Innovative VDI Standards: Moving an Industry Forward

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ABSTRACT

Effective self-service automation requires data sharing among non-proprietary system components. Historically, the original self-service provider, the vending industry, has failed to develop and implement open architecture standards that enable seamless data sharing among disparate devices and servers in a network. This lack of interoperability among the main entities in a sophisticated vending system (e.g. vending machine controller, telemetry device, vending management software, and cashless payment equipment) has contributed to a lack of innovation and creativity in the evolution of unattended point-of-sale retailing. Recently crafted Vending Data Interchange (VDI) standards from the National Automatic Merchandising Association (NAMA) provide a non-proprietary means by which to share machine-level data among diverse technology providers. The VDI standards are designed to ensure reliability, continuity, and longevity among installed hardware, software, and netware. In essence, VDI standards contain technical specifications that bundle vending machine-level data for easy distribution throughout a vending operator's technology network and can be implemented by a qualified provider without operator involvement.
Keywords: *data interchange, vending, self-service technologies, unattended point-of-sale*

INTRODUCTION

The NAMA Technology Leadership Committee, under the direction of the NAMA Board of Directors, formed a specialized technology task force charged with developing data interchange standards that could be implemented industry-wide. The task force was directed to develop a set of data transport protocols enabling the sharing of vending machine data among competing back-end technology providers. These standards had to ensure reliability, continuity, and longevity. Reliability relating to each participating technology provider of a vending operator receiving identical data files, continuity in terms of data retrieval and distribution throughout a vending operator's network, and longevity by providing assurance to vending operators that interfaces between installed applications would remain viable going forward. As a result, the task force produced NAMA VDI (**V**ending **D**ata **I**nterchange) standards. These standards contain technical specifications that bundle vending machine-level data for rapid distribution throughout a vending operator's technology network and can be implemented by technology providers without vending operator intervention.

Simply stated, vending operators desire technology capable of reliably passing data sets from one application service provider to another so that multiple application service providers can contribute to a single networked solution. The essence of the NAMA VDI standards is to enable data movement through a messaging technique that ensures data integrity of a transmitted set of data, regardless of whether it was pulled or pushed to a server. In other words, NAMA VDI standards render vending technology capable of linking together diverse software solutions, from different vending technology providers, into unified applications and likely represent a tipping point in the accelerated adoption of vending technologies as operator concerns related to supplier-dependence are significantly reduced.

Data Sets

NAMA VDI is an innovative set of protocols designed to package vending machine-level data (e.g. DEX and MDB data, alerts data, cashless transaction data, etc.) into a message format that can be shared among diverse supplier systems to enable multiple software applications on the identical data set. For example, consider the situation in which a telemetry provider remotely polls DEX data from a vending machine (e.g. Company "X"). The telemetry provider transfers machine-level generated data file to its server (e.g. "X" Server). The server in turn authenticates the file with a NAMA VDI message wrapper and labels its contents for subsequent communication to any other provider's server in a vending operator's network (e.g. Company "Y" or Company "Z" etc.). Additionally, the vending operator may have machine-installed cashless readers that collecting electronic payment data for transmission to cashless gateway for reconciliation. The polled data set would consist of both DEX data and electronic payment data and packaged into an aggregated data set. Movement of the data set to a host vending management software (VMS) system capable of processing DEX data could occur while simultaneously forwarded data to a cashless gateway system could be applied for processing and settlement. This multiple tasking one a single data set is indicative of the robust nature of VDI messaging.

The functionality of VDI standards is somewhat analogous to an email communication in that the file of machine captured data file forms the content of the message while VDI programming places a wrapper, akin to an email message envelope that enables distribution among any number of file servers (e.g. email recipients), regardless of supplier, provider, or manufacturer. NAMA VDI standards, for example, allow for DEX data to be transmitted by a telemetry device or server in real time. This approach provides a platform for a vending operator's VMS to upload data nightly for use in pre-packaging (also referred to as pre-kitting) and/or dynamic scheduling algorithms that rely on variable replenishment strategies. The goal of NAMA VDI standards is to ensure that a vending operator can confidently implement multiple, diverse vending technology solutions while utilizing operational data in existing application software (regardless of supplier). NAMA VDI specifications are open architecture technology standards designed to be extensible, uniform, stable, and manufacturer neutral.

