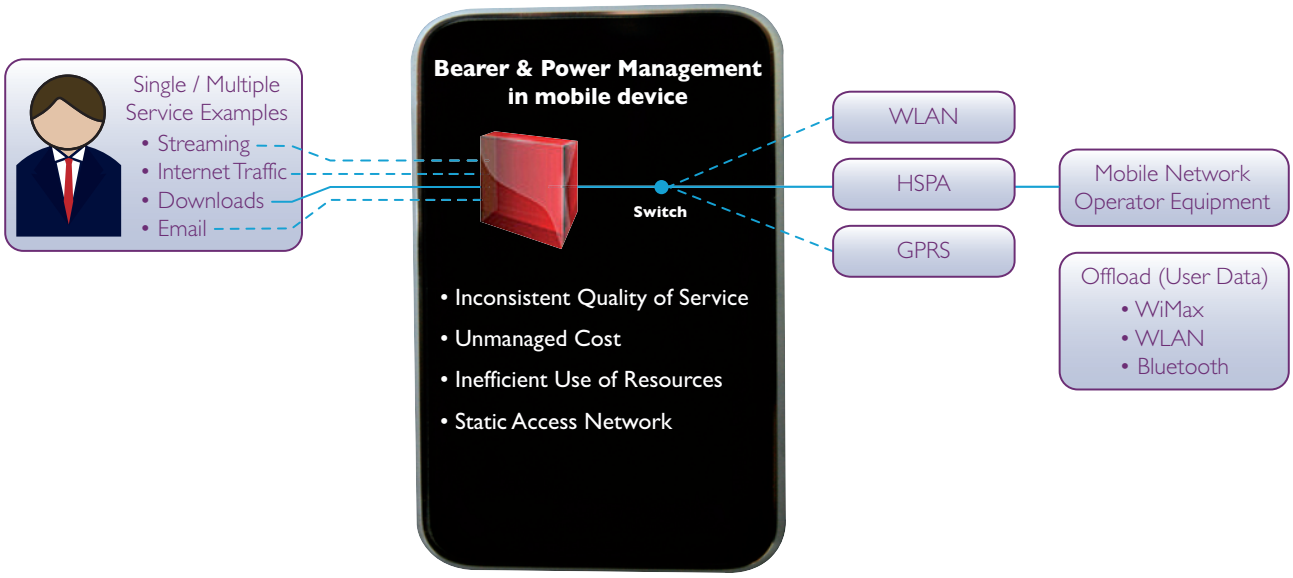
Roke Manor Research Ltd
a Siemens company

Smart Switch: Unleashing the Potential of Multimode Devices

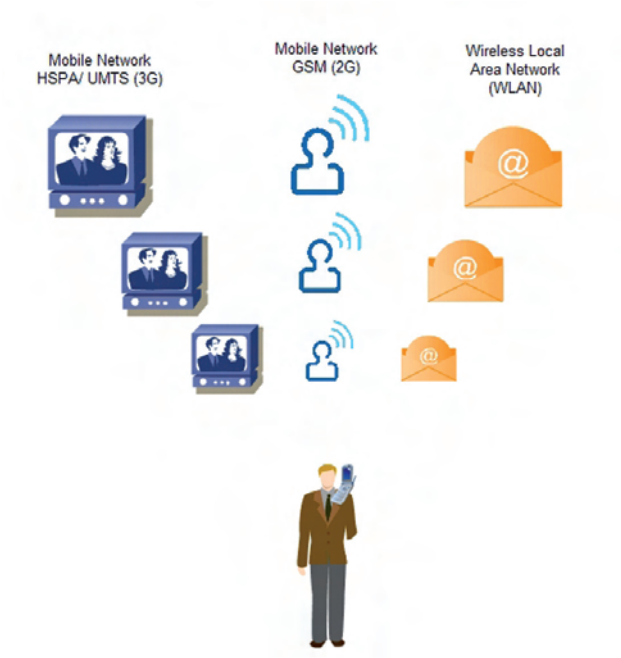
Multimode devices i.e. devices with one or more interfaces based on different access technologies, are forming an ever increasing proportion of the mobile device market. The growth of smart phones unlocks the potential to use cellular, metro or local wireless interfaces for data traffic. However, the true possibilities of these devices for operator revenues and user experience are yet to be realised.

