CLINICAL INFORMATION PROCESSING PLATFORM™

RFID Solutions for Delivering Efficient, High Quality Healthcare

White Paper
October 2005

Retail and defense industries have realized supply chain efficiencies by the deployment of RFID systems. This success has led to broader use of RFID applications in other vertical industries such as healthcare, travel and finance. Specifically in the healthcare industry, inefficient supply management, multiple proprietary systems and lack of standards have led to high operating costs and lowered care quality and have directly impacted patient safety. Aventyn, Inc. addresses these needs with its standards-based Clinical Information Processing Platform. CLIP™ enables the healthcare industry to deliver efficient, low cost and higher quality services with value added RFID information processing solutions for medical asset tracking and interoperable electronic health information.

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Radio Frequency Identification

Overview

Radio Frequency Identification (RFID) as an auto identification technology has been around for several decades. More recently, due to mandates from industry leading retailers and government agencies, RFID systems are being deployed at a fast rate to reduce inventory losses, increase on-shelf product visibility and lower overall supply chain costs. Increased investment in RFID technology has brought retailers such as Wal-Mart, Tesco, etc. closer to the goal of item level visibility today than two years ago. The U.S. Department of Defense, with perhaps the most intricate global supply chain system, has deployed RFID as an enabler to its vision of an integrated supply chain. The DoD has claimed its RFID systems have increased reliability, improved visibility of assets throughout the supply chain, improved process efficiency and secured customer confidence.

The success of RFID in retail and defense for improved supply chain efficiency has led to broader use in other vertical industries. Healthcare, travel and financial industries are gradually embracing RFID as they overcome deployment challenges and realize benefits through key learning from pilot programs tailored to meet their particular customer's needs. Initial RFID applications to track medical equipment in hospitals, baggage identification by airlines and payment processing by banks have been successful. Specifically in the healthcare industry, broader use of RFID can solve several business problems. The healthcare industry is experiencing inefficient medical supply management due to multiple proprietary systems and a lack of technology standards. Use of paper forms adds to significant patient and medication administration errors in hospitals. Instant availability of critical clinical information that can increase patient safety and care quality largely remains a persistent problem that needs to be solved. These problems contribute directly to care delivery costs rising exponentially, impact patient safety and reduce overall care quality. Clearly, a tailored RFID solution that has benefited the retail and defense industries improves efficiency and reduces costs, while increasing reliability is needed for healthcare. Furthermore, a standard solution that enables interoperable, seamless sharing of electronic health information can go a long way in managing health care efficiently with improved care quality.

Aventyn, Inc. addresses this need by enabling the healthcare industry with its standards based Clinical Information Processing Platform (CLIP™) solution. CLIP enables the healthcare industry to deliver efficient, low cost and higher quality services through value added RFID information processing solutions. CLIP tracks medical assets, processes portable electronic patient health information and provides a robust web-enabled interface for monitoring and managing interoperable healthcare information.

Technology

Radio Frequency Identification is a method of identifying unique items using radio waves. RFID complements and enhances bar code identification technology. RFID systems consist of three key components: **Tag**, a microchip that contains a unique digital serial number and is attached to an antenna. **Reader**, a device used to communicate with RFID tags to read tag data. **Software** that processes, routes and manages Tag data and Readers. RFID systems are generally used to identify, track and manage assets by tagging objects such as products and pallets by reading the tag data. Current RFID tags have the capability to hold data that can amount to over 60 billion items. In cases where the tag data has to be read multiple times, several terabytes of data is generated in the network. This RFID generated data is several orders in magnitude compared to existing data present in the network that needs to be processed at several stages within the network. The RFID data needs to be analyzed, secured, filtered and presented dynamically by multiple systems in a relevant manner.
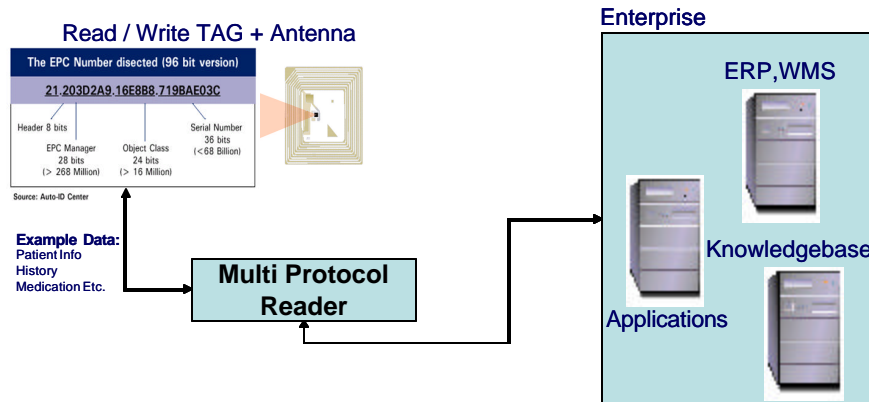
Industry Challenges

