Applications of Bare Machine Computing (Research Topics)

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Obsolescence and Security are the two most daunting problems facing today's information systems (IS). Both of these problems are created by design in the current evolutionary computer architectures and systems. Conventional solutions are further aggravating obsolescence and security vulnerabilities over the years. We need revolutionary ideas to address these problems. Perfect solutions lie in our history of computing, where applications were running on bare hardware. According to our studies, operating systems (Oss) are the root cause of the above problems. When OSs are eliminated, the IS computing pyramid collapses into a flat model resulting in applications and hardware, thus eliminating all computing environments. When computer applications directly communicate to hardware, most of the security vulnerabilities disappear in addition to minimizing obsolescence. This approach results in a bare machine computing (BMC) paradigm.

The BMC approach is based on ten fundamental principles: (**1**) inherent security, (**2**) obsolescence-resilient systems, (**3**) application and owner centric, (**4**) bare machine computing (BMC), (**5**) object-oriented (OO) methodology, (**6**) green computing, (**7**) upward compatibility, (**8**) no middleware, (**9**) no layering, and (**10**) no heterogeneity. Based on these principles, we have developed over a dozen complex applications such as Webservers, Web clients, VoIP, Email and Webmail servers, Email clients, File System, Text only browser, Bare SQLite, Gateways and Routers, Multi-core servers, Split servers, UDP based servers and so on. These applications run on bare PCs with no hard disk and OS. These applications are written in a single programming language C/C++ with very little assembly code. These applications can be run individually or they can be created as bare application suites. Over 25 doctoral dissertations and 65 publications resulted during the last 20 year period. More details of our research can be viewed at the Web site as listed above and also at the bare server Web site running on the Internet.

Most exciting research topics related to BMC are briefly mentioned here for your research interest under consideration. Any questions or comments on these topics can be discussed with either Dr. Bharat K. Rawal or me. We will be glad to work with you, if you are keen on researching on revolutionary ideas and make contributions to IS field and society.

Bare Internet: Look at our current Web for the global world! There are 4.5 billion users that have the same access as you do. That means, there are some small percentage of bad users (which are too many), who can exploit system vulnerabilities and hack your system to make financial gains. How about designing a bare Internet system that is used for super secure users within their application domain and enterprise? This Internet will be solely based on BMC nodes with bare components and limited users within an enterprise. We have made some initial attempts to do this

and demonstrated its feasibility. We have all bare components that are needed for this system. Now, it is time to actually integrate the existing components into the bare Internet and study it's operational and security issues. This system will demonstrate to the world that there is another option for users, who want to communicate within their own enterprise in super secure manner without exposing to the global world. This topic can use several doctoral dissertations.

Machine Learning on BMC: Currently, machine learning and AI is everywhere! Build machine learning algorithms with BMC paradigm and study the security aspects of these applications. Alternatively, you can also develop ML instructions that can be simulated on bare machines. These bare machine nodes can provide required help to ML applications that run in super secure manner. There are many possible investigations that can be made using integration of ML in BMC paradigm. This topic can use several doctoral dissertations.

Big Data on BMC: Big Data is another most common problem in today's IS. As we have bare file system and bare SQLite, we can model big data on bare and compare it with the conventional systems. We can also study the security of big data on bare systems. This topic can use at least two doctoral dissertations.

Data Mining on BMC: Data mining algorithms can be implemented in BMC applications and study their simplicity and security in this paradigm. Data mining algorithms and data structures can also be integrated with the CPU instructions. This can be demonstrated by simulation models. This topic can be studied by one or two doctoral dissertations.

File Object Notion: Dr. Karne found a way to model all computer applications using file-object concept using OO methodology. We need to model some bare applications using this concept and validate the hypothesis. This topic can use at least two doctoral dissertations.

Ethernet to USB: Startech company has Ethernet-to-USB cables that eliminates the need for Ethernet on board for Intel PCs. This offers immense benefits in BMC applications to avoid writing a variety of bare network card drivers, thus making BMC applications to run on any IBM compatible PCs. The same thing can be applied to Wireless drivers as well. This is a reverse engineering problem to convert the existing Startech driver to run on a bare machine. Dr. Karne, has made some progress in this process, and now it needs to be taken to the next level. At least two doctoral dissertations can be done in this area.

BMC related CPU: We can model a BMC based CPU and study the architectural parts of this concept. One can study the simplicity of this approach and compare with the existing models. There are many other architectures evolved from the BMC paradigm that will revolutionize the computer architecture in general. Several doctoral dissertations are possible in this area.

Distributed BMC Models: Instead of limiting the BMC concept to a CPU, this idea can be extended to I/O processors, which can communicate to main CPU and make the distributed computing more like a message passing or a peer-to-peer models. Several doctoral dissertations are possible in this topic.

Extend the Text only Browser with Graphics: Add graphics and security to the existing Text Only Browser and make it available on the Web for bare PC users. This is a real world needed application for users. One or two doctoral dissertations are possible in this area.

Bare VI Editor Transformation: Some progress has been made to transform VI editor to run on bare PCs. Continued work in this will result in a bare VI editor. There is no such editor at this time. We have made some successful steps in binary transformations.

Bare MySQL: Making MySQL bare will be a great binary transformation problem. This will make your doctoral dissertation legendary.

BMC based Computer Architecture: Dr. Karne has many ideas in this area, where one can explore this as a simulation topic and demonstrate the architecture. This topic will also make it a legendary topic. For example, a CPU can't address I/O directly today! How about having one address space that can address CPU and I/O? How about reduce the semantic-gap between applications and hardware and develop instruction set that reduces the semantic-gap. We can develop some macros to demonstrate this concept. Extend the concept to ASM/C/C++ and build macros based on this single language environment to build high level applications such as HTML, JavaScript and Python.

BMC in Education: Bare machine computing can be used in a classroom to demonstrate the internals of the bare machine in many ways. One doctoral student worked on this and produced very interesting results. This work can be continued further to make more progress in education. Several doctoral dissertations are possible in this topic.