



Government of Ontario IT Standard  
**Advanced Metering Infrastructure**

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Prepared for the Information Technology Standards Council (ITSC) under the delegated authority of the Management Board of Cabinet

## Foreword

Government of Ontario Information Technology Standards (GO-ITS) are the official publications on the guidelines, preferred practices, standards and technical reports adopted by the Information Technology Standards Council (ITSC) under delegated authority of the Management Board of Cabinet (MBC). These publications support the responsibilities of the Management Board Secretariat (MBS) for coordinating standardization of Information & Information Technology (I&IT) in the Government of Ontario. Publications that set new or revised standards provide enterprise architecture guidance, policy guidance and administrative information for their implementation. In particular, GO-ITS describe where the application of a standard is mandatory and specify any qualifications governing the implementation of standards.

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# 1. Introduction

## 1.1 Background and Purpose

The Government of Ontario's Smart Metering Initiative intends to create a conservation culture in the Province of Ontario and to make the Province a North American leader in energy efficiency. Key elements forming part of the Government's program to create a conservation culture include:

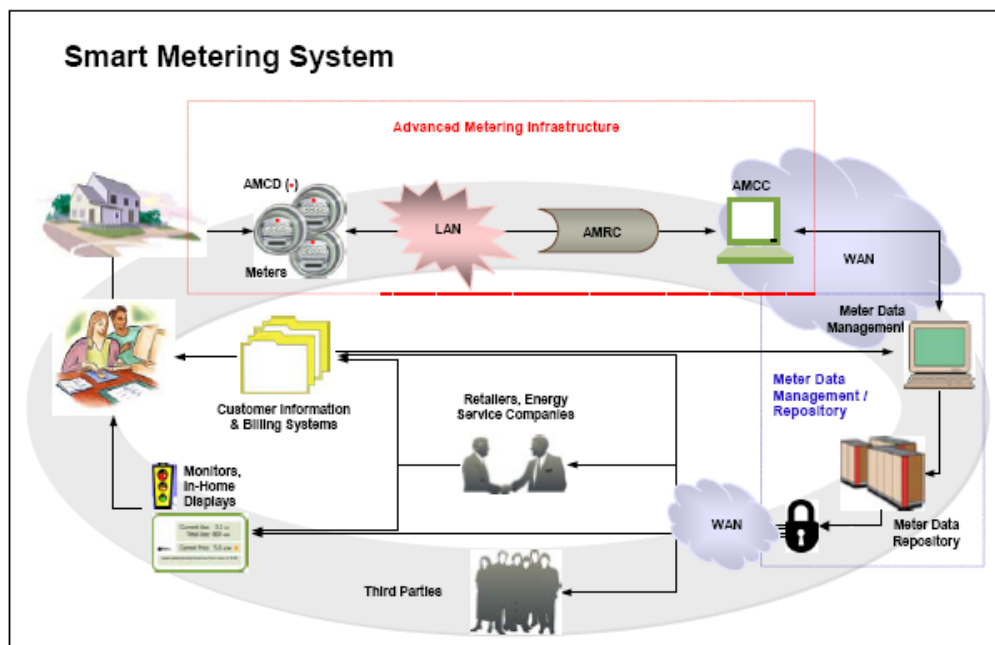
- The introduction of flexible, time-of-use pricing for electricity;
- A targeted reduction in Ontario's energy consumption by five percent by 2007; and
- A commitment to install a smart electricity meter in 800,000 homes by 2007 and in each and every home in Ontario by 2010.

## 1.2 Scope

### 1.2.1 In Scope

Specifications and standards for all elements of the Smart Metering Initiative through a consultative process including, but not limited to, the subject of this GOITS, namely, GO-ITS 51 'Advanced Metering Infrastructure'.

