

HISC Potentials

Background

Computing style has been evolving from the original von Neumann to structure programming, and now, object-oriented programming (OOP). Today, Java, J2EE, C#, and .NET are among the most popular OOP technologies, because they provide better productivity, sharing, and security, especially in Internet computing. The conventional von Neumann procedure-oriented programming model allows many access and security gaps.

Our concept of a computer architecture extends von Neumann with operand descriptors of system attributes traditionally handled by software, including hardware access control. Access control resolution and verification activities contribute the majority of execution time. **Our hardware solutions greatly enhance performance, but more important, the computing security and simplification of the tasks.** A simplified simulation model was built, and won a Second Class Price of the National Challenger's Cup in Xi'an, China, in September 2001: 新世纪计算机体系结构-支持面向物件的微处理器设计与实现.

We are conducting investigation on object-oriented computing, particularly the security and sharing issues. We will investigate and build an object-oriented operating system based on an open-source UNIX-based, to be integrated with the object-oriented processor, with a circuit model of this architecture, and Java Virtual Machine (JVM).

The UNIX-based operating system will be multi-threading instead of today's multiprocessing for object-oriented computing, to achieve high performance and efficiency. **Virus and unauthorized access to data and procedures will also be vastly reduced, if not totally inhibited, with hardware enforcement through access control caches.** This project serves as the foundation for an object-oriented computing system, ultimately for distributed computing, and Internet and Grid computing.

There are several object-oriented processors by the U.S. patents and patent applications, e.g. U.S. Patent Number: 6,003,038, Dec. 14, 1999, "Object-oriented processor architecture and operating method" by Sun Microsystems, and International Application Publication Number: WO 02/48864 A2, 20 June 2002, "System registers for an object-oriented processor" by COTTO Wireless, Inc. of La Jolla CA. Ours are superior, on both *security* and *performance*.

- Ours ensures security of different data structures in the system with register pairs, avoiding out of boundary access of data structures.
- Ours provides continuous access control when passing information/data from memory/memory stacks into general registers for fast processing. There are descriptors to specify access control information, which are generated by compilers and whose access privileges will be checked and maybe reduced by operating systems or their equivalent.
- Ours avoids the use of pointers to eliminate illegal accesses between different modules.
- Ours avoids code bypassing with the rigid rules defined in invoke and revoke instructions.
- Ours ensures securities of the system. With threading technology and hardware supported threading instructions, ours provides a fast and efficient multi-tasking environment, and substantially increases the performance of the system.
- Our invention includes hardware memory allocation, deallocation, and garbage collection, and multi-threading for OOP.

HISC Patent granted:

1. U.S. Patent #6,292,879, 18 Sept 2001: A. Fong, "Method and apparatus to specify access control list and cache enabling and cache coherency requirement enabling on individual operands of an instruction of a computer".

HISC Patents pending:

1. U.S. Patent Application LOJAQ Attorney Docket No.: 513.000120US, 13 Sept 2001: A. Fong, "Specifying access control and caching on operands".
2. U.S. Patent Application QIPLG Attorney Docket No.: 528.000120US, 18 Jul 2002: Richard C.L. Li, A. Fong, "Method and Apparatus of Storage Allocation/De-allocation in Object-Oriented Programming Environment".
3. U.S. Patent Application QIPLG Attorney Docket No.: 530.000100US, 5 Sept 2002: P.L. Mok, A. Fong, "Secure Control Transfer in an Information System".

Technology Success Stories

In 1960, Kenneth Olson and Stanley Olson (brothers) and a third person in Lincoln Laboratory of MIT started Digital Equipment Corporation (DEC) in "the mills" of Maynard, Massachusetts, a small run-down town near Route 495 highway. In 1968, an engineer of DEC - Ed DeCastro, started Data General in Southborough, Massachusetts with his Nova machine. Then some engineers from Data General (DG) and DEC formed Prime Computer in Natick, Massachusetts. Then a V.P. from DEC and some others from Prime and DG started Apollo Computer in Chelmsford, Massachusetts, which was consequently bought out by Hewlett-Packard of California, and many computer ventures started in California later, such as Tandem and Strauss Computer (Bill Foster from DG/HP). There were other ventures such as Rational Machines (David Burstein from DG), now Rational Software in California, and Prozac (Steve Wallach from DG), a mini-Cray supercomputer compatible in Dallas, which was subsequently bought out by HP. Meanwhile, there began many computer-related companies to start in Massachusetts, mostly by people from the computer start-up's in applications, networks, and data communications. There are easily more than 200 companies in Massachusetts today tracing back to DEC; most are located on or near 495 highway.

This project is to be a part to pilot Hong Kong to bring some fundamental technical contributions of her own to the high-tech industry. **The least the project will achieve is to train the staff to be experts in object-oriented programming**, and help Hong Kong to be proficient in object-oriented programming.

Transistors in 1950s-1960s Japan

In the 1950s, Japan started her electronic industry with transistors after WW2 from ground zero. Japan was bombed severely and nothing was left untouched. On the other hand, even though transistor was invented in Bell Laboratory of the United States, the U.S. industry did not work on transistor in full-scale because of the existing vacuum tube business. This contributes a factor for Japan to pass the U.S. in electronic products.

Hong Kong and China are new comers in computer and computer-related industry, while the front-runners in the world have the existing business to protect. It is a good opportunity for Hong Kong and China to participate in the industry as original technology contributors, not merely as users.

Nokia mobile phones in Finland

Finland is a relatively small country, and yet its Nokia came from nowhere and captures the number-one handset manufacturing position of the world. It just happened in the past few years. This demonstrated that anything can happen in technology.

History is likely to repeat. What happened in Finland with Nokia, 495 highway of Massachusetts in computing-data communications and Japan in transistor industry, can happen in Hong Kong, if there is adequate support and determination.

Brief history of computing system evolution

Period	Machines	Characteristics
1940s	Univac, Control Data, IBM	Different Instruction-sets for individual machines, software incompatible.
1960s CISC	IBM System 360 family	Family of machines – made IBM the industry leader.
1980s RISC	MIPS (Stanford-John Hennessy) SPARC (Berkeley-David Patterson) PowerPC – RS6000 (IBM Project 801-John Cocke)	To fix CISC inefficiency. Note: Even though IBM had RISC first – machine 801, they chose not to market the product, afraid to hurt their on-going business.
2000s OOP	CityU (and other universities) to develop an object-oriented computing system, just like MIPS in Stanford and SPARC in Berkeley	To meet today's requirements: OOP, Java, security, Internet, and Grid computing. To enhance computing security. Note: Although computer vendors started to research OOP processors, they hesitate because of the potential of hurting their on-going business, just as IBM 801 case.

The message: *HISC has the potential to be a "Nokia" in Hong Kong just like Nokia in Finland, and generates other IT business opportunities similar to DEC in Highway 495 of Massachusetts. The timing now is similar to transistors in Japan after WW2.*

Project HISC can make a significant impact for Hong Kong!