Current solution: all data sent over a single interface



The ongoing efforts in the industry to unlock the dynamic use of multiple interfaces will inevitably give the desired results. However, smart phones are becoming similar in performance and the level of differentiation between them less noticeable. It is highly likely that an improved integration of multiple interfaces could provide device manufacturers with the next significant differentiator, offering advantages in operating cost, performance and battery life.

Roke's experience and expertise with multimode device development means we know what can be achieved with interface management. Our development of a unique suite of algorithms has proved the viability of dynamic allocation of individual sessions to multiple active interfaces based on operator policies. For example, Figure 1 illustrates how a user with multiple applications running on their devices is able to exploit the connectivity around them to meet the specific requirements of each application – support for applications with high quality of service requirements such as voice and video streaming is through the cellular infrastructure, whilst the more delay tolerant e-mail application is exploiting local WLAN connectivity.



Multiple simultaneous services

The Problems

Responding to User Expectations

With the widespread penetration of fixed broadband services, users have grown accustomed to flat rate Internet access with high bandwidth availability and good performance. The next generation of smart phones has revolutionised user interfaces, opening up a whole range of Internet applications that users access whilst on the move. Accessing email, downloading music, watching films, and playing games from mobile devices has become the norm. Users no longer expect "a phone, but mobile"; they now expect "the full Internet experience, but mobile", and one that costs as little to run as possible.

In addition to the above, users also want devices that are easy to use, reliable and offer a battery life of days under normal use. Users expect certain behaviour and levels of responsiveness from their applications – especially those that are provided directly by their operator for value-added services – but may be prepared to compromise on performance if they gain from cheaper access or, in some situations, extended battery life. As a result, it is expected that users will be attracted to devices that provide them with the ability to influence behaviour through the setting of static and dynamic user preferences. However, it is important that these preferences are presented in a simple way and do not conflict with operator policies.

Directing Load

The growth of Internet access from mobile devices is placing additional strain on the network infrastructure. Pressure on operators for faster data speeds to meet heavy user data application (for example streaming) is difficult when smart phones are also adding significantly to the mobile network control data signalling. The Internet itself holds a cloud of independent services hosted by different end points, and these services often engage in regular synchronisation with client devices. This is true even when the user is not actively using the service.

As a result, operators are burdened with the transport of low revenue data services for minimal return, even when it contends with operator provisioned higher value-add services. However, the availability of the flat rate services is a key element in maintaining and increasing the operator's customer base, and underpins long term data volume growth. The ability to direct load from mobile devices across available access networks offers significant benefit to operators in terms of maximising revenue from their infrastructure whilst meeting user service expectations. It enables operators to move certain data traffic off the mobile data network and onto other available local access networks, e.g. WLAN.

What should the solutions look like?

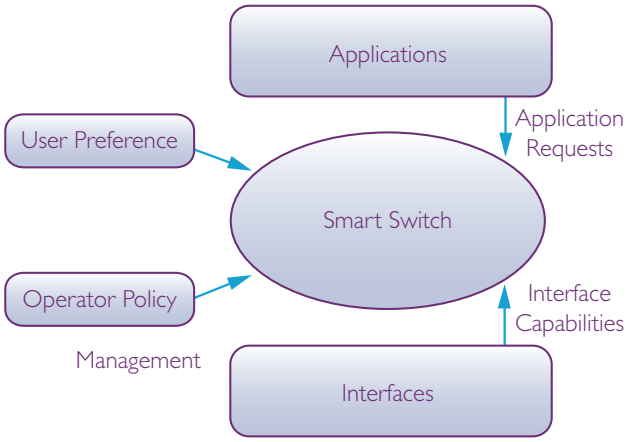
There will inevitably be a number of solutions presented to the industry over the next few years. These currently seem to be coming from the WiFi device manufacturers as well as cellular Tier 1 and Tier 2 vendors. Of course, each solution will have its differences and subtleties but the following benefits should at least be offered in a solution that will benefit both users and operators.

