



ATIS-0300110

ATIS Standard on -

**Business Case for Radio Frequency Identification (RFID)  
in Communications Service Provider Warehouses**



As a leading technology and solutions development organization, the Alliance for Telecommunications Industry Solutions (ATIS) brings together the top global ICT companies to advance the industry's most pressing business priorities. ATIS' nearly 200 member companies are currently working to address the All-IP transition, 5G, network functions virtualization, big data analytics, cloud services, device solutions, emergency services, M2M, cyber security, network evolution, quality of service, billing support, operations, and much more. These priorities follow a fast-track development lifecycle — from design and innovation through standards, specifications, requirements, business use cases, software toolkits, open source solutions, and interoperability testing.

ATIS is accredited by the American National Standards Institute (ANSI). The organization is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a founding Partner of the oneM2M global initiative, a member of and major U.S. contributor to the International Telecommunication Union (ITU), as well as a member of the Inter-American Telecommunication Commission (CITEL). For more information, visit [www.atis.org](http://www.atis.org).

---

### Notice of Disclaimer & Limitation of Liability

The information provided in this document is directed solely to professionals who have the appropriate degree of experience to understand and interpret its contents in accordance with generally accepted engineering or other professional standards and applicable regulations. No recommendation as to products or vendors is made or should be implied.

NO REPRESENTATION OR WARRANTY IS MADE THAT THE INFORMATION IS TECHNICALLY ACCURATE OR SUFFICIENT OR CONFORMS TO ANY STATUTE, GOVERNMENTAL RULE OR REGULATION, AND FURTHER, NO REPRESENTATION OR WARRANTY IS MADE OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. ATIS SHALL NOT BE LIABLE, BEYOND THE AMOUNT OF ANY SUM RECEIVED IN PAYMENT BY ATIS FOR THIS DOCUMENT, AND IN NO EVENT SHALL ATIS BE LIABLE FOR LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. ATIS EXPRESSLY ADVISES THAT ANY AND ALL USE OF OR RELIANCE UPON THE INFORMATION PROVIDED IN THIS DOCUMENT IS AT THE RISK OF THE USER.

NOTE - The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to whether use of an invention covered by patent rights will be required, and if any such use is required no position is taken regarding the validity of this claim or any patent rights in connection therewith. Please refer to [<http://www.atis.org/legal/patentinfo.asp>] to determine if any statement has been filed by a patent holder indicating a willingness to grant a license either without compensation or on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain a license.

---

*Published by*

**Alliance for Telecommunications Industry Solutions**  
**1200 G Street, NW, Suite 500**  
**Washington, DC 20005**

Copyright © 2017 by Alliance for Telecommunications Industry Solutions  
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher. For information contact ATIS at 202.628.6380. ATIS is online at < <http://www.atis.org> >.

# **Business Case for Radio Frequency Identification (RFID) in Communications Service Provider Warehouses**

**Alliance for Telecommunications Industry Solutions**

Approved June 8, 2017

## **Abstract**

This document is a business case for Radio Frequency Identification (RFID) in communications service provider warehouse.

## Foreword

---

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between carriers, customers, and manufacturers. The **Automatic Identification & Data Capture (AIDC)** Committee establishes guidelines for common shipping labels, product marking labels, product changes, and software issuance standards. These common guidelines simplify the receiving, shipping, transportation, and tracing of telecommunications products through company and industry business processes and the global supply chain.

The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages. The word *may* denotes an optional capability that could augment the standard. The standard is fully functional without the incorporation of this optional capability.

Suggestions for improvement of this document are welcome. They should be sent to the Alliance for Telecommunications Industry Solutions, AIDC, 1200 G Street NW, Suite 500, Washington, DC 20005.