An Advanced Metering Infrastructure (AMI) is to be deployed by every Local Distribution Company (LDC) in Ontario. The AMI includes meters, Advanced Metering Communication Devices (AMCD), Local Area Network (LAN), Advanced Metering Regional Collector (AMRC), connections to the Wide Area Network (WAN), and an Advanced Metering Control Computer (AMCC). It does not include the WAN.



## 1.2.2 Out of Scope

Responsibility for purchasing, owning, installing, operating, and maintaining smart electricity meters as they are rolled out across the Province; and continued responsibility for the customer interface, including billing and access to smart meter information and data (together with third parties).

## 1.3 Applicability Statements

### 1.3.1 Organization

Government of Ontario IT Standards and Enterprise Products apply (are mandatory) for use by all ministries/clusters and to all former Schedule I and IV provincial government agencies under their present classification (Advisory, Regulatory, Adjudicative, Operational Service, Operational Enterprise, Trust or Crown Foundation) according to the current agency classification system.

Kindly refer to [http://intra.pmed.mbs.gov.on.ca/mbc/pdf/Agency\\_Establishment&Accountability-Dir.pdf](http://intra.pmed.mbs.gov.on.ca/mbc/pdf/Agency_Establishment&Accountability-Dir.pdf) for a list of provincial government agencies with their classification under the current classification system, as well as their previous Schedule under the former Schedule system.

Additionally, this applies to any other new or existing agencies designated by Management Board of Cabinet as being subject to such publications, i.e. the GO-ITS publications and enterprise products - and particularly applies to Advisory, Regulatory, and Adjudicative Agencies (see also procurement link, OPS paragraph). Further included is any agency which, under the terms of its Memorandum of Understanding with its responsible Minister, is required to satisfy the mandatory requirements set out in any of the Management Board of Cabinet Directives (*cf.* Operational Service, Operational Enterprise, Trust, or Crown Foundation Agencies).

As new GO-IT standards are approved, they are deemed mandatory on a go-forward basis (Go-forward basis means at the next available project development or procurement opportunity).

When implementing or adopting any Government of Ontario IT standards or IT standards updates, ministries and I&IT Cluster must follow their organization's pre-approved policies and practices for ensuring that adequate change control, change management and risk mitigation mechanisms are in place and employed.

For the purposes of this document, any reference to ministries or the Government includes applicable agencies.

### 1.3.2 Other

The procurement of Smart Meters applies to the Local Distribution Centers (LDCs) and Ontario Hydro One.

## 1.4 Requirements Levels

Within this document, certain wording conventions are followed. There are precise requirements and obligations associated with the following terms:

<b>Must</b>	This requirement is not optional
<b>May</b>	The implementer <i>may</i> choose to take one or more of a selection of options, but <i>must</i> make a choice of one or more, as dictated within the context of the item
<b>Should</b>	The implementer <i>must</i> choose this action, <i>unless</i> business functionality dictates otherwise. Exceptions <i>must</i> be approved by management, as modifications to the standard practice

## 1.5 Recommended Versioning and/or Change Management

GO-ITS 51 Advanced Metering Infrastructure is an OPS mandatory standard. Modifications during the life of the standard must be approved by the organizational owner of the document.

The organizational owner of GO-ITS 51 is the Coordinator of Regulatory Policy, Office of Consumer and Regulatory Affairs, Ministry of Energy

Ministry of Energy will submit revised documentation to the Information Technology Standards Council (ITSC) for endorsement, Architecture Review Board (ARB) approval and publication.

