

Distributed Development at Symbian Ltd

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Introduction

This paper covers the learning process and the implementation of a distributed development environment at Symbian and the lessons being learnt. These include the requirements to setup Offshore Development Centres (ODC), how Symbian is overcoming issues regarding export control and the end goal of parallel development across the globe. This paper also covers the problems and obstacles Symbian is still facing while implementing this type of development method.

Symbian

Company Profile

Symbian is a software licensing company that develops and supplies the advanced, open standard operating system – Symbian OS™ – for advanced mobile phones, also called “smartphones”. Symbian was established as a private independent company in June 1998, and is now owned by Ericsson, Nokia, Panasonic, Samsung, Siemens and Sony Ericsson (Figure 1). It is an independent, for-profit company whose mission is to establish Symbian OS as the world standard for mobile digital data systems, primarily for use in cellular telecoms. Non-executive directors, representing each shareholding company, sit on the Symbian Supervisory board. Their role is to set the standard licensing terms and conditions for Symbian OS.

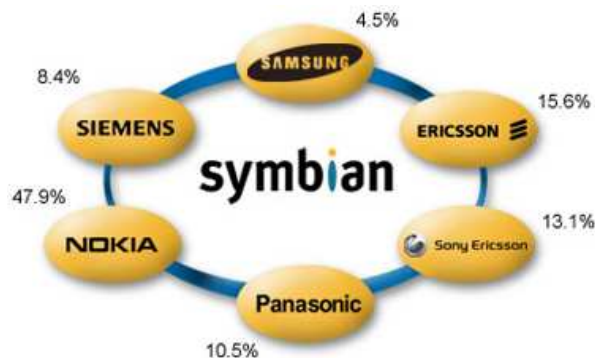


Figure 1 Symbian Ownership

Symbian OS licensees represent over three quarters of global mobile phone shipments globally. Mobile phone manufacturers that currently license Symbian OS are Arima, Ben Q, Fujitsu, Lenovo, LG Electronics, Motorola, Mitsubishi, Nokia, Panasonic, Samsung, Sharp and Sony Ericsson. By the end of March 2006, shipments of Symbian OS exceeded an average of 2 million per month, and cumulative shipments since the formation of Symbian have surpassed 70 million phones. Also at that time, there were over 4500 commercially available, third-party applications for Symbian smartphones.

Up until 2003, Symbian was based solely in the United Kingdom and all development of the operating system was done in this location by 600 employees. Since then, Symbian has grown significantly and now has offices in several parts of the world. Its headquarters are in London, United Kingdom and Symbian also has operations in the United States,

Sweden, India, China, Korea and Japan, Figure 2. Symbian now has over 1300 employees spread over these locations.



Figure 2 Symbian Offices Around The World

Symbian OS Development Process

At present, Symbian OS contains approximately 300,000 files in about 16,000 directories. The total size is over two gigabytes. These files are held in what Symbian calls the “Master Codeline” (MCL). The master codeline contains all supported platforms, which are maintained in parallel. It is maintained at a product quality level and managed by a Software Change Control Board (SCCB). The internal structure of the MCL consists of directory trees for each supported platform plus source trees that are common. As a result of this, whenever the MCL is built, all of the platforms are built and tested.

Symbian follows a development-master-delivery codeline pattern (Brad Appleton’s “Mainline Model”), Figure 3, whose core is the MCL submission process that maintains a level of quality for leading edge code. Development of Symbian OS is done in a “Development” codeline which is then branched or integrated into the MCL after intensive testing. Once code has migrated to the MCL, the Symbian Build and Integration teams are responsible for overnight build’s and smoke tests on it. When successful builds and smoke tests have been completed, they are responsible for branching/integrating it into the delivery codeline. All product deliveries come from delivery codelines, where quality is more strictly regulated, leading to the final release of a particular version of Symbian OS, which in turn gets shipped to customers.