At a high level, processing the vast amount of RFID data presents complex challenges to the technologist, business manager and enterprise. Technologists have the challenge of defining a standard hardware and software architecture to deliver solutions based on the architecture. Solutions must provide the most efficient means of processing the incremental data without clogging and compromising the network. Business models have to address the feasibility of using RFID technology where relevant, deploying standard solutions that deliver real world benefit with sustainable return on investment. Enterprises have to balance deployment of emerging technology and solve business problems with well defined strategies that bring about business process efficiency, cost improvements and assure global competitiveness.

At present, the retail and defense industries have experienced success at various levels in the supply chain by enforcing RFID deployment mandates. These industries have overcome early challenges posed by deploying RFID technology and realized tangible return on investment. The healthcare industry can overcome several challenges related to supply, business process and interoperability, not just by mandates, but also by the adoption of standards based interoperable RFID solutions.

Healthcare Industry

National Health Information Network Initiative

Healthcare cost in the U.S. continues to soar with healthcare expenditure amounting to approximately $1.8 trillion, or about $6,300 per person per year, accounting for 15.8% of gross domestic product (GDP.) This high cost is expected to grow to more than $2.75 trillion by 2010. To address this national burden of healthcare cost, patient safety and care the president signed an executive order in 2004 creating the position of the Office of the National Coordinator for Health Information Technology (ONCHIT) within the Department of Health and Human Services. As the national coordinator, David J. Brailer M.D., Ph.D., is charged with the development, maintenance, and oversight of a strategic plan for nationwide adoption of health information technology.

The healthcare industry is one of the last industries to realize the full potential of global IT to increase productivity and compete cost-effectively. Dr. Brailer in a recent address said, "A recent study showed that clinical information is frequently unavailable in primary care, and that this missing information can be harmful to patients. That study also showed that clinical information was less likely to be missing in practices that had electronic health records. This adds to the substantial evidence that health IT - such as computer-physician order entry, ePrescribing, preventative reminders, and bar code scanning to name a few - improves care, reduces wasteful and redundant treatments, and prevents medical errors. Little doubt remains about the health status benefits of health IT."

The National Health Information Network initiative under the auspices of ONCHIT outlined the nationwide implementation of interoperable health information technology across the industry. The initiative recommends the need for using identification technology to meet key goals such as portable electronic patient records, interoperable clinical information and medical asset tracking to increase patient safety to name a few.

While Dr. Brailer and ONCHIT have taken the first steps in setting a vision to "Information Technology enable" healthcare, numerous issues need to be addressed in making this vision a reality. Specifically, existing technology and health management standards will need to be used and new standards developed to ensure interoperability, security and portability. Applications and back-end systems which efficiently process and manage the enormous amount of health information need to be developed based on standards.

Industry Standards

To realistically implement NHIN, technology standards are a critical element to ensure interoperability, portability, data security and privacy at a very minimum. Existing health related standards ranging from Health Level Seven and HIPAA for health care interoperability, EPCglobal and ISO for RFID implementation, XML, JDBC for data

formats and SOAP, HTTP, SMTP for communication protocols are relevant and available for implementing viable solutions at present. However, standards that ensure high availability, reliability and safety are some that will need to evolve as use cases and new applications come to bear in the near future.

RFID FDA Mandate

RFID use in the Healthcare industry has gained traction as a means to address the U.S. Food and Drug Administration mandate to track regulated prescription drugs. In February 2005 the FDA mandated the use of bar codes on drugs dispensed in hospitals to reduce medical errors and increase patient safety from adverse drug effects. It is estimated that non-compliance with medication i.e. dispensing of contraindicated medicine in the U.S. causes 125,000 deaths yearly, 11 per cent of hospital admissions and costs $100 billion yearly. The immediate benefit of the FDA mandate is clear. Its adoption helped reduce medication error rates by as much as 85% at some test-bed hospitals, but, more is needed to enable real time tracking and recording of drugs in an automated fashion.

New Opportunities

Supply costs represent approximately one third of a hospital's cost structure. Inefficiencies in business processes and lack of real time information from disparate applications deployed amongst suppliers, payees and payers account for a majority of this cost. Many hospitals can benefit from improved patient care and lower costs by deploying standards based interoperable RFID clinical information processing solutions to track and manage assets real time.