## 1.6 Publication Details

Check One	Web Site for Publication
<input type="checkbox"/>	ITSC Web Site at <a href="http://intra.occto.mbs.gov.on.ca/occtoservices/goits_standards">http://intra.occto.mbs.gov.on.ca/occtoservices/goits_standards</a> (Available to the OPS)
<input checked="" type="checkbox"/>	GO-ITS Web Site at <a href="http://www.itstandards.gov.on.ca/">http://www.itstandards.gov.on.ca/</a> (Available to the public)

## 2. Technical Standards and Specifications

### 2.1 Local Area Network

#### **Power Line Communication (PLC)**

Guidance Note: If networks are implemented using the specifications below, the following advice should be noted (for acronyms, see section 1.2 Scope):

- It is assumed that the AMI will require high-speed capability to transmit meter data from the AMRC, or in some cases directly from the AMCD, to the AMCC
- WAN service is acquired outside of the Advanced Metering Infrastructure

#### **IEEE P1901 Draft Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications**

The standard will use transmission frequencies below 100 MHz. This standard will be usable by all classes of BPL devices, including BPL devices used for the first-mile/last-mile connection (<1500m to the premise) to broadband services as well as BPL devices used in buildings for LANs and other data distribution (<100m between devices). This standard will focus on the balanced and efficient use of the power line communications channel by all classes of BPL devices, defining detailed mechanisms for coexistence and interoperability between different BPL devices, and ensuring that desired bandwidth and quality of service may be delivered. The standard will address the necessary security questions to ensure the privacy of communications between users and allow the use of BPL for security sensitive services. This standard is limited to the physical layer and the medium access sub-layer of the data link layer, as defined by the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) Basic Reference Model. The effort will begin with an architecture investigation, and this will form the basis for detailed scope of task groups that will work within P1901 to develop the components of the final standard.

Contacts: Jean-Philippe Faure (IEEE P1901 Co-Chair); Jim Mollenkopf (IEEE P1901 Co-Chair)

Remote URL: <http://grouper.ieee.org/groups/1901>

#### **Wireless Wide Area Network (WWAN) for Cellular/Packet-switched Data Networks**

Guidance Note: If networks are implemented using the specifications below, the following advice should be noted (for acronyms, see section 1.2 Scope):

- It is assumed that the AMI will require high-speed capability to transmit meter data from the AMRC, or in some cases directly from the AMCD, to the AMCC
- WAN service is acquired outside of the Advanced Metering Infrastructure

#### **ITU International Mobile Telecommunications-2000 (IMT-2000)**

Global standard for third generation (3G) wireless communications, defined by a set of interdependent ITU Recommendations. IMT-2000 provides a framework for worldwide wireless access by linking the diverse systems of terrestrial and/or satellite based networks. It will exploit the potential synergy between digital mobile telecommunications technologies and systems for fixed and mobile wireless access systems.

Author: International Telegraph Union (ITU)

Remote URL: <http://www.itu.int/home/imt.html>

*[Universal Mobile Telecommunications System (UMTS) is one of the 3G mobile phone technologies. It uses W-CDMA as the underlying standard, is standardized by the 3GPP, and is the European/Japanese answer to the ITU IMT-2000 requirements for 3G Cellular radio systems].*

### **Wi-Fi Standards**

Guidance Note: If networks are implemented using the specifications below, the following advice should be noted (for acronyms, see section 1.2 Scope):

- It is assumed that the AMI will require high-speed capability to transmit meter data from the AMRC, or in some cases directly from the AMCD, to the AMCC
- WAN service is acquired outside of the Advanced Metering Infrastructure

### **IEEE-Std-802.11 - Part 11: Wireless LAN Medium Access Control & Physical Layer Specifications**

This standard is part of a family of standards for local and metropolitan area networks. This family of standards deals with the Physical and Data Link layers as defined by the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) Basic Reference Model (ISO/IEC 7498-1: 1994). The access standards define seven types of medium access technologies and associated physical media, each appropriate for particular applications or system objectives. Other types are under investigation.

Specification Identifier: IEEE-Std-802.11-1999

Remote URL:

<http://standards.ieee.org/getieee802/download/802.11-1999.pdf>

### **IEEE-Std-802.11b - Wireless LAN MAC and PHY specifications: Higher speed Physical Layer extension in the 2.4 GHz band**

Changes and additions are provided for IEEE Std 802.11b-1999 to support the higher rate Physical Layer for operation in the 2.4 GHz band.