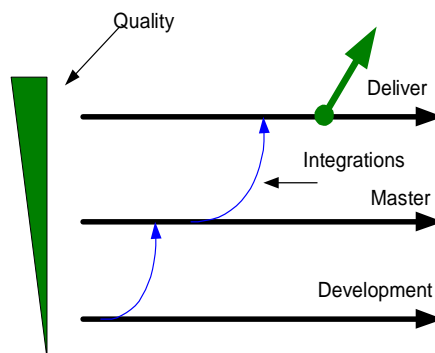


Figure 3 Development, Master and Release Pattern

Symbian development projects follow a life-cycle which reflects the progression of quality and each project has a configuration management plan that provides specific details on the codelines involved and their management.

Symbian Export Control and Intellectual Property

The majority of Symbian business involves delivering Symbian OS overseas and these foreign markets contribute significantly to our success. Export controls currently in use by the UK Government and the European Union affect the delivery of Symbian OS to all our export markets. Symbian OS contains code that enables and supports cryptography. The security applications offering protection to data on a Symbian handset are driven by cryptographic algorithms that turn meaningful text into cipher text by the application of a key. Export control legislation has identified cryptography as a dual-use technology, meaning that whilst its intended purpose may be harmless e.g. for use in mobile phones, it has the potential to be used for purpose contrary to the security interests of the governments of the UK and European Community (EC). For this reason, export controls in use by the UK Government and EC apply to Symbian OS.

As a result of this, Symbian requires an export licence to deliver Symbian OS (outside of the EU member states) and is required to keep records of all deliveries of Symbian OS made outside the UK. Where software development of Symbian OS is being done by staff outside the UK, Symbian is required to keep track of what has been exported at the file level

As Symbian deals with third-party code, there are additional issues involved such as; Intellectual Property Rights (IPR), export control, contractual agreements and configuration management patterns. The necessary involvement of third-parties in the development of Symbian OS means that it is difficult to cover the entire system under a single legal agreement. It is important that the company clearly understands the legal requirements connected with every part of the code and to do this, Symbian devised a set of nine policy categories with which the code is labelled. Paraphrased, these are:

- A. Confidential Source. Not distributed. All customisation performed by Symbian.
- B. Third-party Confidential Source. Source for which the Symbian licence from the third-party supplier forbids distribution in source form.
- C. Jointly Developed Source. Not distributed at all except to the co-developer of the software or by special arrangement.
- D. Reserved Rights Source. Provided to all licensees. Symbian retains the right to take back any changes to this source.
- E. Standard Source. Source code which licensees are allowed to modify and include in products.
- F. Example Source. Freely provided to all Symbian OS developers.
- G. Application SDK Source. Code which licensees are allowed to modify and include in products. May also be shipped under licence as part of the licensees own SDK.

- T. Test Source. Test source code which cannot be included in a device

- I. ISC. Independent Software Component. Not part of Symbian OS.

Category F and G code can generally be distributed without specific signed agreements. The ideal for Symbian is to have as much code as possible under these unrestricted categories.

Contained within Symbian OS are Distribution Policy files in the Perforce repository. These files describe the Symbian intellectual property rights (IPR), and the Symbian third-party's source code. Every directory in Perforce that forms part of Symbian OS must contain a distribution policy file which details distribution instructions along with the policy categories mentioned above.

The Symbian Perforce Service

Symbian has been using Perforce successfully for the last six years. It was first introduced in 1999, where previous software configuration management (SCM) tools and processes were based around a 1990 version of PVCS. This was used in conjunction with a set of command procedure wrappers to provide a standardised environment for SCM and for building the software. The current Symbian Perforce server environment consists of the following:

- 1 Perforce server for development purposes, holds Symbian OS - located in London, UK
- 1 Perforce server for the Technical Consulting (TC) department, holds licensee specific code – located in London, UK
- 1 Perforce server for joint projects between Symbian and third-parties – located in London, UK
- 1 Perforce server for UIQ services(subsidiary of Symbian), holds the UIQ source repository – located in Ronneby, Sweden
- 2 Perforce Proxy servers for distributed development – located in Bangalore, India and with a Partner in Canada
- 2 backup Perforce servers for shadows and disaster recovery (DR) purposes – located at two different locations

The Symbian Perforce server configurations can be seen in Appendix A of this document. Fig.4 shows the Perforce servers/Proxy servers and where each one resides.