Users:

- Improved application performance – available connectivity should be matched to individual application requirements, exploiting higher bandwidth connections for some applications or providing appropriate QoS for others
- Extended battery life –the mobile device should be able to adapt its behaviour based on current battery levels and available wireless networks

Operators:

- Differentiation between data services - flat rate data may need to be separated from operator value-added services, ensuring that operators can maximise the performance of the latter
- Controlled offload of data – congestion within the mobile network infrastructure will certainly need to be reduced, including data and signalling at the air interface as well as within network equipment, backhaul and local breakout.
- Easy to deploy – there will need to be minimal impact on the network infrastructure, and the interface selection algorithms should be easily integrated into current mobile device architectures and operating systems



Interfaces and switch solution

The Smart Switch Concept

Through our long history in both commercial and mobile multimode device development, Roke have tested and refined algorithms for managing the smart allocation and switching of application sessions between active interfaces. It is apparent that current solutions, where all applications are assigned to the same interface and moved between interfaces on mass is not going to provide the granularity of control required to achieve all that the users and operators want. A concept we call Smart Switch would enable the interface selection decision to be carried out per application, or even per application session. This provides a powerful tool for ensuring that the optimal interface for each application is used based on a combination of application requirements, interface characteristics, device status, device battery life, operator policy and user preferences.

The development of these types of solutions is fraught with subtlety. The indiscriminate switching of services onto different available radio access networks without proper management within the mobile device will result in service disruption, and reduced device performance. This is partly because the operator is not in control of the services accessed by the user and therefore not being able to enforce the appropriate QoS, and partly due to the temporary availability of some access networks that are also unable to support mobility and service continuity.

At Roke, we believe that the best solution to this complex problem will come from a collaborative effort within the industry. The Smart Switch concept has been developed through years of experience in designing mobile handsets, and exploiting our extensive understanding of the challenges and constraints imposed by these types of devices.

Smart Switch demonstrates that it is possible to provide easy integration into existing mobile device architectures and operating systems, and would conveniently be installed as a shim layer within the terminal. Implementing a solution within the lower layers of the terminal software also provides the opportunity to manage the flow and aggregation of best effort traffic from multi-application environments. This should further benefit the selection of the interface and the efficiency at which the interface is used, directly offering an improvement to battery life and network scheduling.

We also understand the cost-benefit trade-offs faced by operators, and have deliberately minimised requirements on the network, such that using the Smart Switch concept enables a solution deployment without the need for significant infrastructure investment.

If desired, Smart Switch can interact with existing management systems to allow operators to configure and update their policies, but this can potentially be implemented as an overlay to the existing management infrastructure. Alternatively, the operator policies can be configured within the device as part of the factory settings.

The ideas behind Smart Switch will also allow for the management of terminal-centric handover of applications between interfaces i.e. when the network does not provision support for the handover. This would be executed using a combination of proven interface selection algorithms, combined with technology for managing the re-establishment of underlying connectivity transparent to the application. These are both areas where Roke's expertise, knowledge and example implementations will accelerate the development of a solution suitable for current multimode devices, such as smart phones.

Application Type	Application Requirements	Available Interface Characteristics	Operator Policies	User Preferences	Decision
E-mail	Best Effort, preferred >1Mbps	3G: 2.8Mbps downlink, guaranteed traffic class based QoS/QoS via DPI, dynamic resource allocation WLAN: best effort, 24Mbps 2G: 64kbps, guaranteed QoS, static resource allocation	Low Priority	Cheapest	WLAN
File Download	Best Effort, preferred >2Mbps		Low Priority	Lowest Power	3G
Voice	CBR, 64kbps, seamless handover		High Priority	Best QoS	2G
TV Streaming	VBR, 128kbps, seamless handover		High Priority	Cheapest	3G