Specification Identifier: IEEE-Std-802.11b-1999

Remote URL:

<http://standards.ieee.org/getieee802/download/802.11b-1999.pdf>

### **IEEE-Std-802.11b - Amendment 2: Higher-speed Physical Layer extension in the 2.4 GHz band**

This amendment specifies the extensions to IEEE Std 802.11 for Wireless Local Area Networks providing specifications for conformant operation beyond the original six regulatory domains of that standard. These extensions provide a mechanism for an IEEE Std 802.11 access point to deliver the required radio transmitter parameters to an IEEE Std 802.11 mobile station, which allows that station to configure its radio to operate within the applicable regulations of a geographic or political subdivision. This mechanism is applicable to all IEEE Std 802.11 PHY types. A secondary benefit of the mechanism described in this amendment is the ability for an IEEE Std 802.11 mobile station to roam between regulatory domains.

Specification Identifier: IEEE-Std-802.11b-1999Cor1-2001

Remote URL:

[http://standards.ieee.org/getieee802/download/802.11b-1999\\_Cor1-2001.pdf](http://standards.ieee.org/getieee802/download/802.11b-1999_Cor1-2001.pdf)

### **IEEE-Std-802.11g - Amendment 4: Further Higher-Speed Physical Layer Extension in the 2.4 GHz Band**

This amendment specifies the extensions to IEEE 802.11 for wireless local area networks (WLANs) providing mechanisms for dynamic frequency selection (DFS) and transmit power control (TPC) that may be used to satisfy regulatory requirements for operation in the 5 GHz band in Europe.

Specification Identifier: IEEE-Std-802.11g-2003

Remote URL:

<http://standards.ieee.org/getieee802/download/802.11g-2003.pdf>

### **IEEE-Std-802.11i - Amendment 6: Medium Access Control (MAC) Security Enhancements**

This amendment allows for security improvements in existing wireless LAN products (through firmware upgrades). Most current products can be upgraded to use certain IEEE 802.11i features, such as Temporal Key Integrity Protocol and IEEE 802.1x authentication. This provides a considerable security improvement over the Wired Equivalent Privacy feature in the original standard. The amendment also contains options for backward compatibility with the original standard. Even greater security can be gained in new products having new hardware architecture. Products coming on the market will be able to use the most advanced features of IEEE 802.11i, such as AES methods, key caching and pre-authentication for persistent authentication, which allows mobile stations to switch from one access point to another without incurring the time overhead of a key exchange each time.

Specification Identifier: IEEE-Std-802.11i-2004

Remote URL:

<http://standards.ieee.org/getieee802/download/802.11i-2004.pdf>

### **Wireless Personal Area Network (Bluetooth)**

Guidance Note: If networks are implemented using the specifications below, the following advice should be noted (for acronyms, see section 1.2 Scope):

- It is assumed that the AMI will require high-speed capability to transmit meter data from the AMRC, or in some cases directly from the AMCD, to the AMCC
- WAN service is acquired outside of the Advanced Metering Infrastructure

### **IEEE 802.15.1 - Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Wireless Personal Area Networks (WPAN)**

The lower transport layers [(Logical Link Control and Adaptation Protocol (L2CAP), Link Manager Protocol (LMP), baseband, and radio)] of the Bluetooth™ wireless technology are defined. Bluetooth is an industry specification for short-range radio frequency (RF)-based connectivity for portable personal devices. The IEEE 802.15.1 Task Group has reviewed and provided a standard adaptation of the Bluetooth specifications (version 1.1) medium access control (MAC) (L2CAP, LMP, and baseband) and physical layer (PHY) (radio). Also specified is a clause on service access points (SAPs), which includes a logical link control (LLC)-MAC interface for the ISO/IEC 8802-2 LLC. A normative annex is included that provides a Protocol Implementation Conformance Statement (PICS) proforma, and an informative high-level behavioural ITU-T Z.100 specification and description language (SDL) model for an integrated Bluetooth MAC sublayer are also specified.