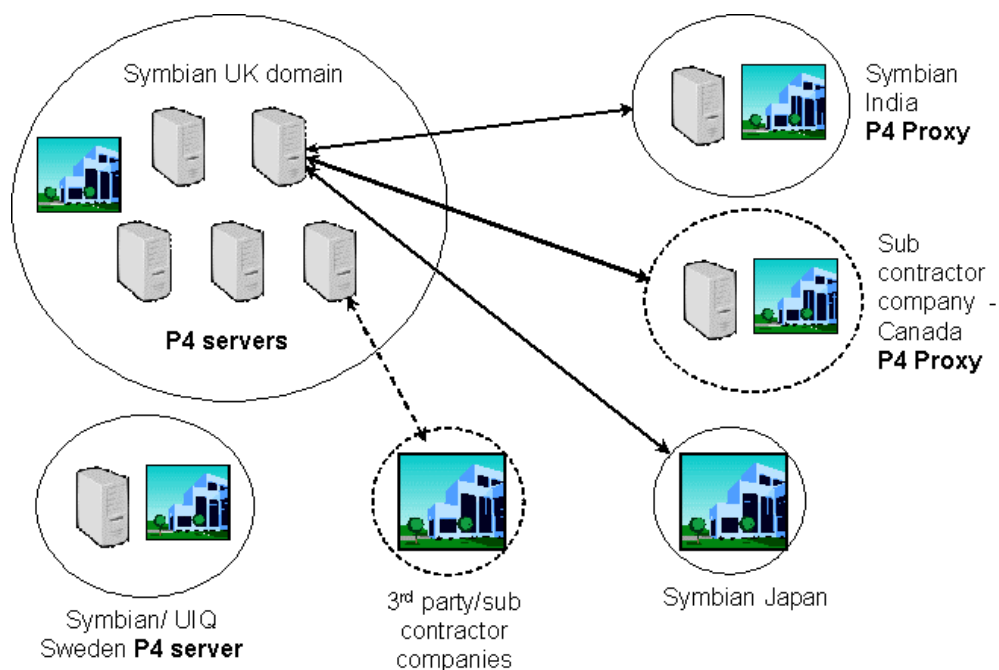


Figure 4 Symbian P4 Locations

Offshore Software Development Outsourcing

Offshore outsourcing is the practice of hiring an external organisation to perform some or all business functions in a country other than the one where the product or service will be sold or consumed. Offshoring can be defined as relocation of business processes from one country to another. This includes any business process such as production, manufacturing, or services performed either by the foreign subsidiary of the same company or a third-party.

Offshore outsourcing is one of the most popular management practices today. Though it is generally driven by the cost reduction factor, this is just one of the many reasons, why many businesses today consider offshore outsourcing. Like several other businesses, Symbian too had a great interest in outsourcing some of its software development work offshore.

Why Outsource Work Offshore?

From its formation in 1998 through to 2002, Symbian experienced rapid growth in all aspects of its business. This speedy expansion was the result of the increasing requirements of Symbian customers, along with the successful consolidation of the Symbian "Ecosystem"- or third-party community. These factors made it progressively more difficult to address requirements domestically and it became harder to restrict software development projects inside company walls.

Another major factor in the company's decision to outsource development was the fact that the economies of scale in joining diverse development skills and expertise with more sophisticated communication media, together with cost and technology pressures, created a need for a global software development strategy.

These factors contributed to the idea of outsourcing development work to offshore sites, and Symbian decided to investigate the offshoring phenomenon and the option for Symbian to outsource. In 2001, the first offshoring proposals on offshore use were written. In these proposals, the decision in favor of offshore development was taken, to compliment existing sites and for a few reasons mentioned below:

- Increase risk control
- Broaden access to a global talent base
- Deliver further functionality whilst maintaining the same cost base
- Provide a broader development capacity for customers and partners
- Take advantage of time differences
- Reduce overheads, free up resources
- Offload non-core functions
- Establish long-term, strategic relationships with world-class service providers to gain a competitive edge

It was decided that Symbian would make use of an offshore development site - Bangalore, India. The time scale in which the whole outsourcing activity took place can be seen in Figure 5.

Why India?