Vending Technology

More than two decades ago, in an effort to standardize the control of machine-level transaction and event data collection, storage, and transmission technical specification committee members of the National Automatic Merchandizing Association (NAMA)[i] and the European Vending Association (EVA) collaborated to develop a set of protocols necessary for efficient data handling and processing. [i]One of the outcomes of this effort is DEX data. DEX, which is an acronym for Data EXchange standard, is capable of capturing machine-level cash in/out data, product movement data, and financial audit data. DEX data is designed to assist operators with product replenishment strategies, product mix rotations, and cash management safeguards. In order to optimize contribution margins, while controlling operating expenses, DEX data plays an important role in productivity and profitability analysis. Accompanying the advent of DEX, a Data Transfer Standard (DTS) was devised so that the DEX data could be exported from the machine in a decipherable electronic format. Once the data was transmitted, it could be entered into a vending management software system (VMS) and used in combination with product mappings to evaluate route coverage, cash handling procedures, and sales performance. It is for this reason that the DTS protocol is often considered an integral part of the DEX standard; not a separate element.

More recently, the Multi-Drop Bus (MDB) protocol emerged is an internal communication protocol designed to ensure that coin mechanisms, bill validators, and cashless payment devices could be effectively interfaced to a vending machine controller (VMC) without regard to proprietary manufacturing specifications. MDB, often compared to USB standards used in generic computer component interfacing, replaced prior practices built on supplier-specific design connectivity. An MDB cable (also termed a machine harness) provides the physical connectivity for attaching peripheral devices (e.g. card reader, bill validator, etc.) to the VMC of a vending machine. MDB is credited with initiating the movement toward open system architecture in vending technology. Since vending machine-level data capture involves the retrieval of stored audit information (akin to a snapshot) via local or remote transfer, there is a need to apply data in various ways to produce a comprehensive analysis of transactions. In fact, some telemetry providers actively monitor the MDB bus to detect, in real-time, product movement and operational alerts (e.g. bill jam, change shortage, door open, temperature variance, etc.).

As a result of prior developments, vending machine-level data formatting and content derivation conforms to the European Vending Association-Data Transfer Standard (EVA-DTS) and provides access to system status data, transactional data, and machine configuration information. In a typical data connection, a polling device actively surveys the vending machine for stored data then follows DTS standards for transmission to an external device. Once the data transfer is complete, the received vending machine-level data can be wrapped in a NAMA VDI message format for subsequent distribution to installed vending system servers (see Figure 1).

DEX Data Collection	>	**DEX Data Extraction**	>	**DEX Data Transmission**	>	**NAMA VDI Standard**

Figure 1. Machine Data Transmission to NAMA VDI Application

MDB Standards

A more recently developed vending machine technology standard than DEX is the multi-drop bus (MDB) standard. Vending machines have one master communication channel and it is labeled the vending machine controller (VMC). The role of the VMC is to define the functionality of peripheral equipment (coin changer, bill validator, card reader, etc.) that must be interfaced with the electronic circuitry of the vender to work properly. MDB is the short form of multi-drop bus/internal communication protocol (MDB/ICP). MDB/ICP is an open global standard governing the interface between a vending machine controller and payment system peripheral devices and is maintained by NAMA and the European Vending Association (EVA). The MDB standard defines a serial bus interface for electronically controlled vending machines. It also standardizes vending machines that employ electronic controls so that all vending and peripheral equipment communicate identically.