### **Wireless Personal Area Network (ZigBee)**

Guidance Note: If networks are implemented using the specifications below, the following advice should be noted (for acronyms, see section 1.2 Scope):

- It is assumed that the AMI will require high-speed capability to transmit meter data from the AMRC, or in some cases directly from the AMCD, to the AMCC
- WAN service is acquired outside of the Advanced Metering Infrastructure

### **IEEE 802.15.4 - Wireless Medium Access Control and Physical Layer Specifications for Low Rate WPANs**

This standard defines the protocol and compatible interconnection for data communication devices using low data rate, low power and low complexity, short-range radio frequency (RF) transmissions in a wireless personal area network (WPAN).

Specification Identifier: IEEE-Std-802.15.4-2003

Remote URL:

<http://standards.ieee.org/getieee802/download/802.15.4-2003.pdf>

## 2.2 Measurement Canada Specifications and Procedures

### **S-E-01 (Rev. 1) Specifications for the Calibration, Certification, and Use of Electricity Calibration Consoles**

The specifications in S-E-01 apply to all electricity meter calibration consoles which are currently being used by Accredited Meter Verifiers for the verification or reverification of electricity meters. All remaining consoles that are used for verification or reverification of electricity meters are required to meet these specifications by February 28, 2000.

Remote URL: <http://strategis.ic.gc.ca/epic/internet/inmc-mc.nsf/en/lm01205e.html>

*[References above include both specification and procedure]*

### **LMB-EG-07 Specification for Approval of Type of Electricity Meters, Instrument Transformers and Auxiliary Devices**

This specification establishes acceptable performance criteria for new types of electricity meters, instrument transformers and auxiliary devices intended for use in revenue metering. The criteria apply also to modifications which may be made, in future, to existing approved devices.

Remote URL: <http://strategis.ic.gc.ca/epic/internet/inmc-mc.nsf/en/lm01530e.html>

*[References above include both specification and performance requirements]*

### **S-E-02-E - Specifications for the Verification and Reverification of Electricity Meters**

A range of specifications applying to any electricity meter submitted for verification or reverification under the *Electricity and Gas Inspection Act*.

Remote URL: <http://strategis.ic.gc.ca/epic/internet/inmc-mc.nsf/en/lm04498e.html>

## 2.3 Advanced Metering Communication Device (AMCD)

The Advanced Metering Communication Device (AMCD) is an advanced metering communication device that is housed either under the meter's glass or outside the meter. It transmits meter reads from the meter directly or indirectly to the Advanced Metering Control Computer (AMCC).

This sub-component is applicable to all GO-ITS 51 Advanced Metering Infrastructure.

## 2.4 Advanced Metering Regional Collector (AMRC)

The Advanced Metering Regional Collector (AMRC) is an advanced metering regional collector that collects meter reads over the LAN from the Advanced Metering Communication Device (AMCD) and transmits these meter reads to the Advanced Metering Control Computer (AMCC).

This sub-component is applicable to all GO-ITS 51 Advanced Metering Infrastructure.

## 2.5 AMI Communication

### ANSI C12.19-1997 Utility Industry End Device Tables

This standard organizes metering device data and operating criteria to be conveyed into and out of the metering device into defined groupings of information called tables. The standard is a first tool towards having interoperable metering systems using multiple hardware and software vendors.

Remote URL: <http://public.ansi.org/ansionline/portal> (search keyword C12.19)

### ANSI C12.22-200x Protocol Specification for Interfacing to Data Communication Networks

Specification for interfacing meters to data communication networks.

Remote URL: <http://public.ansi.org/ansionline/portal> (search keyword C12.22)

### ANSI C12.23-200x Compliance Testing For Standard Protocols and Tables (C12.18, C12.19, C12.21, C12.22)

Standard for testing compliance to ANSI specifications C12.18, C12.19, C12.21, and C12.22.

