



Internet Business Systems

System Integration and Interoperability

Alan Metcalfe, January 2009

No word is more important in Information Technology (IT) than “interoperability”. At the same time, no word is more widely misused and misunderstood than “**interoperability**” – a close second is the word “**integrated**”. Obviously however, what needs to be understood by the casual observer is that integrated systems are interoperable; and to be integrated and interoperable, it is critically important to understand that they must also be semantic. If a system is not integrated, it is not interoperable or semantic, and vice versa. The extent to which a system is integrated, determines the extent to what that system is interoperable and semantic.

- **“Information systems today are not interoperable,”** (The 2003 EU Commission’s Working Paper on enabling seamless (fully integrated and fully interoperable) e-Government: “Linking up Europe: the Importance of Interoperability for e-Government.”)
- “AMR Research analyst Louis Columbus told the E-Commerce Times that dot-com mania brought integration to center stage. **‘Integration is king.** That was a huge lesson,” he said, referring to what the businesses learned from the dot.com boom and bust. “Enterprises found that to develop a comprehensive e-commerce strategy, their applications had to work together seamlessly (but they couldn’t on the Web).” (Teri Robinson, Lasting Benefits of the Dot-Com Bubble, E-Commerce Times, 07/15/02)
- **“The Holy Grail is interoperability.”** (Microsoft software designer Andrew Layman, New York Times, 2001)
- **“Integration is so difficult** that several of the approaches, specifically online marketplaces and B2B software products have left many vendors injured or out of business. The B2B marketplace has now even been referred to as close to dead.” (Infoworld Magazine, 13 August 2001)
- “IDC in Framingham, Mass., suggest that for every \$1 companies spend on middleware software and installation, they spend between \$5 and \$20 to integrate back-end disparate and legacy systems.” (Infoworld Magazine, 13 August 2001)

- “An alarming new IT trend is in the making: companies are abandoning the best practice of enterprise-wide integration of applications in favour of a point-to-point or tactical approach. However, these companies, simply put, are making a mistake. In fact, they are ‘laying landmines for the next generation.’ Point-to-point integration is an excuse many companies use for their broader IT strategies. Companies need to wake up and smell the EAI coffee; all those hand-built connectors cannot ever scale, over time. ...While each discrete project and its subsequent integration may make sense on a tactical basis, eventually the company is going to wake up and realize it has built an infrastructure that resembles spaghetti. Sooner or later, such a company is going to have to architect an approach to integration that will pay off over multiple projects.” (Jeff Comport, Gartner research analyst, NewsFactor Network, July 2003)
- “The need for interoperability in the Internet economy is becoming critical.” (Andrew Whinston, Professor of Economics and Computer Science, The University of Texas at Austin, US Senate Hearing on “The Role of Standards in the Growth of Global Electronic Commerce”, 28 October 1999)
- “An interoperable global electronic commerce system is necessary if we are to maximize the potential benefits of digital networking and computing technologies.” (Andrew Whinston, Professor of Economics and Computer Science, The University of Texas at Austin, US Senate Hearing on “The Role of Standards in the Growth of Global Electronic Commerce”, 28 October 1999)
- “The need for interoperability will increase as we focus on process automation.” (Andrew Whinston, Professor of Economics and Computer Science, The University of Texas at Austin, US Senate Hearing on “The Role of Standards in the Growth of Global Electronic Commerce”, 28 October 1999)
- "Interoperability is a fundamental requirement, from both the economic and technical perspectives." (The European Union's 2003 Working Paper on enabling seamless e-government, "Linking up Europe: the Importance of Interoperability for e-Government")
- "Failure to put in place interoperable e-government systems will have both economic and social costs." (The European Union's 2003 Working Paper on enabling seamless e-government, "Linking up Europe: the Importance of Interoperability for e-Government")
- “Without interoperability, both within and between the public and enterprise sectors, electronic ways of working are bound to fail.” (The European Union's 2003 Working Paper on enabling seamless e-government, "Linking up Europe: the Importance of Interoperability for e-Government")

- “The need for enterprise integration is intensifying.” [US National Institute for Science and Technology (NIST)]
- To integrate business discourse internationally requires not only intra but inter-enterprise integration.” [US National Institute for Science and Technology (NIST)]
- “As different infrastructures, protocols and APIs emerge, interoperability will greatly affect the technology decisions made by the governing bodies of “federated” SSO (single sign on systems), as well as ensuing investment decisions by service providers. Companies that don’t want to start from scratch every time they launch a new service need to watch what SSO emerges, so they can think ahead in terms of provisioning, billing and customer care issues.” (Sanjay Swamy, Senior director of market development, Portal, March 2002)
- “Interoperability is a **fundamental requirement** of an efficient network. Through standardization and interoperability, communications software and business applications **lower costs** for products and **increase user benefits.**” (Andrew Whinston, Professor of Economics and Computer Science, The University of Texas at Austin, US Senate Hearing on “The Role of Standards in the Growth of Global Electronic Commerce”, 28 October 1999)

