Improving Software Process to Implement a Wireless Mobile Network

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1. Introduction

In the future, computer networks will consist of multiple personal computing devices connected by wired and wireless links. The system will operate in a peer-to-peer mode, allowing the network of computers to act as one large server, providing information to each node as needed. In addition, the computers will be mobile, connecting and disconnecting from networks at will, to meet the needs of the user. Because wireless links will be prevalent, users will be able to compute while on the move, increasing the utility and complexity of the information network. These mobile, wireless network characteristics add many dynamic aspects that can be addressed by object-oriented, knowledge-based, and simulation methods.

Software engineering currently is composed of several detached activities consisting of requirements analysis, design, implementation, and test. These activities are performed and documented in segments with little automatic flowthrough of information. This segmented approach impedes the progress to a working understandable system. As the software changes during implementation and test, even the best efforts fail to keep the documentation up-to-date. In the end, the product is difficult to maintain and impossible to understand.

This manual process of software engineering must be changed to automate repetitive tasks and to remove opportunities for human error. In this paper, a wireless, mobile networks application is used to illustrate the improvements in the process that will lead to an effective implementation of such complicated distributed systems.

2. Wireless Mobile Characteristics

The mobile computing scenario consists of a mobile computing device that can plug in at any network connection. This device may have its own processing capabilities or may rely on the processors within the network for most of its computing. The complexities that are presented by such a scenario revolve around communication, address, and security issues. In order for other users to communicate with this user, the network and the user must be talking the same language. Even with open systems standardization, a variety of protocols will be in use for a number of years to come. Also, they will constantly evolve to improve service and efficiency. Object-oriented methods in software can be used to mediate these difficulties. For example, protocols can exist within the device as objects. The necessary object can be enabled depending upon the communication needs of the network and the computer.

Dynamic resource allocation is required in a wireless environment as well. Because the mobile units can move between networks while still connected, the available resources at a particular location are constantly changing. Recognizing these changes and adapting to them are important aspects to the system software.

Other issues which must be solved include addressing that moves with the user and the effects on routing messages to the user; managing the dynamic ongoing configuration changes while the network is operational, data access for users as they move, and security without a central clearinghouse. These are difficult problems which must be understood more fully before answers can be found. But advances in the methods we use to solve such problems are the next step. Instead of focusing on the implementation issues of parallel and distributed systems, these must be pushed to a lower-level, so we can concentrate on the solution rather than the implementation.

3. Enabling Technologies

The software technologies that hold promise for the implementation of a wireless, mobile computing network involve object-oriented, knowledge-based methods aided by simulation and visualization. Although these are general research topics, they offer the benefit of revolutionizing software development for all parallel and serial computing, not just this one application area. Object oriented methods are the current trend and offer an interesting model of the problems in this arena as well. By developing within a modular environment, much of the software for these systems can be constructed from
components. The components, or objects, would greatly decrease the difficulty of implementing such software.

Knowledge-based development plays an interrelated role in the system software engineering. Instead of delivering executable applications which cannot be modified by the end-user, knowledge-based development would construct application generators with which the user constructs his own custom program. This would allow dynamic configuration of the software for the particular use, enabling a more adaptive, flexible end-product.

Simulation and visualization are necessary in the development phase of the system software. The architecture for the mobile, wireless system is a complex matrix of nodes with different capabilities. Visualizing this structure and relationship between its nodes over time is difficult for the human mind. It is widely known that 7 ± 2 items are all that the human mind can focus on easily at one time. Visualization tools must bridge this gap by intelligently showing the network relationships. Also, simulation is important in large, complicated software efforts to determine the behavior of a particular design, or help analyze the requirements before implementation. This is a more cost-effective method and, as tools improve, a more reliable method to verify designs than human review.

From the simulation model, the application generator should be able to complete the project with little intervention. This is the next big step in software development technology. The first computers were programmed with 1's and 0's, and then assemblers came along that allowed programmers to use codes which were then translated to the binary representation. Then, higher level languages were developed making it easier yet for the human developer to implement software. In the near future, the developer should be able to design a program using an unambiguous design language and then use a design-compiler to translate his design into code. With this step much of the art will be removed from software development, evolving it to an engineering discipline.

These enabling technologies are just a sample of what is needed in the software discipline to implement the mobile, wireless universal network. Other important issues that focus on antenna and transceiver characteristics and multiplexing schemes will need to be addressed to fully realize a wireless, mobile network. However, these enabling technologies will bring software to the level necessary to meet this challenge.

4. Commercial and Military Applications

Wireless mobile networks offer various applications for both the commercial and military arenas. Commercial users can benefit from the increased mobility while computing. Also, the ability to access the data they need wherever they are will improve the efficiency of their efforts. One scenario that is already being implemented in a limited wired form is the virtual office. With wireless, mobile communication, the virtual office can be realized to its full extent. This will provide cost-effective solutions to small businesses which need to cut the costs of operating a business by allowing them to decrease actual office space. In this environment, computers would be as common as pagers and cellular phones are now.

Military possibilities are numerous as well. Mobile, wireless capabilities would enable deployable computer networks to become a reality. Adding multimedia capability would allow imagery, data, and voice to be transmitted and received anywhere on the battlefield. With this enhanced information flow, commanders would be able to make decisions with more complete information. This type of network would also increase communication between forces and enhance their capabilities to coordinate toward a common goal.

5. Conclusion

In the future, network architectures will move toward a mobile, wireless environment to meet the needs of our increasingly mobile society. In order to implement these types of networks, new technologies must be developed to meet their dynamic characteristics. Possible candidate technologies include knowledge-based development, object-oriented methods, as well as simulation and visualization tools. These and other technologies will provide efficient, scalable and maintainable solutions to the dynamic problems of wireless and mobile environments, thus bringing revolutionary changes to the supporting software development technology base. Because both military and commercial customers desire larger, more reliable systems, they will provide the impetus for such technology improvements which will enable engineers to build large complex systems, such as a wireless, mobile network.