Remote URL: <http://public.ansi.org/ansionline/portal> (search keyword C12.23)

### IETF Securing Layer Two Tunneling Protocol using IPsec

Layer Two Tunneling Protocol (L2TP) may utilize IPsec to provide for tunnel authentication, privacy protection, integrity checking and replay protection. Both the voluntary and compulsory tunneling cases

are discussed. *[N.B. When end-to-end security is required, it is recommended that additional security mechanisms (such as IPsec or TLS) be used inside the tunnel, in addition to L2TP tunnel security]*

Specification Identifier: RFC3193; Authors: B. Patel. B. Aboba. W. Dixon, et al.

Remote URL:

<ftp://ftp.isi.edu/in-notes/rfc3193.txt>

## **IETF Transport Layer Security (TLS)**

The primary goal of the TLS Protocol is to provide privacy and data integrity between two communicating applications. The protocol is composed of two layers: the TLS Record Protocol and the TLS Handshake Protocol. At the lowest level, layered on top of some reliable transport protocol (e.g., TCP), is the TLS Record Protocol. The TLS Record Protocol provides connection security that has two basic properties - the connection is private and reliable.

**Specifications:** (These specifications can be accessed through the Standards section under Technical Standards Knowledge Management (TSKM) of the Office of the Corporate Chief Technology Officer (OCCTO) website)

- The TLS Protocol Version 1.0
- Addition of Kerberos Cipher Suites to Transport Layer Security (TLS)
- Upgrading to TLS Within HTTP/1.1
- Lightweight Directory Access Protocol (v3): Extension for Transport Layer Security
- Advanced Encryption Standard (AES) Ciphersuites for Transport Layer Security (TLS)
- Transport Layer Security over Stream Control Transmission Protocol
- Transport Layer Security (TLS) Extensions
- Transport Layer Security Protocol Compression Methods

## **2.6 Advanced Metering Control Computer (AMCC)**

This is a sub-component of the Meter Data Management and Meter Data Repository (MDM/R) functionality that stores hourly data in an XML format.

## **2.7 Electricity Meters**

### **ANSI C12.20-2002 Electricity Meters (for 0.2 and 0.5 Accuracy Classes)**

This standard establishes the physical aspects and acceptable performance criteria for 0.2 and 0.5 accuracy class electricity meters meeting Blondel's Theorem. Where differences exist between the requirements of this Standard and C12.1 and C12.10, the requirements of this Standard shall prevail.

Remote URL: <http://public.ansi.org/ansionline/portal> (search keyword C12.20)

## **ANSI C12.10-2004 Physical Aspects of Watthour Meters**

This standard covers the physical aspects of both detachable and bottom-connected watthour meters and associated registers. These include ratings, internal wiring arrangements, pertinent dimensions, markings, and other general specifications. Refer to the latest version of ANSI C12.1 and ANSI C12.20 for performance requirements.

Remote URL: <http://public.ansi.org/ansionline/portal> (search keyword C12.10)

## **ANSI C12.1-2001 Code for Electricity Metering**

This Code establishes acceptable performance criteria for new types of AC watthour meters, demand meters, demand registers, pulse devices, and auxiliary devices. It describes acceptable in-service performance levels for meters and devices used in revenue metering. It also includes information on related subjects, such as recommended measurement standards, installation requirements, test methods, and test schedules. This Code for Electricity Metering is designed as a reference for those concerned with the art of electricity metering, such as utilities, manufacturers, and regulatory bodies.

Remote URL: <http://public.ansi.org/ansionline/portal> (search keyword C12.1)

## **IEEE C37.90.1-2002 Standard Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus**

Two types of design tests for relays and relay systems that relate to the immunity of this equipment to repetitive electrical transients are specified. Test generator characteristics, test waveforms, selection of equipment terminals on which tests are to be conducted, test procedures, criteria for acceptance, and documentation of test results are described. This standard has been harmonized with IEC standards where consensus could be reached.