Avoiding Confusion

Where public sector confusion arises when the IT industry speaks about integration and interoperability, is, because there are many parts of e-business and any two parts of a business system may be integrated in themselves, and therefore they can be said to be interoperable. However, they are only integrated and interoperable to their own extent – they are not necessarily integrated and interoperable with the system as a whole, or with other systems outside their domain. Unfortunately, because of the importance of integration and interoperability to the marketplace, advertising and IT sales agents regularly ignore this fact and stretch the truth when talking about the integration and interoperability capabilities of their systems.

- “Although interoperability has played an important role in the industrial economy, its need is magnified in (the electronic) economy where interactions and exchanges among firms and consumers occur constantly, in real time, throughout the entire stage of the value chain, and with an increasing number of partners.” (Andrew Whinston, Professor of Economics and Computer Science, The University of Texas at Austin, US Senate Hearing on “The Role of Standards in the Growth of Global Electronic Commerce”, 28 October 1999)

Three Types of Interoperability

The 2003 EU Commission’s Working Paper on enabling seamless (fully integrated and fully interoperable) e-Government: "Linking up Europe: the Importance of

Interoperability for e-Government that found that it helps us to better understand interoperability by saying that: "Interoperability has **three aspects**:

- (i) **Hardware interoperability**, which is concerned with the technical issues of linking up computer system hardware, and the necessary telecommunications infrastructure.
- (ii) **Software interoperability** that is concerned with organizational interoperability, which is the modelling of business processes, aligning information architecture with organizational goals and helping business processes to co-operate; and
- (iii) **Semantic interoperability** that is concerned with ensuring that the precise meaning of exchanged information is understandable by any other application of the system."

Hardware disintegration and disinteroperability is evidenced by the problems that exist between Apple Computer systems and PCs like those pioneered by IBM. Having said this, it is widely recognized that:

- "Technological standards at the infrastructure (hardware) level are relatively **easier to reach** than those at the applications and business process (software) levels." (Andrew Whinston, Professor of Economics and Computer Science, The University of Texas at Austin, US Senate Hearing on "The Role of Standards in the Growth of Global Electronic Commerce", 28 October 1999)

The extremely difficult-to-deliver interoperability at the applications and business process levels (software) is what the Semantic Web is expected to deliver. This is what Safe Worlds delivers now.

Interoperability and the Semantic Web

Semantics is the study of meanings; it is the logical connection (relativity) between things (even systems) and what they mean.

- "The Semantic Web is primarily a tool for **interoperability**. The project will involve the creation of **interoperating systems** ...a software and information environment, in which complex applications can **interoperate** by exchanging information with a basis in high level logic and well-defined meaning." (Tim Berners-Lee, "The Semantic Web Road Map", February 2000)

When Tim Berners-Lee was asked by Business Week Magazine on 27 March 2002, "Where do things stand (with the Semantic Web) now?"

- “The upper layers are still in research, the upper layers being things like a universal logic language that can basically represent *any* logical statement. ...**There is a need for a powerful universal logic language.**”
- “To achieve its potential, the Semantic Web must provide **a common interchange language** bridging these diverse systems,” Tim Berners-Lee said in the paper “Semantic Web Development – Technical Proposal”, dated February 4, 2000. “Like HTML, the Semantic Web language should be basic enough that it does not impose an undue burden on the simplest web software systems, but powerful enough to allow more sophisticated components to use it to advantage as well.”
- “The strategy is to translate the various languages into **a common 'base' language** thereby providing them with a **single** coherent model theory.” (W3C Working Group Note 10 relating to “Semantics for Languages of the Semantic Web” said on October 2003)

Total Integration and Interoperability

While the world is still searching for the answer, I found Universal Logic in 1999 and have since applied it to the design and the construction of the Safe Worlds system. Safe Worlds is the world's first and only fully integrated, fully interoperable, semantic system.

- “In the same way that universal algebra is a general theory of algebraic structures, universal logic is a general theory of logical structures. During the 20th century, numerous logics have been created: intuitionistic logic, modal logic, many-valued logic, relevant logic, paraconsistent logic, non-monotonic logic, etc. Universal logic is not a new logic. It is a way of unifying this multiplicity of logics in a way that can be applied to all logics.” (The 1st World Congress on Universal Logic planned for 2005 – <http://www.uni-log.org/one2.html>)

Integration at the data level, which is how the Safe Worlds system is designed, is the lowest and most effective level at which data can be integrated and made interoperable.

For further information

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