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Information technology — Year 2000 terminology

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Abstract: This standard provides concepts, definitions, remediation techniques, and other supporting terms fundamental to a lexicon for Year 2000 terminology. It addresses key topics pertinent to the development of resolutions to the Year 2000 problem. The core of this standard is the definitions Clause which contains the definition for Year 2000 compliance. Two critical aspects of this definition are: first, the acknowledgment of the significance of documentation associated with technology, and, second, the recognition that compliance is a two-way street, i.e., the proper exchange of date data is paramount for technology to remain compliant.
Keywords: date exchange, remediation techniques, Year 2000 compliant

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International Standard ISO/IEC 16509 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*.

Annexes A to C of this International Standard are for information only.

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This introduction provides background on the rationale used to develop this international standard. This information is meant to aid in the understanding and usage of this standard.

This international standard addresses the key industry concern over the existence of multiple terms and lexicons that carry varied meanings. IEEE has designed this standard to assist individuals and organizations in their efforts to develop Year 2000 solutions. Having a base-line set of terms and definitions that can serve as a foundation for such efforts is vital.

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Contents

Information technology—Year 2000 terminology

1. Overview

The Year 2000 issue appears to be a simple problem that is intuitively understood. However, when examined closely, the solutions are varied and complex in nature. The essence of this problem is the representation of the year as a two-digit number in hardware and software elements of computer systems and other technologies. This representation may, for example, cause hardware or software malfunctions to occur when a system date or application date crosses the year 2000 boundary (whether that is the actual arrival of the date or for date processing purposes) or when the system or application must refer to a date that occurs on, before, or after 1 January 2000. These malfunctions can include the following:

- Incorrect arithmetic calculation, comparison, sorting, or sequencing resulting in the failure of logical, relational, and set-membership operations;
- Incorrect recognition of leap year;
- Conflict with values in data fields used for non-date purposes, e.g., “no date provided,” or “never expires”; and
- Date data field overflow.

The two-digit date may not be the sole cause of these malfunctions. They may also result from poor programming practices or a lack of full understanding of the Gregorian calendar. The consequences of these malfunctions could range from immediate system failures to more insidious long-term data corruptions.

The impact of the Year 2000 problem is potentially significant to virtually any segment of the global digital infrastructure and the economies it supports. Among the environments in which critical applications may be affected by Year 2000 issues are:

- Bio-medical
- Telecommunications/transportation
- Finance/banking
- Aviation/aerospace
- National security/law enforcement
- Other critical infrastructure

As this standard is being prepared, many organizations are in various stages of addressing this problem. Some are just beginning to assess the impact on their own information technology (IT) environments. Others

have already begun to implement solutions. The rising need for solutions has created a market environment wherein there are a growing number of organizations offering such solutions. These organizations have also created a diverse set of terms. Many of the terms may seem similar, but will actually have multiple meanings within differing environments, which brings the potential for confusion to what should be an easily understood problem.

This standard identifies common terms, definitions, and related concepts that have broad applicability to this area of work. Those presented herein may be applied wholly or in part to fit a specific requirement.

A lexicon within which the common terms, definitions, and related concepts are understood is vital. The IT industry's use of the terms defined in this standard will minimize confusion. In addition, having common terms, definitions, and related concepts will speed the development of urgently needed solutions. This standard describes what these terms, definitions, and related concepts mean, not how to implement or verify Year 2000 compliance.

It is not the intent of this standard to specify how Year 2000 compliance should be implemented or verified.

1.1 Scope

This standard identifies terms and concepts pertinent to the resolution of the Year 2000 issue, including the rollover from the year 1999 to 2000, incorrect recognition of leap years, and values in date fields used for non-date purposes, and provides definitions of these terms and descriptions of these concepts.

This standard does not specifically address operating system anomalies such as might occur in the year 2038.

1.2 Purpose

This standard provides a common lexicon with descriptions and definitions for the Year 2000 issue. These descriptions and definitions may be applied in whole or in part depending on the requirement.

This standard is composed of a Definitions Clause (3), a Concepts Clause (4), and two Annexes (A and B).

1.2.1 Concepts

A concept is a set of interrelated ideas pertaining to the Year 2000 issue. This standard offers a description of these concepts. This is not an exhaustive list.