Basically, MDB defines and performs as the serial bus interface for electronically controlled vending machines. It also standardizes processes for vending machine interoperability and communication among various peripheral components (i.e. coordination and validation of peripheral equipment interactivity). The serial bus, or MDB, is typically configured as a master-slave arrangement enabling a single master the capability of communicating with up to thirty-two peripheral devices. The VMC serves as the system master unit. The purpose of MDB is to ensure that the necessary functionality of any device on the bus (i.e. interfaced peripheral equipment) is compatible with the capabilities of the VMC. Hence, the software employed by both the peripherals and VMC must be compatible, but not necessarily at the same level of capability in order to establish peripheral functionality. Within the MDB standard, the capability of each peripheral device is designated by a classification Level identifier. Levels of peripheral functionality were established in response to the addition of major extension in the capability of add-on devices. Level designations are used to avoid potential conflicts that may arise when a VMC Level and a peripheral Level are incompatible. Should this occur, neither the VMC nor the peripheral will be able to issue or reply to a command not supported by the device.

For example, connecting a Level 2 MDB peripheral device to a Level 1 VMC creates a condition of incompatibility that prohibits the proper functioning of the peripheral device (e.g. payment acceptor). The current level for the MDB standard is referred to as Version 3/Level 3 (first introduced March 2003) that pioneered the incorporation of features associated with cashless transactions. In essence, the VMC must initially determine the Level of a peripheral device in order to determine the command set to communicate with the device. A VMC can only issue commands that are supported by the peripheral. For example, a Level 3 command may only be issued for a Level 3 or higher peripheral and will not work with a command issued for a Level 1 or 2 peripheral. A cashless payment peripheral, for instance, deciphers the Level of a VMC through a setup command designed to establish compatibility and functionality.

A compilation of component Levels indicates varying functionality among installed peripherals. For each classification of peripheral device there are a set of mandatory requirements that equipment developers must adhere to ensure compatibility and Level designation. It is a fundamental principle of the MDB standard that all peripheral devices must be implementable with both backward and forward compatibility relative to a machine VMC. The VMC typically gravitates to the highest common Level among peripheral devices.

MDB Interfaces

MDB/ICP enables the VMC to determine what coins the coin changer, and what bills a bill validator, can accept as payment. Additionally, MDB/ICP establishes the amount of credit available through a payment card reader. Through coordination of components, the VMC is able to manage and direct the coin changer in determining how much change to pay out; bills to recycle, or outstanding credit balance to return to the card. There are additional peripheral devices, beyond coin changers, bill acceptors, and card readers, like paykey and other closed systems, for which the VMC can be configured via an MDB interface. Historically, the manufacturer of components being placed into a vending machine had to manually define technical functionality among machine components. Since each component manufacturer acted independently, a number of proprietary device interfaces emerged. The problem with a proprietary interface is that its uniqueness adds unnecessary costs and complexity to vending machine configuration and operation. The MDB/IPC standard was adopted to establish a communication method that allowed the devices in a vending machine to use a common interface. Despite the fact several devices can tie into the same MDB interface, each will operate independently on the interface. Since each interfaced device is assigned a unique address, the VMC can determine which device is active and communicating.

A majority of vending machines support the MDB/IPC standard and thereby are capable of allowing a vending operator to choose payment and other devices primarily based on reliability, performance, and price. Since the MDB/IPC standard establishes the manner by which each component device communicates with the VMC, the connection to each device tends to be identical. Every device has basically two MDB/IPC connectors to allow it to both connect to the MDB/IPC bus in the machine while providing a linked connection to another device (if needed). This design reduces the number of

MDB connectors needed as well as allowing for additional devices. Hence, adding an additional peripheral device to a vending machine is simplified since the requisite hardware and bus connectors to add the device are already in the machine. The MDB/IPC is an internationally supported interface. Through the cooperative efforts of the National Automatic Merchandising Association (NAMA) in the U.S. and the European Vending Association (EVA) and the European Vending Machine Manufacturers Association (EVMMA) in Europe, the standard was developed with provisions for varying currency acceptance and payment technologies.

