Android for Rugged Devices -
The Challenges and Way Forward

Whitepaper
With Android making a strong mark in the smart devices space, there has been a spurt in its growth in other areas such as entertainment, automotive, and rugged devices. Android had initially germinated from an idea of a mobile operating platform for smart devices and it has been designed accordingly. However, with ample opportunities in the market, the gaps in Android are being worked upon to make it attractive for users in various segments.

This paper looks at the rugged device market space, shortcomings in Android for this segment, and attempts to highlight the challenges faced by OEMs in adopting Android for rugged devices.

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Introduction

Usage of smart devices in retail, healthcare, manufacturing, logistics, field services, government and other industries has increased over time. Since most smart phones and tablets are not designed for industrial or rugged usage, hardware and software failures are major issues especially storage (file system corruption), displays and keyboards.

As a result of increased failures of devices in enterprise environments, their total cost of ownership (TCO), relative to rugged counterparts, has increased considerably as shown in Figure 1. Also, additional costs of accessories (such as barcode scanner) have also added to higher TCO for consumer devices to meet similar level of enterprise functionality.

Figure 1: Average Annual TCO by Form Factor
(Source: Mobile Device TCO Models for Line of Business Solutions, VDC Research - February 2013)
Due to the high failure rate of consumer smart devices used in such enterprises, users prefer devices with higher levels of ruggedness without sacrificing the features of smart devices, including touch display and user experiences. This has made the rugged device segment become one of the fastest growing segments of the smart devices market.

Based on the VDC report, the rugged device market is estimated to reach 9.9 million units by 2018 with a CAGR of about 16% as shown in Figure 2.

![Figure 2: Growth in Rugged Smart Devices segment](Source: The Global Market for Rugged Handheld Computers and Smart Devices for Line-of-Business Applications, VDC Research Group, Inc. 2014)
Rugged smart devices are designed to achieve a four-to-six-year lifespan while devices designed for personal usage have shorter lifespan. Because of addition of new features, products are usually updated after only six to eight months. This doesn’t create a problem for individual consumers, who typically have one device at a time, but can create a major problem for enterprises those which have hundreds or even thousands of mobile devices to manage. Since product life is longer in case of rugged smart devices, there is a challenge to support legacy devices and platforms, especially when semiconductor vendors do not support upgrading to newer versions of the OS. **Sasken plays a crucial role in such scenarios by bridging the gap between the chipset vendors and OEMs.**
Rugged device manufacturers have historically been using Windows based OS (Windows CE and Windows Embedded) to power their devices. However, with Microsoft going slow on their OS development and Android steadily gaining market share in rugged market. The following are contributing to the growth of Android based smart device.

**Enterprise features in Android:**
Google is also trying to increase Android’s footprint beyond smart devices towards rugged devices by beefing up on enterprise required features like – encryption, device administration, device management, multi-user capability and support of Android for Work. These features have surely kept rugged device manufacturers actively engaged with Android.

**Enterprise Applications:**
For rugged device manufacturers, the need for Android is also being driven by their enterprise customers who are developing Android applications utilizing rich functionality of Android SDK and developer friendly tools and environment.

**Stable Android:**
Android stack comprises of mature software from many active open source projects. Google matures the quality further through its multiple levels of testing. Beyond this, chipset vendors take this software from Google and improve quality on their hardware after porting. At the end of these phases, device manufacturers get quality software which is resulting in rugged device manufacturers preferring Android.

**Security Enhancements:**
Security patches for vulnerabilities in Android platform are very frequently released by Google and mandated through compliance tests. For security conscious OEMs, this further aligns their need towards Android as their devices can now be made safe.
Challenges in Porting Android for Rugged Devices

The use cases of rugged devices mandate some of the hardware components to be different from that regularly used in normal smart devices. This requires configuration changes, possible redesign of Android frameworks, development and inclusion of customer apps for factory testing. Some of the challenges are:

- **Resistive touch screen:** Resistive touch screen is preferred so that it can be used by users wearing gloves. This usually requires calibrating and fine tuning touch points for single and multi-users. The challenge is to run this under various conditions to validate and improve the responsiveness.

- **Bar code scanner:** Bar code scanning feature is necessary for rugged devices involved in inventory management. AOSP does not have this feature for reading, deciphering bar codes, and securely delivering the deciphered bar code with extremely fast response time.

- **Keypad:** Rugged devices usually have their own keypad or specific keys which, depending on the customer usage, would need to be remapped to different keys or mapped to launch specific quick launch application.

- **Connectivity:** Connectivity subsystem needs to be enhanced to include enterprise safety authentication methods for Wi-Fi, VPN, etc. Additionally, since rugged devices are deployed in customer premises, device manufacturers have to ensure interoperability of device with various access points and have to support fast handover/switching between various Wi-Fi access points in the premise.
• **Networking:**
It has to be always kept up-to-date in terms of adopting all critical security fixes that have been noticed and fixed recommended by Google and the open source community.