Offshore outsourcing has been popular for several years. Countries like India are popular offshore outsourcing locations which offer cost effective solutions. There is a wealth of articles and write ups about the cost advantages of offshore outsourcing with a majority claiming anywhere between 40-50% savings. It is not surprising that corporate giants in the United States, Europe, and Japan are increasingly looking to India for cost-effective and high-quality software solutions.

India has invested heavily in technical education and can provide a ready supply of skillful people at relatively low cost. Infrastructure improvements in India, particularly in the area of telecommunications, and the independent nature of working in IT make it possible to bring this talent to bear on virtually any programming task. Traditionally, the most active location for staging these types of IT outsourcing initiatives has been India. A large pool of high-quality programming talent, favorable government and tax incentives, and the ability to complement U.S. time zones with a virtual around-the-clock approach are some of the advantages India has to offer.

Symbian chose India as a location to create an Offshore Development Centre (ODC) not only for the reasons mentioned in the previous paragraph, but also for the following:

- India has a vast selection of engineering talent. The local universities accredit an extensive number of engineers every year, not to mention the existing number of people already working for the IT firms based in the country;
- Offshoring is already well established in India for many IT services and there is proven track record of research and development activities;
- Risk and third-party acceptability; some Symbian customers and third-party partners agreed with the idea of outsourcing to India;
- Optimum balance between cost, risk, developer and process capability;
- Symbian already has strong partnerships in India and is keen to capitalize on this fact and to continue its growth in the country;
- India has solid process capability, many companies at CMML5/CMMI.



Figure 5 The Symbian India Offshore Journey

Evolution of Symbian India

From its startup in 2003, the ODC in India was used via a staged approach from full software testing and low-level maintenance work to fully blown, independent development. Symbian went for this approach, as you would expect for starting up any ODC, as expectations and achievement levels were unknown. Starting off with low-level maintenance bug fixing seemed to be the right way to go about integrating the ODC with Symbian. At this point, there is basic understanding from the ODC side about the company and how it runs its business and development activities. Other factors at this stage are assessing particular skill sets, determining the types of potential work that may be carried out and scalability of resources etc.

The next stage of evolution of the Symbian ODC was to introduce co-development with the UK development teams. At this stage there is better functional understanding of the business and its development processes. There is also more confidence in resources, people and co-design skills. In addition to this, comes a higher level of acceptance from the UK development teams, assurance that the processes are working, and seamless global development becomes apparent.

The final stage of evolution is when independent development is achieved. The ODC has critical domain knowledge at this stage and can utilise the independent design skills. At this point, Symbian setup specialized technology streams for development as the ODC had established the ability to design and lead projects independently. The level of

responsibility is increased dramatically and confidence is high. Global development of Symbian OS is considered a success.

The staged approach was implemented through the duration of starting up the ODC in 2003 through to it officially becoming a Symbian subsidiary. Symbian learned a large amount by working with the local company providing services for the ODC. Once Symbian was confident in working overseas, it established a fully owned company to run the overseas operation and disband the local company service offerings. Also, Symbian had many legal issues with IP ownership from partners and licensees that prevented the company from sharing code, overcoming this operational issue drove Symbian to move to a wholly owned entity, where independent development was possible. Figure 6 shows the staged approach and how responsibility increased over time.