At the time of consensus on this document, AIDC, which was responsible for its development, had the following leadership:

B. Willoughby, AIDC Chair (iconectiv)

Common Language® and Telcordia® are registered trademarks and CLLI™, iconectiv®, LERG™ Routing Guide and TPM™ Data Source are trademarks and the Intellectual Property of Telcordia Technologies, Inc. dba iconectiv®.

# Table of Contents

1	Scope & Purpose .....	1
1.1	Scope.....	1
1.2	Purpose .....	1
2	Informative References .....	1
3	Definitions, Acronyms, & Abbreviations .....	2
3.1	Definitions .....	2
3.2	Acronyms & Abbreviations.....	3
4	RFID Technology & Standards .....	4
4.1	RFID Technology Capabilities & Limitations.....	5
4.1.1	<i>Capabilities of RFID Tags &amp; Readers</i> .....	5
4.1.2	<i>Limitations of RFID Technology</i> .....	5
4.2	RFID Processes & Solution Provider Recommendations .....	5
4.2.1	<i>RFID Processes</i> .....	5
4.2.2	<i>RFID Solution Provider Recommendations</i> .....	6
4.3	Supplier & User Testing.....	7
4.3.1	<i>Service Provider Testing</i> .....	7
4.3.2	<i>RFID Tag Manufacturer Testing</i> .....	7
4.3.3	<i>Communications Equipment Manufacturer Testing</i> .....	7
4.4	RFID Standards .....	7
5	Issues & Considerations .....	8
5.1	Common Concerns – Suppliers, Service Providers, & Transportation Carriers .....	8
5.1.1	<i>General</i> .....	8
5.1.2	<i>Information</i> .....	8
5.1.3	<i>Technology</i> .....	8
5.1.4	<i>Environmental</i> .....	9
5.1.5	<i>Logistical</i> .....	9
5.1.6	<i>Implementation</i> .....	9
5.2	Supplier Concerns .....	10
5.2.1	<i>General</i> .....	10
5.2.2	<i>Information</i> .....	10
5.2.3	<i>Technology</i> .....	10
5.2.4	<i>Implementation</i> .....	10
5.3	Transportation Carrier Concerns .....	10
5.3.1	<i>Tag Reading</i> .....	10
5.3.2	<i>Implementation Considerations</i> .....	10
5.4	Service Provider/Operator Concerns.....	11
5.4.1	<i>Tag Reading</i> .....	11
5.4.2	<i>Implementation Considerations</i> .....	11
5.4.3	<i>RFID Environment</i> .....	12
5.4.4	<i>Embedded Base</i> .....	12
6	Warehouse/Distribution Center Process.....	12
6.1	RF Tag Use in Telecom Distribution Centers .....	12
6.1.1	<i>Receiving</i> .....	12
6.1.2	<i>Returns</i> .....	13
6.1.3	<i>Cycle Counting</i> .....	13
6.2	Other Potential.....	13
7	Summary & Conclusions.....	14

A	Business Case Analysis Approach .....	16
A.1	Assess the Current Processes .....	16
A.1.1	Quantify the Existing Processes .....	16
A.2	Selecting an RFID Technology .....	17
A.3	Evaluate the Business Case Based on Using the Selected Technology .....	17
B	Service Provider 2012 Trials of Tagging & Reading Printed Circuit Board Assemblies (PCBAs).....	19
B.1	Introduction .....	19
B.2	Background.....	19
B.3	Findings .....	19
B.4	Cost Analysis & Savings.....	20
B.5	Summary .....	20
C	Testing of the Reading of RFID Tags through ESD Packaging Performed by an RFID Tag Manufacturer in August 2013.....	21
C.1	Introduction .....	21
C.2	Test Process.....	21
C.3	Test Results.....	24
C.4	Summary & Conclusions .....	25
D	Testing of RFID Tags through ESD Packaging Performed By a Communications Equipment Manufacturer .....	26
D.1	Introduction .....	26
D.2	Test Process .....	26
D.3	Test Result Headers .....	27
D.4	Test Data .....	28
D.8	Annex D Summary & Conclusions.....	36