1.2.2 Definitions

These are focused meanings of terms fundamental to the resolution of the Year 2000 issue.

1.2.3 Annex A

This annex outlines remediation techniques currently being used to make system elements Year 2000 compliant. This list of techniques is not exhaustive. It presents only those techniques acknowledged as having gained a significant amount of industry consensus. Along with the techniques is a list of supporting terms and their explanation. In addition, the annex briefly explains the role of special dates in the development of solutions for the Year 2000 problem. This annex is informative.

1.2.4 Annex B

This is a bibliography listing other related publications.

1.3 Conformance

Vendors who claim that their products conform to this standard declare that their use of the term "Year 2000 Compliant" is in accordance with the definition in this standard.

2. References

No other publication is required for use with this standard.

3. Definitions

3.1 date exchange: The interchange of date data between two or more systems or system elements. In order to facilitate proper date data exchange between two or more systems or system elements, defined formats should be identified and documented by the suppliers of systems or system elements. Such formats may be specified by the standards or other publications listed in Annex B, other generally accepted industry date representations, or other documented methods of date representation. Depending upon the date formats selected, additional information such as, but not limited to, valid date interval, pivot year, and encoding technique may also need to be documented.

3.2 date processing: The processing of date data within a system or system element, which may include receiving, manipulating, and providing date data.

3.3 technology: Hardware, software, and firmware systems and system elements including, but not limited to, information technology, embedded systems, or any other electro-mechanical or processor-based systems.

3.4 Year 2000 compliant[1]: Year 2000 compliant technology shall correctly process date data within and between the 20th and 21st centuries, provided that:

a) The technology is used in accordance with its associated documentation, and
b) All other technology used with it properly exchanges date data with it.

4. Concepts

The term "system element," where used in this standard, refers to any individual component of a computer- or microprocessor-based system that participates systematically in a specific process. System elements may include hardware components, firmware routines, operating systems, middleware components, application programs, system utilities and subroutines, scripts, and the like.

4.1 Valid date interval (also known as compliance date range)

This is the period of time, expressed by a range of dates, over which the system will provide correct date data processing. The system elements or other factors may limit this interval or may introduce multiple intervals. For example, on a system capable of operation between 1970 and 2038, applications may be capable of correctly processing date data over a much wider range of dates such as 1970 through the year 2069.

[1]This definition requires date data to be processed consistently, predictably, and accurately within the valid date interval(s) (see 4.1). This includes date data for the years 1999 and 2000.

4.2 Time horizon to failure (also known as event horizon)

This is the time from a specific date until a point in time beyond which a system element will fail to process consistently, predictably, or accurately. An application that processes dates up to 12 months in the future might fail on or after 1 January 1999 (1999-01-01) if it was unable to process dates beyond 31 December 1999 (1999-12-31). Therefore, on 1 September 1998 (1998-09-01), the time horizon to failure for this application is four months. Since each element of a system potentially has its own unique horizon, the horizon of the entire system is that of the earliest-failing element within it.

4.3 Year 2000 life cycle

The Year 2000 Life Cycle is a process for addressing Year 2000 issues. The following is an example of a model composed of five phases, each representing a major Year 2000 activity. Both the private and public sectors have used this model in addressing their respective Year 2000 issues. The five phases are described simply and very briefly as follows:

— *Planning and awareness:* Define the Year 2000 problem and gain executive level support and sponsorship for establishing the problem as a high priority item for resolution. Research and establish a project plan, and obtain budget and resources. Note that the planning activities are also relevant to the other phases described below.

— *Assessment (inventory):* Evaluate the Year 2000 impact on the enterprise; develop contingency plans to handle data exchange issues and system failures (dysfunction or system crashes); prioritize systems by identifying those that are critical.

— *Remediation (renovation):* Convert, replace, eliminate, or work around one or more system elements; modify interfaces.

— *Validation:* Test, certify, and validate all system elements that have been converted or replaced.

— *Implementation:* Place into production all system elements that have been converted or replaced.

Annex A—Techniques, terms, and special dates

(informative)

This annex is informative and contains more detailed information about selected Year 2000 concepts, terms, and remediation techniques that are becoming commonly used in the IT community. This is not intended to be either a comprehensive or a preferred listing of approaches.