Preventable medical errors in the U.S. cause between 44,000 and 98,000 deaths and cost $17 billion yearly. Hospitals have piloted the use of patient RFID wrist-bands to improve patient administration and access patient records to deliver quality healthcare. This is one of the most promising uses of RFID with the benefit of not only delivering high quality healthcare but also improving business processes to lower cost by integrating back-end services for disease management, drug disposal and billing.

While tracking pharmaceuticals is one application for RFID, hospital investment in this technology can be further leveraged to address the need for tracking and managing expensive medical assets. Studies have shown that more than $11 billion was wasted in 2003/2004 on inefficiencies relating to hospital supply spending. Locating, identifying and verifying expensive medical equipment, lowering thefts and more importantly, maximizing the use of life saving equipment such as an ECG/EKG is critical to addressing this opportunity.

Clinical Information Processing Platform

Aventyn, Inc's vision is to deliver a RFID information processing platform that meets the needs of the healthcare industry's business and information technology requirements. Aventyn brings about standards based innovative solutions to the healthcare marketplace that solve asset tracking, and resource management problems. Aventyn's modular solution enables seamless use of portable electronic health records with interoperable clinical information tailored to patient needs.

CLIP™ is a software solution from Aventyn designed for deployment at Healthcare Providers, Medical Device Manufacturers and Healthcare System Integrators. CLIP is built on Aventyn's innovative modular architectural framework and supports EPCglobal and ISO RFID standards for global systems interoperability. CLIP has the capability to aggregate, secure, filter and route RFID asset and electronic patient health data without compromising the integrity of the network. CLIP enables dynamic monitoring and management of healthcare information with a robust user friendly web-enabled interface. CLIP is fundamentally a solution developed to balance technology with the focus on solving real world healthcare problems. CLIP benefits include lower cost, high performance and standards based information processing solutions that are secure, interoperable, highly available, real time and scalable.

CLIP delivers solutions for Asset Management, Personal Health Management and a Clinical Information Knowledgebase for health and disease management.
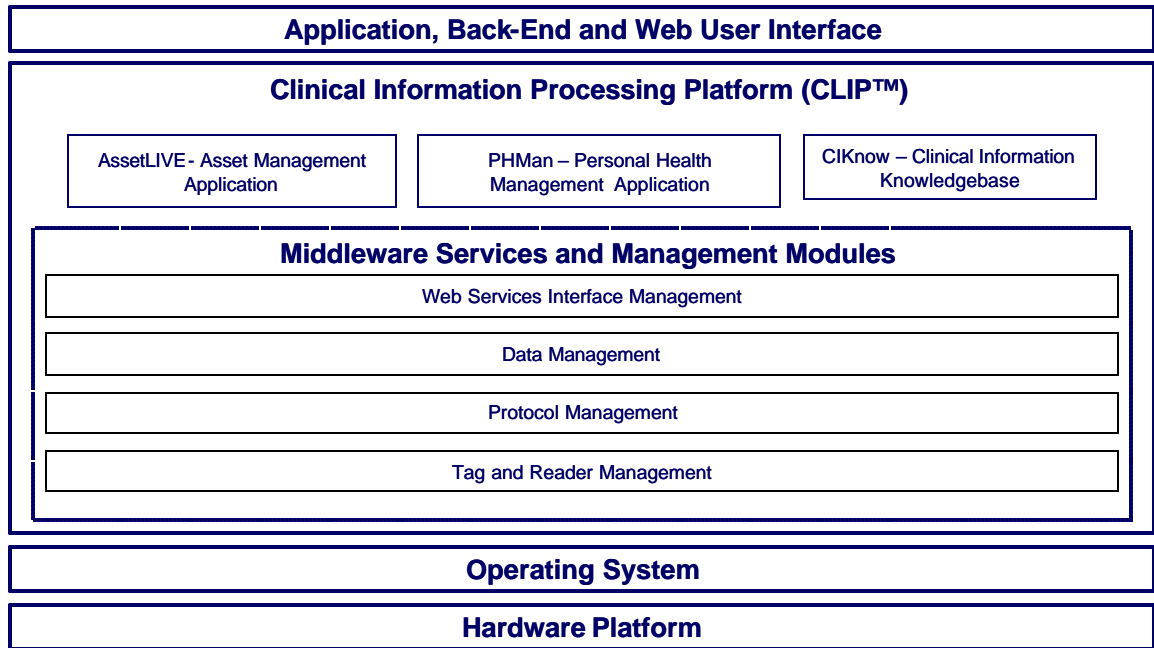
CLIP Architecture Framework

CLIP recognizes the need to support legacy as well as current and future wired and wireless network architectural needs. CLIP's architectural approach considers a model that is a combination of an Electronic Data Interchange (EDI) model for legacy applications and Service-oriented architecture (SOA) based model for forward looking applications.