## Table of Figures

Figure C.1	– Box 1 without Static Bag .....	22
Figure C.2	– Box 1 with Static Bag .....	22
Figure C.3	– Box 2 without Static Bag .....	22
Figure C.4	– Box 2 with Static Bag .....	23
Figure C.5	– Box 3 without Static Bag .....	23
Figure C.6	– Box 3 with Static Bag .....	23
Figure C.7	– Box 4 without Static Bag .....	24
Figure C.8	– Box 4 with Static Bag .....	24
Figure C.1	– Box 1 without Static Bag .....	22
Figure C.2	– Box 1 with Static Bag .....	22
Figure C.3	– Box 2 without Static Bag .....	22
Figure C.4	– Box 2 with Static Bag .....	23
Figure C.5	– Box 3 without Static Bag .....	23
Figure C.6	– Box 3 with Static Bag .....	23
Figure C.7	– Box 4 without Static Bag .....	24
Figure C.8	– Box 4 with Static Bag .....	24
Figure D.1	– Two antennas placed on sides of a table to simulate a portal reader .....	26
Figure D.2	– Handheld RFID reader .....	26
Figure D.3	– Vertical, Towards Antenna .....	28

Figure D.4 – Vertical, Away From Antenna..... 29  
 Figure D.5 – Vertical, Against Each Other, Away From Antenna..... 29  
 Figure D.6 – Vertical, Against Each Other, Towards Antenna ..... 30  
 Figure D.7 – Vertical, Against Each Other, Away From Antenna..... 31  
 Figure D.8 – Tag on Top and Under, ESD Protected Box with ESD Plastic Bag..... 31  
 Figure D.9 – Tag on Top, ESD Protected Box with ESD Plastic Bag ..... 32  
 Figure D.10 – Tag on Top and on Bag, ESD Protected Box with ESD Plastic Bag ..... 32  
 Figure D.11 – Tag Under and in Bag, ESD Protected Box with ESD Plastic Bag..... 33  
 Figure D.12 – Tag on Top and Inside, ESD Protected Box with ESD Plastic Bag..... 34

**Table of Tables**

---

Table B.1 – RFID System Perceived Savings ..... 20  
 Table C.1 - Reading of RFID Tags through ESD Packaging Test Results ..... 24  
 Table D.1 – dBm Translation ..... 27  
 Table D.2 – RFID Chip dBm Measurements ..... 27  
 Table D.3 – Data for Test: Vertical, Towards Antenna ..... 28  
 Table D.4 – Data for Test: Vertical, Away From Antenna ..... 29  
 Table D.5 – Data for Test: Vertical, Against Each Other, Away From Antenna ..... 30  
 Table D.6 – Data for Test: Vertical, Against Each Other, Towards Antenna..... 30  
 Table D.7 – Data for test: Vertical, Against Each Other, Away From Antenna ..... 31  
 Table D.8 – Data for test: Tag on Top and Under, ESD Protected Box with ESD Plastic Bag 32  
 Table D.9 – Data for test: Tag on Top, ESD Protected Box with ESD Plastic Bag ..... 32  
 Table D.10 – Data for test: Tag on Top and on Bag, ESD Protected Box with ESD Plastic Bag  
 ..... 33  
 Table D.11 – Data for test: Tag Under and in Bag, ESD Protected Box with ESD Plastic Bag 33  
 Table D.12 – Data for test: Tag on Top and Inside, ESD Protected Box with ESD Plastic Bag34  
 Table D.13 – Data for test: Tag alone and tag covered by ESD Material, ESD Protected Box,  
 Plastic Bag, Inlay ..... 36

ATIS Standard on –

# Business Case for Radio Frequency Identification (RFID) in Communications Service Provider Warehouses

## 1 Scope & Purpose

### 1.1 Scope

This document covers Radio Frequency Identification (RFID) in communications service providers' warehouses. Part two of this business case will address RFID in communications service providers' distribution hubs/central offices. Communications service providers are continually looking for new processes and technologies to improve managing material within their warehouse(s). Automatic Identification and Data Capture (AIDC) technologies have provided increased efficiencies in the past through use of bar codes and two dimensional (2D) symbols for picking, processing shipments, handling receipts, and managing inventory.