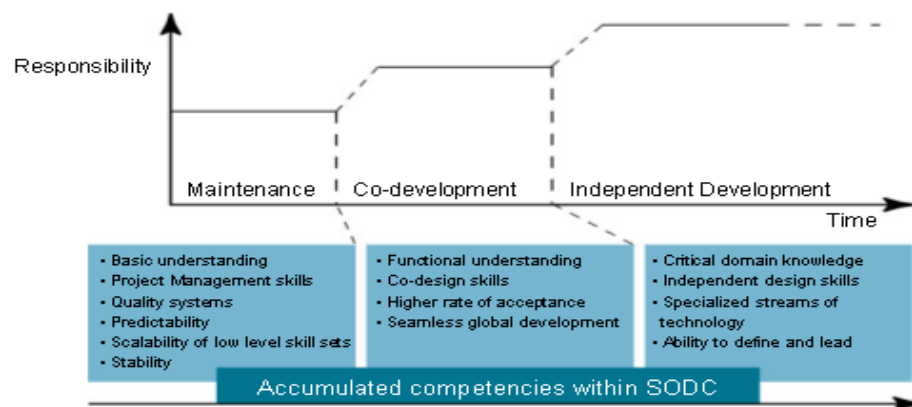


Figure 6 Staged Approach of Symbian India

Challenges Symbian Faced With Distributed Development

While many businesses reap the benefits of outsourcing their development activities, unfortunately, there are some major challenges for businesses to overcome, before a smooth, productive and successful operation is established. The major challenges arise from the lack of or differences in the infrastructure in distinct development locations, including network connectivity, development environment, test and build labs, and change and source control systems to name but a few.

Symbian faced similar obstacles throughout the evolution for the offshore development site, from several aspects of the business. The following sections highlight some of these issues and how they were overcome.

Communication and Cultural/Language Differences

A large source of difficulties is the one of communications across sites. Due to the time zone differences between the UK office and the development site in India, there were very few hours in the day where project/development participants were in both office locations at the same time. These communication issues affected all aspects of Symbian India evolution, moreover, contributed to the other challenges which Symbian faced.

The difficulties in communication meant that the development teams were unsure about who the experts on various subjects were, at each site. Simply trying to identify the right person for a particular subject turned into a time consuming task. In addition to this, it was complicated to communicate because of cultural, language and experience differences. This often meant that conversations or situations were sometimes hard to explain, misunderstood and many questions seemed unanswered. Another contributing factor was that individuals/teams had no personal knowledge of the other at each site, which in turn led to struggles in communicating openly across the sites.

Communication issues still pose challenges at Symbian today, however, the introduction of various communication applications such as instant messaging services, online meetings and video conferencing have improved internal communication a great deal. Other improvements are being observed by increased actual physical contact via frequent visits to the sites and formal introductions of people/teams. Recruitment has also become more selective (as Symbian had full control) with regards to the skill set of new employees, including excellent verbal and communication skills as a basic requirement.

Human Resources

Potentially, massive savings in wage and benefit costs continue to drive the global offshoring movement, but companies are facing a wide range of people management issues both overseas and at home. Symbian also encountered several challenges with offshoring and establishing a Symbian India office.

As outlined in the previous sections, the first step of establishing a Symbian site in India was to identify a local offshore vendor with whom Symbian could work with. Symbian faced some crucial challenges at this stage due to the local vendor providing its own staff to work on Symbian projects, and having control over salary determination etc. As local resources were being assigned to do the development work, Symbian had little control over who was being allocated to specific projects. The lack of experience and knowledge of Symbian OS meant that resources were not optimized. The new staff employed followed the local vendor's own employment process, policies and criteria, which differed from the Symbian way of recruitment. Initially, staff was pessimistic about the ODC as time and effort were increasing in order to rectify problems and generally the costs of running the ODC were also generally increasing.

Most of the challenges were overcome once Symbian India was established. A Symbian management team was created with a new style of recruitment, creating their own policies and processes tailored to the India market, and a

formal Symbian interview process was introduced. Along with a successful marketing and advertising campaign, Symbian enhanced its presence in India. Roughly 200 ODC employees applied for positions within Symbian India and approximately 80 candidates were successful. Other people were recruited externally, who met the specific criteria and as mentioned before, the skill set of the candidates improved.

One of the toughest challenges today, for the Symbian India HR team is to deal with the prevalent high attrition and retention levels in Bangalore. While there are a high numbers of new starters, there are also a significant amount of leavers. As India is becoming a highly successful IT centre for an extensive number of major businesses, competition is endemic. As such it is common that candidates fail to show-up for interviews and some successful candidates have a number of work offers and decide at the very last minute to work elsewhere. Symbian is working hard in new recruitment and retention in India by implementing an equal employment policy which involves providing the Indian staff with similar benefits to all other Symbian staff around the world. This includes high standard of working conditions, rewards and bonus schemes. The equal employment policy has not only helped increase employee satisfaction and retention, but has also attracted a significant number of high-caliber new starters.

IT Infrastructure

One of the most important factors of establishing an ODC and which is core to distributed development is the IT infrastructure between the development locations. A flexible and responsive IT infrastructure is imperative if distributed development is to be a success.