MBD and DEX

Technically, the MDB/IPC standard defines a serial master-slave communication bus used by the internal devices in the machine, like the coin acceptor. MDB allows for instantaneous updating of the current status of the machine (i.e. data changes as each product is sold). It is for this reason that the MDB standard is considered a transaction-based mechanism, unlike DEX, which is a cumulative-based reporting system. The MDB protocol allows for the attachment of an audit (DEX) device that, acting as a passive slave, receives information of all events that happened on the machine (e.g. vends, sold outs, coins and bills accepted, etc.). On the other hand, DEX involves the retrieval of stored information (a snapshot) through a serial plug designed for connectivity with a handheld terminal (HHT) or small PC. The connection conforms to the EVA-DTS standard and provides access to status data, testing routines, and machine setup. In a DEX connection, the connected device actively polls the machine for stored information.

Cashless transactions are not dependent on DEX but rely on MDB processes. The fundamental difference between DEX and MDB is that MDB is the only method for a bill acceptor or a coin changer to report credit deposited to authorize a vending transaction. DEX cannot do this. This fact makes it necessary to have MDB installed; DEX, while needed for sales reporting, is not mandatory for the machine to operate. Hence, from a cashless payment perspective, MDB is more useful than DEX since it details the transaction (card number, transaction value, product(s) sold, date, and time) for reconciliation. The results of the transaction will be posted as an MDB record. For operators not employing cashless vending, DEX data is often sufficient to provide necessary information for a vending management system. It is for this reason, some vending operators only use MDB for cashless transactions, and ignore DEX data. For those operators desiring DEX data, a DEX cable can be used to transfer the DEX file along with the cashless MDB data.

DEX is the key to technological advancements in the vending industry worldwide as it enables data capture at the point of purchase. DEX has earned international recognition and support and can be used to facilitate consistent data formatting throughout the vending channel. In the past, machine manufacturers varied in how data exchange transmissions occurred. In response, DEX designers and equipment engineers have established standards governing data recordation, file formatting, and file exportation through common interface linkages. As a consequence, vending machines are manufactured as DEX-enabled and are often labeled “DEX-compliant.” From a sales perspective, DEX provides the vending operator the ability to track brand and/or product preferences at the point of purchase. DEX has been found to improve sales performance, reduce operating expenses, and minimize machine malfunctions. In addition, DEX enables space to sales analysis, for machine-level column allocation optimization, in vending management software. This is an important outcome of a DEX-compliant device. The main benefit of line item tracking is accountability and machine plan-o-gram (i.e. rotating menu of product offering) development.

The fact that vending equipment tends to be strategically placed in disparate locations presents a challenge to efficient replenishment, sales analyses, malfunction notification, and comprehensive audit reporting. Fortunately, machine-level transactional data can be captured through an electronic control board installed within each vending machine. Aggregating machine-level data enables remote review of transactions and inventory without having to have a physical presence at the machine. The fact data can be exported to a remote warehouse, central office, or product fulfillment center extends the opportunity for more thorough, immediate, and frequent analysis. A majority of v-commerce applications are the result of DEX implementation.

In the past, machine manufacturers varied in how data exchanges and transmissions occurred. Recently released DEX software (Edition 6 and higher) tightens the specifications of the protocol to prevent possible misinterpretations in accountability or brand identification. Since there has been a proliferation of diverse vending products, and several variations in the packaging of the same product, the DEX standard has been refined to acknowledge and differentiate between product offerings. While not all vending operators demand identical informational output, vending machine circuit boards are built to possess similar data collection capabilities to ensure the delivery of consistent content. For example, three data elements referenced in the DEX standard are: 1) number of bills held in the bill stacker, 2) quantity and denomination of coins stored in the coin box, and 3) number of vends or products sold.

