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Standard-compliant, but incompatible?!

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Abstract

This paper addresses the question why standard-compliant IT products often do not interoperate. The findings are based on an institutional analysis, three case studies, and a debate among experts. The paper concludes that some dilemmas cannot be resolved easily. However, many causes *can* be addressed, in particular those in the area of standard development. Where interoperability is concerned, standard development and implementation issues cannot be meaningfully separated.

Keywords: Standards; Implementation; Interoperability; Incompatibility

1. Introduction

Standard-compliant products do not always interoperate, as most IT users will have experienced. It is a frustrating problem, and sometimes drastic measures are taken to circumvent it. For example, in a well-documented case study a university decided to adopt a standard-based single-vendor solution for its wide area network (IEEE 802.11b [1]). This single-vendor 'solution', be it based on open or de facto standards, is a rather wide-spread defensive procurement strategy. It usually resolves incompatibility in the short run, but it undermines the basic notion that open standards allow us to combine the best of different vendors and protect us from vendor lock-in — a different, but equally frustrating problem (as a warning, in the said case study the single vendor added a proprietary extension to the standard which later, as other vendors became involved, caused its own set of interoperability problems [1]).

In this paper the problem of standard-compliant, but incompatible IT products and services is examined more closely. It addresses causes of incompatibility between standard-compliant software, and makes recommendations about how to deal with them.

The paper applies one important restriction. It does not address incompatibility which has a 'malevolent' background. That is, there are companies which introduce changes to standards to frustrate the development and adoption of competitive products, or to lock users into a proprietary technology. These companies, for example, elaborate standards by adding extra functionalities (embrace-and-extend strategy). Or they implement only part of the standard (embrace-and-omit strategy); or they introduce local adaptations to the standard (embrace-and-adapt). In all three situations the integrity of a standard is at stake.[1] Egyedi and Hudson [28] refer to instances where (de facto) standards are adapted, extended or selectively implemented as problems of *standard integrity* — that is, as a specific subset of compatibility problems. Sometimes interoperability can be re-created, but this requires much extra effort. More commonly market fragmentation results.

What Sherif et al. [2] argue with regard to standards quality, namely that there is no corrective market incentive to address lack of standards quality, also applies to the corrupt use of standards. "The diverse interests that affect standardization, the distributed nature of its management process and the time lag between a standard and its implementation in products and services mean that there is no clear accountability in terms of profit and loss responsibilities due to deficiencies in an ICT standard. In some cases, those who pay the cost of the lack of

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[1] Egyedi and Hudson [28] refer to instances where (de facto) standards are adapted, extended or selectively implemented as problems of *standard integrity* — that is, as a specific subset of compatibility problems.

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quality are not those who made the decisions. Thus, market mechanisms will rarely provide the driving incentive to carry out the intensive planning and coordination across organizational boundaries that are needed to produce a quality standard" [2]. Little can be done if harm is meant. This paper therefore does not deal with the intentional corruption of standards, or 'malevolent standard deviations'. Instead, it focuses on incompatible implementations that come about unintentionally or for valid economic, functional or other reasons (i.e. *benevolent standard deviations*). For example, certain standards' features may be unnecessary for the intended use and may therefore not be implemented. Although the consequences may be the same, namely incompatibility and in its wake uncertain exchangeability, loss of self-evident interoperability (increased transaction costs), and possible market fragmentation,[2] the benevolent setting of these deviations offers more leeway for action.

2. Framework and methodology

If standard implementations are not interoperable, despite the best of intentions, the cause may lie in one or more of the phases leading up to standard implementation. Schematically speaking, the average standards committee starts with an idea, adopts it as a work item and then takes it through the successive stages of standardization (i.e. the standards process). A document results, i.e. the standard specification. The standard is then implemented in a product or a service. The implementation process results in a standard implementation, see Fig. 1.[3] It highlights the three main states of a standard: the conceptual idea, the specification, and the implementation; and the two translation processes between these states: the standard or standard maintenance process, and the implementation process. The examples below illustrate in what manner each phase can be the source of implementation problems:

- The *idea* that underlies a standard may not be implementable (e.g. too comprehensive).
- The ideal of consensus decision-making may affect the *standards process* (e.g. lead to too many options) and, indirectly, the implementability of standards.
- Different use of terminology in a *standard specification* may lead to problems of interpretation, implementation and interoperability.
- Modest user requirements and cost-constraints in the *implementation process may lead to partial standard compliance and incompatible implementations*.

As Fig. 1 indicates, the immediate cause of incompatibility may primarily lie in the standard implementation setting, but the underlying causes may lie in factors that affect standard development.

Three complementary methodologies have been followed to gather data about possible causes of incompatibility. Firstly, to investigate whether certain institutional characteristics of standardization can lead to problems of interpretation and implementation, formal standards policy documents and literature on standardization have been analysed. Secondly, to gain insight in what happens in practice with standards from formal and other standards bodies, three case studies of ICT standardization areas have been done, i.e. Standard Generalized Markup Language (SGML)/Extensible Markup Language (XML), Open Systems Interconnection (OSI) standards, and Unified Modelling Language (UML). From earlier studies these cases were known to highlight different implementation problems.

The third source was an expert panel discussion. The panel members, who were standardization experts from formal standards bodies, standards consortia and industry,[4] were asked to discuss implementation problems from their personal experience and illustrate them.

The structure of the paper follows the methodologies used. The institutional analysis, which focuses on possible causes in the standard development setting, is discussed in Section 3. The findings from the case studies are discussed in Section 4. The findings from the panel of experts are presented in Section 5. Section 6 summarizes the causes of incompatibility problems and discusses ways to solve them. The paper ends with conclusions (Section 7).

3. Institutional dilemmas

In the past, the policy of the formal standards bodies such as ISO was to focus on standards development, and on their role in supporting the democratic, voluntary consensus process. Formally, the question of implementation of standards lay outside their framework [3].[5] A policy shift took place in the mid-1990s which coincided with the rise of standards consortia and other 'grey' standards fora [27]. Overall, these consortia prioritised the usability of standards, and treated standards development and implementation as co-evolutionary issues, see Table 1. For example, Internet standardization, which at the time had an exemplary status, included demonstrated implementability in its standards process (IETF/RFC 2026). More policy recognition of the importance of standards implementability and use by the

[2] The classic example of market fragmentation is UNIX, the multi-user operating system that became a de facto standard in the late 1970s. Different versions developed that fragmented the market.

[3] Fig. 1 aims to help identify and localize causes of implementation problems. I.e. it does not portray a life-cycle model for standards. For a discussion of life-cycles, see Söderström [30].

[4] Panel discussion, 22 October 2003, 1700–1830 h, 3rd IEEE Conference on 'Standardization and Innovation in IT', October 22–24, 2003, Delft Univ. of Technology, the Netherlands. Panel discussion 'Problems of Standards Implementation' with Jim Carlo, President-Elect IEEE-SA (Moderator), Oliver Smoot, ISO President (Commentator), and the panel members Patrick Droz, IBM, Manager Networking Software; John Hill, Chairman JTC1/SC22 Programming Languages, Sun Microsystems; Erik Huizer, IETF trustee of Internet Society, Univ. of Twente; Steven Pemberton, Chair W3C HTML and Forms working groups, CWI/W3C; Anthony Wiles, ETSI Protocol and Testing Competence Centre. In addition, some remarks made by Jim Isaak (IEEE board of directors) and Mostafa Hashem Sherif (AT&T) during the discussion are included in the text.

[5] However, on the practical level conformance testing already took place in the 1980s (e.g. in ISO/ CCITT on X.25) (Linn and Uyar [29]).