Symbian wanted to minimize the risks in setting up an ODC, therefore when the ODC was first introduced, it was agreed that the local company would provide the network and Symbian would make use of their IS people, network link and Internet Service Provider (ISP). They provided a relatively small satellite network link (below 3MB) with a high latency delay. Symbian faced several problems due to this kind of network infrastructure. The low network link between the UK office and the ODC was proving cumbersome to carry out even the smallest of tasks. Copying project documents, files and other work across the network seemed to take forever. For example, a 2MB PowerPoint presentation would take anything up to 10 minutes to open across the network. One of the major problems encountered over this network was working with Perforce. Even with a Perforce Proxy server installed locally at the ODC site, it was performing very poorly and syncing single files at the ODC were taking anything up to 2-3 minutes. Syncing large number of files resulted in users waiting hours in order to get a copy of the files on their local machines. As a result of all the network problems, Symbian had to change its working practices as the ODC about 3-4 days work behind.

After some negotiations, Symbian upgraded the network link (below 5MB) and reduced the latency by a fraction. This made some improvement to the network between the UK and ODC office but Symbian was still facing performance problems for some networked tasks. To further improve the situation, the Symbian IS team, introduced some replication technology for documents and files. By using some NetApp solutions, content was replicated to the servers at the ODC. This meant faster access to local users, however the IS/network infrastructure was still controlled by the ODC themselves and this meant Symbian had to work with what they had been given.

Once Symbian India was born, as expected, the UK IS team took full control of the IT infrastructure and implemented their own network link. They introduced a much larger network link (below 50MB) with a very small latency delay. As expected, this improved performance a great deal and the Symbian India office is able to work more productively now, carrying out network dependent tasks, with a delay of a matter of minutes. In addition to this, many advances were made working with Perforce and the local Perforce Proxy server was now fully functional. By introducing Perforce sync tests before and after the network change, we were able to confirm that Perforce sync times were reduced by nearly a 50%, using the proxy over the new network.

To improve things further, the Symbian UK IS team were stationed at Bangalore in order to recruit the appropriate personnel, maintain the IS infrastructure and introduce even more improvements to the IS service. New telephone systems were introduced and internal switchboards are in operation making it much easier to contact a person via their

direct extension number whether they are in the UK or India. Symbian India is now operating successfully and is almost at par with Symbian UK.

Training

Training is another very important factor for ensuring distributed development is a success. All offshore employees must receive adequate training in order for them to produce quality work. In essence, the training provided at offshore sites should be of the same standard as the Symbian headquarter's training programme.

From the outset, there were some setbacks for providing training to the staff at the offshore centre. It was agreed that the offshore vendor would be responsible for providing Symbian training for all the offshore staff and therefore a Technical Trainer was appointed at the ODC, employed by the vendor company. This was a big challenge, as the trainer had to be trained on specific Symbian course subjects. This was achieved by UK Symbian staff visiting the ODC and "training the trainer", as well as the trainer visiting the UK for some intense Symbian courses.

As there were IP and export control factors to be considered, providing the training materials/presentations to the ODC also proved difficult. As the ODC did not have full access to the Symbian configuration management system, materials were manually sent via email or given to the trainer personally on visits, which in turn meant that materials would not be configuration managed properly, resulting in incomplete or old versions of the training materials at the ODC.

Cultural and language barriers were also in place. Many ODC engineering managers were not taking training seriously which resulted in high numbers of non attendance at courses. Another difficulty encountered was the punctuality of ODC staff as the majority of attendees would often arrive late. It was also a challenge to get attendees to actively participate in discussions and workgroups and most were reluctant to ask questions on matters which they were unsure about which related to a cultural issue.

Even though Symbian provided sufficient knowledge and information to the ODC trainer, the quality and standard of the training given was not as good as the training provided in Symbian UK. In addition to this, as the ODC trainer was not part of the Symbian Technical Training team, it was hard to keep the ODC trainer up-to-date with the relevant skills and knowledge acquired by the UK's training team. Moreover, day to day issues were not communicated to the ODC trainer. All these factors were creating significant impediments to Symbian as development engineers were not getting the proper training they needed to work on Symbian OS. As a consequence, productivity and development quality declined. In turn, UK development teams were finding it difficult to work with India teams due to these errors and were spending more time fixing ODC mistakes.