CLIP architecture framework is built using a modular approach that takes into consideration the following guidelines:

- Modular architecture based approach
- Standards based for interoperability
- Supports security and privacy
- Support for multiple operating systems
- Support for multiple data formats
- Support for multiple hardware platforms
- Scalable across platforms
- Support for multiple wired and wireless communication protocols
- Support for multiple application interfaces

Technology Solution Stack

A detailed block diagram describes CLIP technology building blocks and how they fit within an enterprise solution. It is clear that from an implementation standpoint CLIP is flexible as a standalone solution or integrated within an existing solution as a seamless component.

Application, Back-End and Web User Interface

Clinical Information Processing Platform (CLIP™)

AssetLIVE - Asset Management Application	PHMan – Personal Health Management Application	CIKnow – Clinical Information Knowledgebase

Middleware Services and Management Modules

Web Services Interface Management
Data Management
Protocol Management
Tag and Reader Management

Operating System

Hardware Platform

Flexible implementation of CLIP solutions even at the application level is possible due to the innovative modular architecture framework. Modularity allows several elements within CLIP to be added, deleted and/or tested and validated independently. Application interfaces are provided for coupling, decoupling hardware, software, data management and communication layers, back-end applications and services.

Architecture Framework Design Considerations

Interoperability

There are several barriers to interoperability starting with hardware platforms to operating system to applications that use multiple data formats. In order to achieve a class of interoperability that allows disparate systems, applications and transactions to materialize in near real-time fashion, CLIP uses standardized data formats. Today and in future, a reliable class of interoperability can be enabled by standardized data formats ASCII, XML, JDBC using SOAP messaging protocols for enterprise industries to share data seamlessly and be interoperable. A SOA model, in other words, a Web services model architected for payer, providers as well as administrators and several other players within the ecosystem benefit from accessing interoperable information.

Scalability

CLIP is scaleable both as a stand alone solution and when implemented as a subset of an existing enterprise solution. Software and services are designed to adapt and conform to available communication and computing resources to ensure optimum usage and operation of the execution platform be it a handheld, mobile device or a personal computer.

High Availability

CLIP provides services and support to ensure a level of high availability. This is made possible by implementing checks and balances that utilize real time resources to ensure information, application and platform availability with redundant, fail safe options. Because CLIP is itself built on a standards based architectural approach, platform performance predictions and redundancy makes high availability a reality.

Security

There are critical pressure points related to security in a device, system and network that are prone to malicious attacks. CLIP data security from a technology standpoint is supported by means of standard solutions derived from SSL, RSA, and 3DES for encrypting, decrypting and authenticating sensitive information. Standards based IEEE wireless security is supported where needed and future standards that are going through the process of industry standardization. It must be noted that data security does not start and end at a single location or vendor, the entire ecosystem needs to ensure the safety, security and integrity of sensitive information. CLIP ensures the level required to meet necessary security levels using available approved standards.

Privacy

CLIP privacy concerns are addressed by maintaining status quo at the very minimum. The privacy level is not to be compromised from present day levels. Allowing flexible user

options for disclosures is a basic guideline. It is the ultimate responsibility of the user as well as the network provider to maintain extremely high levels of security starting with individuals' information, to medical records to business transactions. CLIP supports the Privacy Act and informs users of the presence of RFID technology where relevant. CLIP provides users several options to implement privacy. Mechanisms are available for disabling tags, encrypting tags, authenticating readers and a true framework to address present and future issues critical to meeting acceptable privacy standards.

Standards

CLIP supports existing technology industry standards driven by World Wide Web Consortium, 3GPP, IEEE, IETF, HIPAA, HL7, CHIME, HIMSS, EPCglobal, and ISO. Newer entities created within these bodies that are either in the form of working groups or development groups to address the NHIN standards and policies will be supported where necessary. Special attention will be directed towards supporting standards on security, privacy and interoperability.

CLIP Solutions

Asset Management

AssetLIVE is a medical Asset management solution that helps in Location, Identification and Verification of clinical assets that include a wide spectrum ranging from surgical instruments to capital equipment to the actual drugs themselves.

Several U.S. states have documented reports of individuals dressed as hospital workers or service company employees stealing expensive medical equipment from hospitals. This results in both financial loss to hospitals and the danger that some lifesaving equipment is missing when needed. Hospitals can solve this problem by deploying CLIP to not only identify critical assets but also locate, verify and secure medical assets. CLIP AssetLIVE can be applied with its value add features to improve patient care, protect and secure expensive equipment and reduce maintenance cost.