The Alliance for Telecommunications Industry Solutions (ATIS) AIDC Committee has studied current warehouse processes and related processes of handling assets<sup>1</sup> that move between warehouses and distribution centers. This guideline covers estimated projected benefits of migrating and incorporating RFID usage in these processes. The details and results of this study are included in this report.

This document is not restricted to the telecommunications industry and is intended for a broader audience use so that if RFID becomes a common practice, the issues that are defined are for all types of customers who provide communications assets and services.

### 1.2 Purpose

This study seeks to determine the feasibility of using RFID for managing plug-in circuit cards and other network equipment in a warehouse and its movement within a supply chain. It seeks to determine if there is an incremental benefit over the current processes that use bar code readers, which support linear bar code labels and current practices that include 2D labels.

NOTE: RFID is not seen as a replacement for human readable and other machine-readable symbols, but it can be a complementary solution if found beneficial. Similarly, linear bar codes never replaced plain text marking and 2D is more of an enhancement than a replacement for linear barcodes – especially on packages in open supply chains. A new marking technology typically adds on to the existing technologies. Redundancy of other AIDC technologies is an effective tool for supply chain shipping and receiving package label applications that are at various stages of AIDC maturity/improvement.

## 2 Informative References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

---

<sup>1</sup> In this document, the term "asset(s)" refer to items tracked by RFID (e.g., warehouse inventory).

## ATIS-0300110

ATIS-0300096, *RFID Guideline for Product, Product Package and Transport Unit Tagging*.<sup>2</sup>

ISO/IEC 18000-63:2015, *Radio frequency identification for item management — Part 63: Parameters for air interface communications at 860 to 960 MHz Type C*.<sup>3</sup>

ISO/IEC 15963, *Information technology -- Radio frequency identification for item management -- Unique identification for RF tags*.<sup>3</sup>

ISO/IEC 19762-3, *Information technology – Harmonized vocabulary, Part 3 – Radio Frequency Identification (RFID)*.<sup>3</sup>

ISO 17367, *Supply chain applications of RFID – Product Tagging*.<sup>3</sup>

ISO 17366, *Supply chain applications of RFID – Product Packaging*.<sup>3</sup>

ISO 17365, *Supply chain applications of RFID – Transport Units*.<sup>3</sup>

ISO 17364, *Supply chain applications of RFID – Returnable Containers*.<sup>3</sup>

RFID Journal Live! Conference April 8, 2014 – Preconference Seminar: *RFID for Warehouse*.<sup>4</sup>

*Inventory Management* - Yigal Bendavid, Ph. D. Professor Université du Québec à Montréal School of Management, Co-founder Academia RFID.

ATIS-0300006, *Implementation Guide for Package Labeling*.<sup>5</sup>

ATIS-0300038, *Product Marking Implementation Guide*.<sup>6</sup>

## 3 Definitions, Acronyms, & Abbreviations

---

For a list of common communications terms and definitions, please visit the *ATIS Telecom Glossary*, which is located at: < <http://www.atis.org/glossary> >. All other definitions related to this document can be found in the ISO vocabulary document, ISO/IEC 19762-3, *Information technology – Harmonized vocabulary, Part 3 – Radio Frequency Identification (RFID)*.

### 3.1 Definitions

**Assets:** This term specifically refers to items tracked by RFID (e.g., warehouse inventory).

**Central Office (CO):** A terminology most often used within Telecommunications and pertains to a building or site that contains communications equipment for providing communications services. Similarly, other communication service providers may deviate from this moniker and refer to their central offices as Cell Sites, Distribution Hubs/office, or other, such as Head End. The term Central Office found within this document pertains to all deviations as defined herein.