As ODC progressed, and eventually Symbian India was established, so was a Symbian Technical Training team. A new trainer was appointed at Symbian India who was put through an intensive Symbian training program in the UK and was introduced to the processes and practices of the UK training team. As Symbian India was now part of the Symbian global business, some IP, export control and legal barriers were lowered and more information was accessible from the Indian site. This meant the training team in India had access to up-to-date materials which were configuration managed. A recent program has been setup for new starters and graduates who are joining Symbian India. Boot camp training courses are held every 4 weeks for all new starters and run for 2-3 weeks. Another improvement is the global introduction of a Learning Management System which keeps training records of all employees and sends out course information to potential candidates, along with attendance reminders for courses etc. The training team in Symbian India will also be expanding.

Perforce Access

As mentioned in the previous IT infrastructure section, one of the major obstacles Symbian faced was the performance issues with Perforce, resulting from an insufficient network link between India and the UK. That section detailed how

the company overcame the performance issues and describes its current state. This section however, details the operational issues Symbian faced with Perforce, from startup of the ODC to the current situation.

The first difficulty was around IP, legal and export control issues. Essentially Symbian OS contains code that is covered by contractual restrictions that affects geographic locations and its use by subcontractors. As there were strict export restrictions in place when sending anything to India, Symbian had to adhere to source and release control mechanisms. These restrictions applied to source code, object code, test code and documentation. In this document the term "Restricted software" is meant to encompass all these items.

Symbian enabled access to Perforce for the ODC. However, because of these restrictions the company had to create an entirely separate area, within an existing development codeline, specifically for ODC work where they could only see certain parts of the source tree. As a result of this, additional protection masks were introduced in the Perforce protection table to remove various areas from their views. This added several lines to the protection table. The isolated area in Perforce, which the ODC had access to, included "maintenance" and "development" branches. The named branches were the point of contact with Symbian and populated by Symbian regularly from team development branches. Work was not allowed to be done directly on these branches by the ODC. All work was done under derived "Projects" and "Defects" branches, created by the ODC developers. "Reference" and "Release" branches were also created by UK teams to share Symbian data for reference purposes. This meant that only UK staff were allowed to merge code into the MCL which was an overhead and was very inefficient.

At the end of 2003, Symbian received an OGEL - Open General Export Licence from the UK Department for Trade and Industry (DTI), and was able to establish a formal documentation procedure for exporting under licence via electronic and other means. As the whole of Symbian OS is export controlled, Symbian was required to keep records of all deliveries of the OS. This was achieved by logging the information Perforce generated. In addition to the duties connected with export control, the company also had to honour the contracts with third-parties that covered some of the source code. In some cases, these contracts meant that distribution of source code to subcontractors or development partners was strictly forbidden; in other cases some formal notification was required.

For managing the development codeline available for the ODC, it was necessary to ensure that that codeline never contained code that was constrained by such contracts, IP or export restrictions. After investigation of what source could not be supplied to the ODC, Symbian was left with a long list of restricted software. For Symbian this meant that it had to redefine the work that the ODC could do and reengineer the way they could do it without having access to the restricted software.

However, once Symbian India was established in 2005, most of the restricted software was allowed to be exported after the relevant export/third-party source agreements were signed. There are still some forms of restricted software which Symbian India still cannot have access to. However, this is controlled in the same manner as it was before. Having another Symbian office as opposed to an ODC in India made it much easier for the distribution of Symbian OS.

