

# Consolidation, Convergence and Creativity on the Internet

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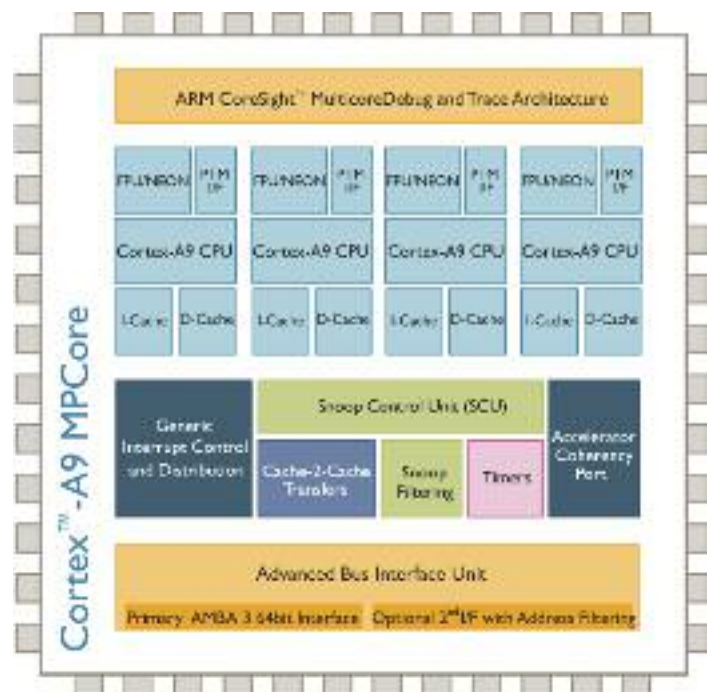
The Internet is playing a huge role in shaping the future of technology and business development. Serious breakthroughs are being made at last where content providers have finally started to take mobile aspects into account when developing their websites, but we are just at the tip of the proverbial iceberg. And while the difference between browsing experiences across devices will diminish – the drive for differentiation will deliver even more creativity than we have seen too date.

The Internet continues to be the access road but the means of traveling on it promises to afford consumers more refined choices, reduced complexity and creative new experiences. The ARM Cortex-A9 and ARM Mali graphics processor technologies are enablers of new, creative and differentiable devices as well as faster, more intuitive and full (Flash 10) browsing experiences – paving the way for Internet Everywhere. This article examines the consolidation in the marketplace, convergence of services across different devices, and the kind of creativity we can expect to see with an ever-increasing need for differentiation and faster, more intuitive Internet browsing experiences.

Today, the browser user experience is close to being the same on all desktops, regardless of the browser application used. Development along these lines will continue in mobile devices and in the various “4th screen devices” such as multimedia home phones and IPTV set-top boxes as Internet access in these devices continues to grow in importance. Eventually the browser user experience within each device category will become even more similar. Consolidation will take place making the browser application eventually less of a differentiator than a regular, expected tool.

This does not however diminish the importance of user experience design. In order to provide consistent browsing experiences across different devices, the browser user interface needs to be optimized separately for each different device category. For example, small handsets will need a simpler browser than netbooks without excessive amount of features that would be difficult or even impossible to use on a small screen. Touch screen tablet devices will require an entirely different kind of browser user interfaces than set-top boxes.

Talented user interface design, a trustworthy integration partner, creativity and the right hardware will play key roles in optimizing the browsing experiences for different devices.



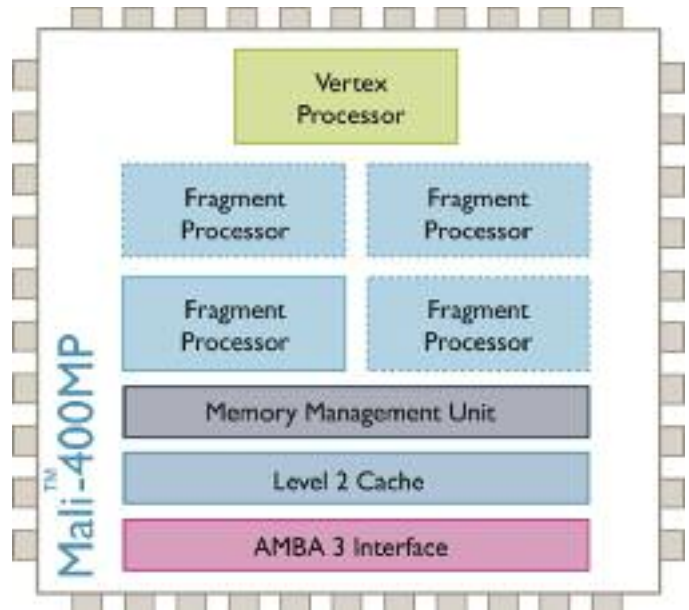
The ARM Mali graphics processor is a good example of the hardware required to support this direction, with its exceptional pixel processing capability allowing for the creation of faster, more intuitive user interfaces and full browsing experiences. The Mali graphics processor enables delivery of highest quality, cutting edge graphics solutions across a broad range of consumer devices.