• **Testing:**
Very stringent quality criteria set by rugged device manufacturers requires running long hours of stress and stability tests with multiple devices and fixing all issues and ensuring high quality of hardware and fault tolerant software.

• **Power management:**
Rugged device usage on field will require efficient usage of battery power as the user won’t find a charging point during their work shifts. This mandates thorough power profiling and fine tuning for the various use cases that their customers are expected to perform.

• **Android upgrades:**
As lifespan of a rugged device is between three to five years, there will definitely be a need to apply security patches or to upgrade to newer versions of Android. Android software changes are substantial and impacts many projects as shown in Figure 3. Leap frog upgrade causes more challenges.

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**# of Projects Changed per Android Release**

<table>
<thead>
<tr>
<th>Version</th>
<th>Projects Changed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jellybean to KitKat</td>
<td>≈150</td>
</tr>
<tr>
<td>KitKat to Lollipop</td>
<td>≈200</td>
</tr>
<tr>
<td>Lollipop to Marshmallow</td>
<td>≈250</td>
</tr>
<tr>
<td>Marshmallow to Nougat</td>
<td>≈275</td>
</tr>
</tbody>
</table>

*Figure 3: Total Project Changes per Android version*
Challenges increase when chipset vendors do not support Android upgrades on legacy chipsets. Upgrades may also need changes in subsystem (graphics, multimedia, sensors) firmware. Supporting new version of Android by retaining old kernel may pose incompatibility issues and security problems. Therefore, a thorough analysis of changes in kernel is required to decide which kernel version can be used.

Sasken has been working with various rugged device manufacturers to bring up Android on their devices and subsequently port the next Android versions on those devices while addressing all the above challenges and working closely with hardware component vendors for subsystem compatibility.

Sasken has helped OEMs launch Android based rugged devices on various chipsets including Texas Instruments OMAP, Qualcomm Snapdragon and Freescale i.MX chipsets. Sasken has successfully ported all versions of android starting from Jelly Bean to Nougat.

![Total # of Git Patches Per Android Release](image)

Figure 4: Total Git Patches per Android version (Note: Data derived by using the concept Script by JBQ here. This uses Git feature to find patches between two tags.)
Conclusion

Mass adoption of Android in the rugged device market space will require security to be enhanced and enterprise features such as device management (to provision, configure, update, and control) to be included. Google has been working on addressing all these and over the various releases has introduced different features catering to this: enhancing device administration support, including AFW (Android For Work), ensuring verified boot using trusted execution environment, enhancing runtime security by sandboxing per application environment, and enforcing system wide SELinux.

The pace set by Google in defining, enhancing, and including the security features is definitely making rugged device OEMs to start moving towards Android, if they have already not started yet. This constant enhancement of features might require OEMs to start adopting set of features, instead of porting to the new versions of Android. **Sasken can help OEMs to port and adopt critical feature sets.**

Also the realities of the longevity of the rugged product and short Android upgrade support cycle from the chipset vendors will remain to be a challenge.

This challenge has to be addressed without a substantial cost to the OEMs in order to increase the volume of Android adoption in this space. **Sasken with its advantage of having expertise in various Android stacks will be ready to help any potential player to succeed in this space.**
About the Authors

Vipin Tyagi:
Vipin is a Pre-Sales Manager at Sasken and manages rugged device Accounts. He works closely with business teams on offerings, solutions, GTM strategy, and competitor analysis. He has authored various technical papers in IEEE sponsored international and national conferences, techno-managerial paper in Emerald Refereed International Conference and articles on social media platforms.

Ponmuthusubramaniam N:
Ponmuthusubramaniam N is a System Software Architect at Sasken. He designs and develops solutions in the embedded devices and smartphone space. Utilizing the hardware functionality and recommending appropriate Linux features is what he looks forward to in products.

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Kishore has over 19 years of experience in architecting, developing and delivering solutions in the domains of portable devices, consumer electronics, automotive, IoT and wearables. Kishore is always on track with emergence and advancements of technologies, assessing business prospects, conceiving solutions and authoring articles and papers for newspapers, magazines, and social media.
About Sasken

Sasken is a specialist in Product Engineering and Digital Transformation providing concept-to-market, chip-to-cognition R&D services to global leaders in Semiconductor, Automotive, Industrials, Smart Devices & Wearables, Enterprise Grade Devices, Satcom, and Retail industries. With over 27 years in Product Engineering and Digital Transformation and 70 patents, Sasken has transformed the businesses of over a 100 Fortune 500 companies, powering over a billion devices through its services and IP.
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