requests. For each Mobile Smartloading client, the control server specifies what content can be downloaded, the order in which it can be downloaded, when it should be downloaded, what access technology should be used, and where each media asset is available in the network. The control server can schedule downloads across multiple clients to prevent network congestion.

The control server supplies each Mobile Smartloading client with policies that specify the operator's preferences, including the network state and conditions — a combination of factors such as battery life, preferred bearers and network load — under which the background download must proceed or be suspended.

***MSL client***

The Mobile Smartloading client component resides on the user's mobile device, and is responsible for downloading media content and caching it on the device.

The client downloads content based on the device-specific inventory provided by the control server. It monitors device and network conditions — such as channel quality, bearer(s), battery status, powering status and processor occupancy — and determines the best download opportunities including the bearer on which downloading takes place.

The client's policy engine reacts to changes in device and network state by interrupting or resuming the download. If required, the client can orchestrate a seamless switchover to a different access network during a download. It can also automatically recover from any disruption — such as a loss of network coverage, low bandwidth, or mobile device power-down — without user intervention and resume the download from where it last left off.

Each smartphone operating system (Android, BlackBerry OS, iPhone OS and Windows Phone, for example) has unique characteristics and restrictions. A dedicated Mobile Smartloading client is provided for each major operating system.

## Using Mobile Smartloading

Service providers can leverage the benefits of Mobile Smartloading by building a new service architecture that differentiates "Smartloadable" content from other content. For example, service providers can deploy policies that specify differentiated delivery options, such as pricing advantages for end-users who choose Smartloading over immediate streaming.

### Other video service use cases

Mobile Smartloading can be seamlessly integrated into a wide variety of alternative video service use cases, including:

- *Datacasting* — Users can subscribe to content of their choice, for example, the last episode of a popular series or a newspaper that includes vodcasts. The datacasting application server automatically publishes required content to the Mobile Smartloading service whenever it is available. The Mobile Smartloading service then transparently delivers the content to the mobile device. The content is already available in the device when the end-user requests it.
- *Network PVR* — An end-user can record a TV show and select a "push to my mobile" option. The personal video recorder (PVR) service automatically pushes the recorded content to the Mobile Smartloading service when the recording process is complete; the Mobile Smartloading service then automatically pushes the content to the mobile device.
- *Predictive push* — Service providers can push popular VOD content to end-users' mobile devices ahead of time based on their respective profiles. When a user requests the VOD content, the client automatically launches the local copy instead of requesting streaming from the network.

### Benefits for service providers

By properly deploying Mobile Smartloading, service providers can use their available network bandwidth more effectively. In particular, service providers can use off-peak bandwidth that would otherwise be wasted without incurring marginal cost. This will allow them to defer network capacity investments and improve their revenue-to-network cost ratios.

The cost benefits offered by Mobile Smartloading will improve the economic balance of mobile data services for service providers. Service providers can share these benefits with end-users as a way to improve their competitive position — for example, by offering a more cost-effective video-delivery service.

The benefits of Mobile Smartloading also extend to network investment. Mobile Smartloading does not require direct investment in the network. It consists of a central software server and software on each device, and uses local memory.

### Benefits for end-users

The ability to consume content stored locally on mobile devices offers end-users a superior QoE. It also reduces the impact of mobile network congestion, non-guaranteed bandwidth and gaps in mobile network coverage.

Downloading content will eventually become a necessity as devices consume more bandwidth and Quality of Service (QoS), particularly through the use of higher-resolution screens. New devices like the Apple iPad, which offers screen resolution similar to HD, will require much more bandwidth to stream native-resolution content than previous-generation devices. Controlled downloading of large files will be an essential means to deliver the proper quality of media content to these new larger-screen devices.

Seeking content and convenience, end-users will want to avoid wrestling with complex downloading or side-loading procedures. A fully transparent mechanism that conveniently delivers the content they want to their mobile devices will be a key part of the end-user experience.

## Conclusion

The explosion of mobile data traffic — particularly that created by demand for video content — is presenting new challenges for service providers, and all projections show that this phenomenon is merely in its infancy. Offers of unlimited mobile data access will not be sufficient to satisfy demand and will require service providers to make huge and continuous investments in the network.

Service providers can combine several alternative strategies to deliver high-quality video while managing cost. Among these strategies, controlled downloading will become more and more important, as it will meet the needs of service providers and consumers alike, combining optimal use of low-cost bandwidth with delivery of higher-quality content to mobile devices.

Mobile Smartloading, which optimizes and controls the process of pushing content to devices, can become an essential element in the strategies service providers use to address the growing smartphone market and deliver tomorrow's large-scale multimedia services.

## Glossary of terms

| | |
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| MSL | Mobile Smartloading |
| QoE | Quality of Experience |
| QoS | Quality of Service |
| PVR | Personal Video Recorder |
| VOD | Video on Demand |

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