Another consideration is that today the browser is no longer used just for browsing. Until very recently, a majority of business applications have been on the desktop, running as native applications. In addition, mobile platforms applications have been mostly native, notoriously consuming tons of power. This use of native applications is no longer sustainable in a world demanding Internet Everywhere. The trend, no, the megatrend is -- that applications, including productivity applications are coming to the mobile platform and they will no longer be native – they will be browser based. Providing easy access via the browser is the DNA of this megatrend – with no more software to download and install and no complex manuals to read.

From a consumer point of view, in addition to being easier to take in use, browser-based applications are generally cheaper than native apps, sometimes even free due to different kinds of business models – think for example about Google Docs that Google is providing free to users (provided they accept advertisements). For device manufacturers the ease of developing web applications is a good motivator to prefer them over native applications – it is much easier and quicker to design and develop browser based applications than native applications. The development costs are lower and there are far more developers available -- in fact the web developer community is the biggest community in the world – bigger even than the Android and iPhone development community. And when the barrier to create is lower, more creativity can be involved to make services appealing and differentiated from other services allowing for increased creative competition.

As the demand for native applications decreases and browser based application demand increases there is also a greater need to conform to Web API standards such as those proposed by the Open Mobile Terminal Platform (OMTP), the carrier driven handset software standards body, (OMTP is now a part of the Wholesale Applications Community (WAC)) which include Bondi, a set of carrier APIs to underpin mobile apps and security.

But in order to realize the full potential of Internet Everywhere – not only do you need to deliver easily accessible applications and a good browser user interface to power business users and impatient consumers, but the browser also needs to be powerful, fully optimized and blazing fast. Technologies such as JavaScript and AJAX can be very power consuming, not to mention all the new features coming with HTML 5 – which for example enables you to even have a small database within the browser. All this increases the required browser performance and with WebOSs and web-based business applications (for example, SaaS models) on the rise, the need to make the browser application run faster is becoming even more imperative.



How is the browser going to get faster then? Well, progress is being made on all fronts – ARM architectures are getting more powerful, there are technical advancements in browser designs; also JavaScript optimizations are getting faster and the industry awaits the promise of faster rendering with HTML 5 improvements. Browsing speed can be improved for example by leveraging the energy efficient high performance ARM Cortex-A9 that enables fast browsing as well as simultaneous use of multiple applications. Its multiprocessing capabilities enable running for example Flash in its own process and the browser application in another, making the performance of both significantly better and faster. It provides higher performance for lower power consumption making it ideal for mobile handsets and various high performance consumer products.

Another important factor is the rollout of 4G. 4G will provide us with super-fast download speeds, smooth video streams and even the capabilities for video chat. Mobile bandwidth will increase and you won't have to wait 30 seconds to have the front page of the New York Times to load – it will happen in a second.

All these improvements will help accelerate the movement of processes on top of the browser such as the core processes of large companies -- like ERP systems where the UI is going to be browser based and the logic will be in the backend – in the cloud. Web-based cloud services are helping to further reduce complexity.

But while hardware and browser software continue to improve, there is the continuous problem that the browser is just not tightly integrated with the hardware. This is a key area where a lot can be done to increase the browser performance and speed responsiveness – how fast the browser is rendering a new page, how fast a user can scroll, pan etc. These are critical issues to address in order to provide rich, satisfying experiences to users who have high expectations for mobile Web performance. And these expectations are escalating as users want websites to load as quickly as

possible or faster on their mobile devices compared to their desktop computers. To take full use of the improved ARM architectures such as ARM Cortex-A9 on platforms like Android and MeeGo, and to provide excellent browsing experiences, the software stack and the platform must be integrated seamlessly together and the browser needs to be optimized to run perfectly on the platform. Working with a trusted systems integration partner to deliver tight integration and optimization of the browser means significant performance gains can be achieved.