**Common Language Equipment Identifier (CLEI)<sup>7</sup>:** A ten-character alpha-numeric code provided by Common Language® Information Services used to identify orderable equipment assets.

**Communications Industry:** The industry that supplies assets and distributes content supporting television, radio broadcasting, telegraphs, publishing, advertising, telecommunications, motion pictures, home videos, public relations, computer databases, and other information industries.

---

<sup>2</sup> This document is available from the Alliance for Telecommunications Industry Solutions (ATIS) at: < <https://www.atis.org/docstore/product.aspx?id=22978> >.

<sup>3</sup> This document is available from the International Organization for Standardization (ISO) at: < <http://www.iso.org> >.

<sup>4</sup> This document is available from RFID Journal LIVE! at: < <https://www.rfidjournalevents.com> >.

<sup>5</sup> This document is available from ATIS at: < <https://www.atis.org/docstore/product.aspx?id=26145> >.

<sup>6</sup> This document is available from ATIS at: < <https://www.atis.org/docstore/product.aspx?id=25017> >.

<sup>7</sup> CLEI is a trademark of Telcordia Technologies, Inc. dba iconectiv®.

## ATIS-0300110

**Customer:** The consumer (e.g., Operator, Service Provider, Cable Operator, or other) who purchases asset(s) from a supplier for its operational needs.

**Electromagnetic Spectrum:** The range of frequencies of electromagnetic radiation from zero to infinity.

NOTE: The electromagnetic spectrum was, by custom and practice, formerly divided into 26 alphabetically designated bands. This usage still prevails to some degree. However, the ITU formally recognizes 12 bands, from 30 Hz to 3000 GHz. New bands, from 3 THz to 3000 THz, are under active consideration for recognition.

**GS1:** Global Language of Business. An association for design and implementation of global standards and solutions to improve the efficiency and visibility of supply and demand chains globally and across sectors. Standards are primarily used in industries such as consumer packaged goods, healthcare, and defense.

**Manufacturer:** A manufacturer is typically the company that manufactures products and often is also the one who supplies (see supplier) the product. However, a supplier may not be the one that manufactures a product but is the company that distributes products.

**Outside Plant:** Refers to all of the physical cabling and supporting infrastructure (such as conduit, cabinets, tower, or poles), and any associated hardware (such as repeaters) located between a demarcation point in a switching/distribution facility and a demarcation point in another switching or distribution center or termination point (e.g., the end user).

**Service Provider:** See definition for *Customer*.

**Transportation Carrier:** A company that transports deliverable goods asset(s) between the supplier and the customer (e.g., FedEx, UPS, or other postal delivery service).

**Supplier:** The company (e.g., vendor, manufacturer, distributor, or network element provider, etc.) that furnishes asset(s) to the customer.

**Warehouse:** The term warehouse includes a centralized distribution center for a “customer” to effectively manage purchased material for further dissemination within the company’s ecosystem. This term can be a single warehouse site or multiple centers depending on the size of the service provider and the customer. Some customers may elect to further expand the warehouse function beyond the centralized distribution center and include remote spares that are distributed as field-deployed spares within a Central Office/Distribution Hub, or other.

### 3.2 Acronyms & Abbreviations

ARPT	Active Reader Passive Tag
AFI	Application Family Identifiers
AIDC	Automatic Identification and Data Capture (technology)
ASRS	Automated Storage and Retrieval System
ATIS AIDC	Automatic Identification and Data Capture Committee, an ATIS Committee
ATIS	Alliance for Telecommunications Industry Solutions
CAPEX	Capital Expenditure
CLEI	Common Language Equipment Identifier
CO	Central Office
DC	Distribution Center
EM	Electromagnetic
EPC	Electronic Product Code
ERP	Enterprise Resource Planning