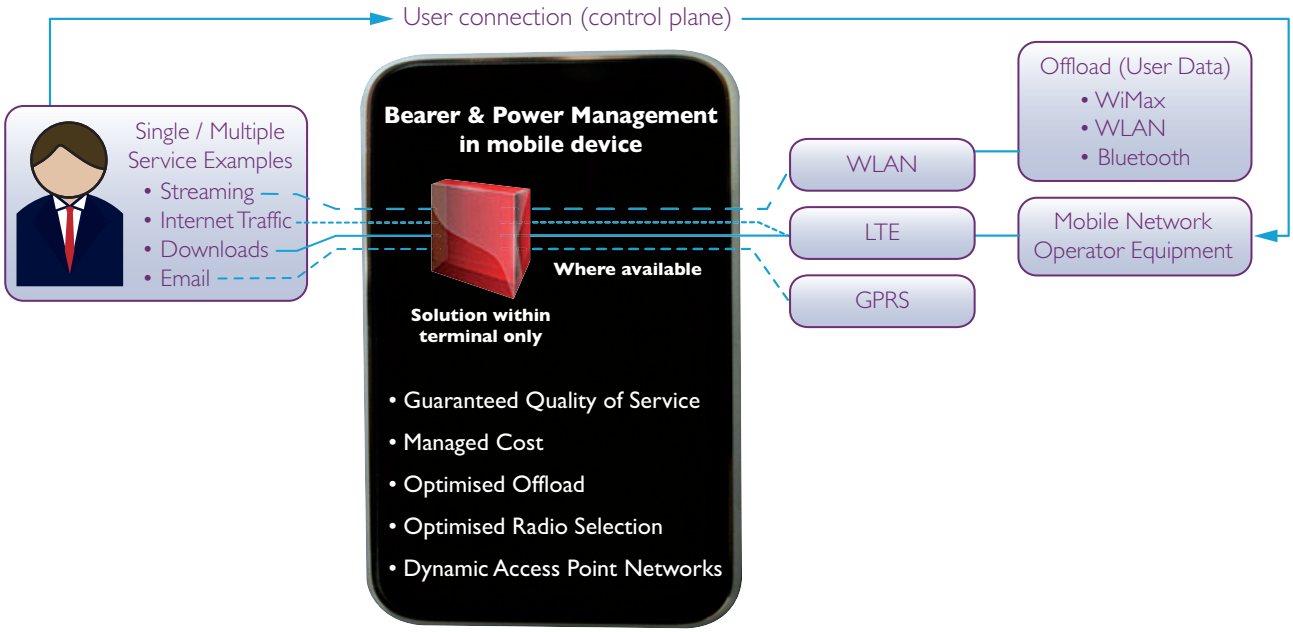
Example Smart Switch Operation

With capability comes new opportunity

Providing a dynamic interface selection capability should unlock the potential for a number of new applications. At the very least, we can expect location based applications to benefit significantly from 'knowing' when it has the opportunity to use an interface of higher quality, or lower latency to provide the user with relevant content without draining valuable battery resources (thinking of the alternative of keeping a GPS receiver going constantly). We also expect that enterprise customers could benefit greatly too. Roaming and mobile data use can be costly for organisations who equip their staff with mobile devices. The ability to subscribe to WiFi access points at the enterprise level and push a corporate policy down to each handset, depending on location, could offer some relief to those with high corporate mobility bills. It could be taken even further and the corporate servers could advise the user to 'move over' to the cheaper interface 50 meters to the left before you download that large email attachment?

At Roke, we apply ourselves to maximising the service from the communications mediums. Advising in standards, developing capability enablers and working with industry to get solutions to the users are a concise description of the way we work. We offer our knowledge for consultancy and collaborative development. Unlocking the potential of multi-mode in mobile devices is where we expect to offer services to anyone looking to provide the next market differentiator.

Simultaneous use of interfaces provides Offload and QoS advantages



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