Another driver for realizing the full potential of Internet Everywhere is that end users are starting to expect a consistent look and feel across their various connected devices, as well as access to the same services. The convergence of services has already enabled combining speech, data and video and using the services through one single user interface to ensure a unified user experience. Convergence of Internet services means that the same services can be used with different devices and access techniques, where and whenever needed. While the way you interact with the devices might be different – such as a touch screen or remote control – the look and feel of the service will be the same – no more native applications that look totally different from one device to the next.

When you go to your Facebook site from your mobile, or your desktop, laptop or even your car – the user experience will be the same, your presence will be known across the devices and there will be a real simplification and freedom from the complexity we see today.

In order to deliver on Internet Everywhere, hardware developers need to understand the end users and their relationship to the browser. One thing is certain – demand for speed and simplicity is premium in the marketplace – and there are many resources available to meet this market need. Ultimately, from a business perspective – the goal of Internet Everywhere is to free business users from their physical desktops. From a consumer perspective the goal is to be able to stream content – so that media consumption once exclusively tied to your living room will be tied to your mobile – and you have new ways to communicate via social media, chatting and video telephoning. The migration path to accelerate and enable universal Internet Everywhere means we will see a great deal of consolidation, convergence and creativity in the marketplace – and a key component to universal adoption is in ensuring the browser based user experience is the same high quality and look and feel across devices.

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## Debugging ARM Software (*continued*)

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The execution of the accurate platform is spread across multiple computers, substantially reducing the time required to obtain correct results.

This same, parallel approach can be applied to other problems as well. In the application above, the checkpoints were used for application performance profiling but those same checkpoints could also be used to perform power profiling at the application level. Instead of bus accesses and resource utilization, waveforms would be created for execution from each checkpoint which could then be

fed into any of the leading power analysis tools. The end result would be a set of quickly gathered, accurate data which details the power consumption of the hardware while the software is executing.

### Conclusion

By combining the speed of Fast Models from ARM with the accuracy of Carbonized models of ARM IP, the use of virtual platforms for ARM-based SoC development can be greatly expanded. Instead of forcing a compromise of speed versus accuracy, a single platform can now run at 100s of MIPS and then swap to an equivalent representation running with 100% accuracy. The same platform which can be used at the beginning of the design cycle to optimize the architecture of the SoC and prevent under- or over-design can be used by the software team to debug software issues. Since there is only one platform required to meet the needs of all the teams, redundant design and validation efforts are eliminated along with their associated costs. This solution delivers a true best of both worlds solution to the entire design team.

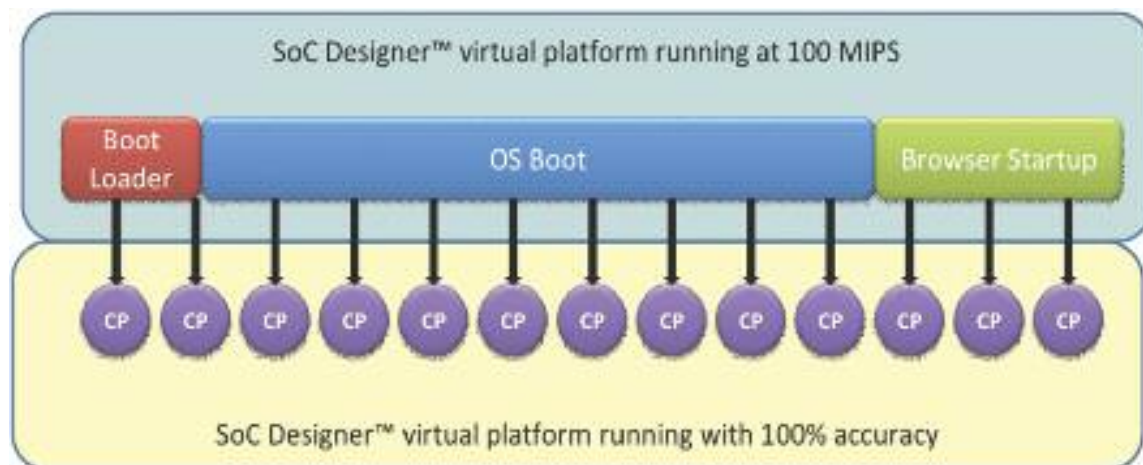


Figure 2: Checkpoints created while running at 100 MIPS with ARM Fast Models can be executed by the 100% accurate representation of the same system. Here, the number of cycles from power on to web browser startup is accurately calculated

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