With Symbian India, now having access to most of the MCL, meant they could make direct submissions to it. Initially, most UK development teams were reluctant for Indian users to make direct submissions to the MCL due to lack of confidence in the working practices at the Indian site. To overcome this issue, the UK teams wrote and communicated their configuration management plans to the Indian team and ensured they understood exactly how the UK team operated, and how both UK and India teams should operate in the future. Submissions from India to the MCL were made in a staggered approach. A handful of teams were identified and only specific Indian users from each of those teams were allowed to submit, after detailed review by UK teams. As time went by, and after the relevant Perforce training was given to the Indian teams, the necessary experience was gained and all teams were eventually allowed to submit directly to the MCL. All MCL submissions are policed and approved by the Build and Integration team in the UK. Another advance was creation of a special "shared" codeline. Prior to this, as previously mentioned, Indian development teams were only allowed to work in a specific codeline, and UK teams had to carry out integrations to and from their development codelines into this location. This was proving to be an unnecessary bottleneck and mistakes were being made with the integration task. The "shared" codeline was created so there would be one place in which



both UK and Indian teams could work regardless of their geographic locations. This “shared” codeline is free of any of restricted software and so is safe for Symbian India to have access.



Conclusion

Although there are plenty of obstacles to offshore outsourcing, it seems that the trend to outsource remains strong. Software development is now a global multisite and multicultural distributed undertaking following an everlasting pressure to improve time to market. The creation of an offshore development site involves tools, practices and processes. Establishing an ODC takes time and therefore, patience and perseverance are key. Moreover, dealing with new cultures, the necessary changes and alignment takes time too. Activities such as project management and risk management require a greater effort and attention than in normal projects. Proper planning is imperative to organize and manage distributed projects properly.

To make offshore outsourcing work, one must define a strategy before moving forward. It is best to keep it simple from the beginning, and like the “staged approach” start with simple, basic, low-level maintenance/development and evaluate how successful it has been. Review the understanding and effectiveness of this first stage and then progress to the next stage, by filling in the gaps or rectifying the issues identified from the first stage.

The main steps in the formation of a successful distributed development site are:

1. Set a common development environment including change, problem and version tracking, build, test and project management;
2. Set the infrastructure for collaborative sessions, including good tools, meeting etiquette, Netmeeting type software for sharing applications and video conference facilities;
3. Give a 360 degree view of project information through regular calendar updates of project management information, FAQs, team web pages and expertise locators;
4. Establish relationships by supporting travel to project kickoff meetings, establishing common communication etiquette and provide training at the remote sites.

The four steps above can all be rolled into one – “Communication”. It is imperative that communication plays a key role in setting up a successful distributed development site.

To conclude this paper, a company must identify a distinct global strategy, to facilitate a continued growth of R&D capacity, a coordinated multi site approach is necessary. Knowing the company’s long-term plans is essential to provide clarity for short-term decisions. Ensure that clear goals are defined at each site, right down to each development team with clear processes to follow. In addition a company needs to have some metrics in place, before a distributed development site is started. This allows for better measurements of improvements. Symbian uses a “Hub and Spoke model” with a clear main hub in the UK (maximising use of existing competence body), and each site, to a large extent, is a replica of the main hub, with clear objectives assigned for each individual site with end-to-end technology responsibility. It took a long, time consuming process, which presented a number of challenges, however Symbian India is now a successful operation and comprises a significant part of the development of Symbian OS.

Appendix A

The principle Perforce development server is built up of the following hardware:

- Hewlet Packard ML570 G2
- Xenon 3.00GHz x2 processors
- 9GB installed memory
- Microsoft Windows 2000 Advanced – Service Pack 4
- RAID Controller Smart Array 5300, 256MB Cache – 75% Read, 23% Write
- Storage – OS using dual RAID 1+0 146.8GB 10k x4, 72.8GB 15k x10
- Network – 5x HP NC7170 cards, Speed 10/100/1000 Full Duplex

Bangalore Perforce Proxy server hardware consists of:

- Hewlet Packard DL360 G2
- Pentium 3 1.40GHz x1 processor
- 2GB installed memory
- Microsoft Windows 2000 server – Service Pack 4
- Storage – 36.4GB 10k x2
- Network - 1x HP ILO, 2x HP NC7780 cards, Speed 10/100/1000 Full Duplex

Vancouver Perforce Proxy server hardware consists of:

- Hewlet Packard DL360 G4P
- Xenon 3.00GHz x2 processors
- 2GB installed memory
- Microsoft Windows 2003 server – Service Pack 1
- Storage – 72.8GB 15k x2
- Network - 2x HP NC7782 cards, Speed 10/100/1000 Full Duplex

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