Personal Health Manager

PHMan is a Personal Health Management solution that physicians, patients and payers can utilize to manage portable personal health records for sick care, preventative care and managing personal well being.

Examples where portable health records can be made available are RFID wristbands and smartcards which relate patients and their health records. Portability is especially applicable in accidents and emergencies to enable physician's timely access to patient health records for critical care and drug disposal. In hospitals, approved care providers can identify and access patient health data anytime, anywhere, anyplace to improve care delivery and ensure patient safety from adverse drug reactions. Additionally, portability empowers patients to create and manage wellness and personal health programs by easily accessing and managing their own general health data.

Clinical Information Management

CIKnow is a Clinical Information Knowledgebase that contains an exhaustive collection of clinical information for managing personal health and disease to deliver high quality health care efficiently.

Clinical information spanning several multi-disciplinary practice areas are made available to the rules engine and work flow model in CLIP to analyze and assist in disease and personal health management. Today, best known methods for Disease Management that are vertical in nature, such as diabetes, exist as a proven model. However, there are several unknowns in creating a horizontal model for disease management. As a start, CIKnow provides an innovative secure clinical information knowledgebase to enable a standard disease management model by relating clinical information and patient data.

Summary

Benefits

CLIP is a standards based platform built on an innovative modular architectural framework that specifically addresses the needs of the healthcare industry. CLIP benefits Healthcare Providers, Medical Device Manufacturers and Healthcare System Integrators with a lower cost, high performance RFID healthcare information processing solution that is interoperable, secure, highly available, real time and scalable.

Asset Location, Identification and Verification benefits include the ability to identify, locate, verify and track various assets in the healthcare industry which include medical instruments, drugs and capital assets such as EKG/ECG equipment.

Personal Health Manager benefits healthcare providers and patients through static and dynamic personal health information management, medication administration, treatment management and wellness.

Clinical Information Knowledgebase benefits physicians, patients, payers and providers with the potential for disease management and multi disciplinary clinical information routing. Interoperable clinical information exchange has the potential to improve drug discovery process, reduce insurance costs and improve business process, work flow and decision making.

Overall, CLIP complements and enhances healthcare delivery by providing a standards based clinical information processing platform that ensures delivery of efficient, high quality healthcare.

References and Resources

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Audience

The audience for this white paper is Healthcare Industry Executives, Hospital CIO, IT Administrator, Business Development Managers and RFID in Healthcare Platform Architects.

Glossary

3DES	Triple Data Encryption Standard
3GPP	Third Generation Partnership Project
AES	Advanced Encryption Standard
ASCII	American Standard Code for Information Interchange
AssetLIVE	Asset Location, Identification and Verification
CHIME	College of Healthcare Information Management Executives
CIO	Chief Information Officer
CIKnow	Clinical Information Knowledgebase
CLIP	Clinical Information Processing Platform
DoD	U.S. Department of Defense
ECG/EKG	Electrocardiogram
EDI	Electronic Data Interchange
EPCglobal	Electronic Product Code Global
FDA	U.S. Food and Drug Administration
GDP	Gross Domestic Product
HIMSS	Healthcare Information and Management Systems Society
HIPAA	Health Insurance Portability and Accountability Act
HL7	Health Level Seven
HTTP	Hyper Text Transfer Protocol
IEEE	Institute of Electronic and Electrical Engineers
IETF	Internet Engineering Task Force
ISO	International Standards Organization
IT	Information Technology
JDBC	Java Database Connectivity
NHIN	National Health Information Network
ONCHIT	Office of the National Coordinator for Health Information Technology
PHMan	Personal Health Management
RFID	Radio Frequency Identification
SOAP	Simple Object Access Protocol
SOA	Service-oriented Architecture
SMTP	Simple Mail Transfer Protocol
SSL	Secure Sockets Layer
XML	Extensible Mark-up Language

About Aventyn, Inc.

Aventyn is a San Diego based wireless technology start-up committed to developing and delivering innovative leading-edge Radio Frequency Identification (RFID) information processing solutions for enterprise industries to secure, track and manage assets and resources.

Aventyn's initial offering to the Healthcare industry is the Clinical Information Processing Platform (CLIP™) with complete software application suite, middleware products and services associated with the deployment and use of its software products.

CLIP is a software solution deployed at Healthcare Providers, Medical Device Manufacturers and Healthcare System Integrators. CLIP aggregates, filters and routes RFID asset and electronic patient data with a robust web-enabled interface for monitoring and processing clinical information in a healthcare enterprise.

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