A.1 Remediation

This concept embodies one or more processes to repair or eliminate malfunctions relating to Year 2000 date data processing under a predetermined set of criteria. The following is a non-exhaustive list of techniques or strategies that have been employed in the remediation process. These techniques are not necessarily mutually exclusive and not necessarily sufficient in and of themselves to solve the problem:

— Bridge—employing a date data bridge that converts date formats
— Elimination—retiring the system
— Encoding—encoding four-digit year information into an existing field
— Field expansion—expanding the year field to four digits
— Replacement—replacing one or more system elements
— Windowing—using a 100-year logic window

A.1.1 Remediation techniques

There is general agreement within the industry that there is *no single* method of remediation that can be applied to all situations. In any given situation, the method chosen will depend on the operating environment and other factors such as the prevalence of interfaces with other applications and the amount of date data processed within or between applications. The following methods include some of the most common fixes being implemented in the industry. This list does not describe a number of low usage or proprietary remediation methods in use.

A.1.1.1 Bridge technique

This is a conversion mechanism that changes data elements to reconcile format differences between system elements. Date-related bridges format dates in such a way that they can be accepted and acted upon properly. For example, a bridge might be a program that is invoked to change a two-digit date field in a sending application to a four-digit date field in a receiving application when date data is transferred between the two system elements.

A.1.1.2 Elimination technique

This is the retirement of a system or application no longer deemed necessary.

A.1.1.3 Encoding technique (also called encryption, offset counter format, or integer date format)

Unlike field expansion, encoding allows current field sizes to be maintained by storing additional information into existing fields. A more efficient use of bits may allow inclusion of century information. This may be accomplished, for example, by using unused bits in an existing representation to encode century information, or by converting the data type from ASCII to binary in order to allow larger numbers to be represented

in the same field. Similarly, if the numbering system was changed from decimal to hexadecimal, two-digit year values greater than 99 could be stored.

A.1.1.4 Field expansion technique

This is a technique that converts existing data and programs by lengthening the year fields from two-digits to four-digits.

A.1.1.5 Replacement technique

This is the retirement of a system or system element that is not Year 2000 compliant and replacement of it by another system or system element that is Year 2000 compliant.

A.1.1.6 Windowing technique (also called logic fix)

This is any of several procedural techniques based upon the addition of logic that uses a specified 100-year interval to interpret a two-digit year value as an unambiguous four-digit year. The procedural techniques commonly used are typically categorized into "Fixed Windowing," "Movable Windowing," and "Sliding Windowing." Use of this method of remediation depends on knowledge of:

— The date format used across interfaces between two or more system elements;
— The pivot year used (see A.2.2);
— The method of changing or "sliding" the pivot year, where applicable; and
— A description of the error handling/reporting when exchanged date data is not in the expected format.

A.1.1.6.1 Fixed windowing

This is a procedural technique in which two-digit year values are interpreted within a fixed 100-year window. The window is typically documented in terms of a range of years (for example, 1950 to 2049) or in terms of a pivot year (for example, a pivot year of 1950 causes values between 50 and 99 to be interpreted as 1950 to 1999, and values between 00 and 49 to be interpreted as 2000 to 2049).

A.1.1.6.2 Movable windowing

This is a procedural technique in which two-digit year values are interpreted within a 100-year window, which may be user- or installation-specified. The range of years in the window or the pivot year can be specified when the system is installed or started.

A.1.1.6.3 Sliding windowing

This is a procedural technique in which two-digit year values are interpreted within a 100-year window that is defined in terms of the current date. With this technique, as the current date moves forward, year to year, the window also moves or "slides" forward. Sliding windows are sometimes documented by specifying a value (usually called a "slider") that, when added to the current year, defines the pivot year of the 100-year window. Thus, for example, a sliding window operating on a current date of 2 February 1998 (1998-02-02) with a "slider" defined as "–40" would result in a pivot year of 1958 (1998-40) and a window range of 1958–2057. On 2 February 1999 (1999-02-02), the pivot year would be 1959 (1999-40) and a new window range of 1959–2058.