Remote URL: <http://standards.ieee.org/cgi-bin/status?C37.90.1-2002>

## **IEEE C62.41.1-2002 Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits**

This is a guide describing the surge voltage, surge current, and temporary overvoltages (TOV) environment in low-voltage [up to 1000 V root mean square (RMS)] AC power circuits. This scope does not include other power disturbances, such as notches, sags, and noise.

Remote URL: <http://standards.ieee.org/cgi-bin/status?C62.41.1-2002>

## **IEEE C62.41.2-2002 Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits**

The scope of this recommended practice is to characterize the surge environment at locations on AC power circuits described in IEEE C62.41.1-2002 by means of standardized waveforms and other stress parameters. The surges considered in this recommended practice do not exceed one half-cycle of the normal mains waveform (fundamental frequency) in duration. They can be periodic or random events and can appear in any combination of line, neutral, or grounding conductors. They include surges with amplitudes, durations, or rates of change sufficient to cause equipment damage or operational upset.

While surge protective devices (SPDs) acting primarily on the amplitude of the voltage or current are often applied to divert the damaging surges, the upsetting surges might require other remedies.

Remote URL: <http://standards.ieee.org/cgi-bin/status?C62.41.2-2002>

### **CSA CAN3-C17-M84 (R2004) Alternating-Current Electricity Metering**

This Canadian Standards Association (CSA) standard applies to the types of meters and associated devices normally used in the measurement of energy or power or both in the supply and distribution of electricity as a commodity.

Remote URL: <http://www.csa.ca>

Guidance Note: Other CSA Electrical Engineering Standards will also apply to electricity meters for safety, installation and use

### **Industry Canada RSS-210 Low-power Licence-exempt Radiocommunication Devices (including RFID)**

This Radio Standards Specification (RSS) sets out requirements for the certification of licence-exempt (i.e. unlicensed) low-power radiocommunication devices (LPDs) defined as Category I equipment as per RSS-Gen *General Requirements and Information for the Certification of Radiocommunication Equipment*

RFID are considered active if they are self-powered and passive if they receive power from an external source. An RFID system typically consists of a reader (interrogator) and a tag (transponder). A tag is attached to the item to be identified, and a transmitter/receiver unit interrogates the tag and receives identification data back from the tag.

This standard only applies to active RFID. In the case of passive RFIDs, this standard does not apply and the devices may operate without approval from Industry Canada.

Remote URL: <http://strategis.ic.gc.ca/epic/internet/insmt-gst.nsf/en/sf08476e.html>

### 3. Related Standards

#### 3.1 Impacts to Existing Standards

GO-ITS Number	Describe Impact	Recommended Action (alternatively provide a page number where details can be found)
GO-ITS 24 Omnibus IT Standard	This does not impact GO-ITS 24 Omnibus IT standards but instead, some GO-ITS 24 Omnibus standards are included in this GO-ITS 51 Advanced Metering Infrastructure. See Section 2, Technical Standards and Specifications, for a list of the included standards.	Not Applicable (N/A)

### 4. Contact Information

	Contact 1	Contact 2
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<b>Job Title:</b>	Security & Technology Integrator	
<b>Organization:</b>	MGS	
<b>Division:</b>	OCCTO	
<b>Branch:</b>	Technology Adoption Branch	
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<b>E-mail Address:</b>	john.kuhn@mgs.gov.on.ca	

## 5. Document History

**Updated:** 2007-02-21

- Version 0.70
  - Approved by the Information Technology Standards Council (ITSC)

**Updated:** 2007-04-24

- Version 0.70
  - Approved by the Architecture Review Board (ARB)
  - Approved document version number reset to 1.0

## 6. Copyright Information

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