A DEX-compliant machine relies upon DEX architecture to enable vending machine polling. The vending machine exports its unique identification number and stored data to an external system for analysis and processing. An optional element of this data stream is the machine's service history, including the last date the machine was serviced. Once DEX data is exchanged with a vending management system various transaction audits can be performed. Since captured data is not accessible or editable prior to interfacing to an auxiliary system, cash accountability will be accurate and complete. Also, the ability to track product information at the machine-level enhances productivity, as machine fulfillment is improved and manual data entry eliminated. The DEX protocol enables different makes and models of vending machines to communicate in a consistent manner. DEX data sets include sales mix, cash collection, product movement, and malfunction alerts. Additionally, DEX specifications may soon include a standard for reporting error codes for payment validation, dispensing jams, and other operational problems. Proposed specifications are pending approval.

Since vending machines have an average life of ten years, it may take a generation of new machine installations to fully realize the DEX potential. Basically, DEX provides an indisputable, auditable accounting method for cash collections, units sold, and product price recordation that capable of enhancing route efficiency and improving warehouse operations. For example, how much cash should be in a machine at the close of a sales period? A route driver, unable to view the DEX electronic record, will have cash collections compared against the machine-level electronic record. Balancing cash against collections provides management with a unique level of information and control.

DEX Polling

NAMA and the European Vending Association (EVA) have jointly adopted a communication protocol for the electronic retrieval of machine-level information via data polling. As a consequence, vending machines are now manufactured as DEX-enabled. Each vending machine is given a unique identifying number by which the DEX data extracted is labeled. During a polling session, this unique number and the date and time that the service occurred, are transmitted to the polling device. DEX data is polled an audit can be performed. Since captured data is not accessible or editable by the route driver, cash accountability is assumed accurate and complete. Also, the ability to track product information at the machine level enhances productivity as route time is improved and manual data entry is eliminated. DEX specifies a data format to enable all different types of machines and machine models to communicate electronically in a similar manner. The DEX information available includes: sales, cash collections, product movement and other vending machine activities. Additionally, the DEX specification contains a standard for reporting error codes for payment validation, jams, and other operational problems. Line item tracking is important to both accountability and assistance in future machine menu development. DEX data retrieval can be accomplished via three distinct polling modes: 1-local polling, 2-dial-up polling or 3-wireless polling.

Local Polling – local polling incorporates a hand-held device (or pocket probe) designed to plug connect to a vending machine's DEX-port or to communicate through an IR port. Once the connection is established, the device is used to extract (upload) transactional data from the machine to the handheld device. A typically DEX data upload takes approximately five seconds. Field collected data can be transferred from the handheld device to a central office computer (downloaded) for processing, analysis, and report generation.

Dial-up Polling – dial-up polling involves use of a modem and telephone line. Once a valid connection is established, DEX data can be transported to a remote office or warehouse location for evaluation over an Internet or virtual private network (VPN) connection. This design enables the machine to be remotely monitored with respect to cash, inventory, and machine malfunctions.

Wireless Polling – similar to dial-up polling, wireless polling enables remote access to DEX data via a cellular network. Wireless polling however relies upon cellular network connectivity to establish the proper linkage. The advancement of wireless technology has emerged as an attractive alternative. Wireless applications possess tremendous potential for the vending industry, an industry that desires mobility, flexibility, and reliability in enterprise-wide operations. Vending practitioners dissatisfied with the constraints and complexities of hard wiring are migrating to the convenience of design portability and user mobility that wireless technology solutions provide.

Common network connectivity options include both the Internet and virtual private networks (VPN). Cellular connectivity presents challenges based on the architectural structure surrounding the vending equipment combined with strength of signal requirements. While connectivity to a VPN tends to be more direct and less susceptible to structural infringements, it is likely to be more costly. Historically, vending operators have benefiting from such devices as hand-held terminals, personal digital assistants, smart paging units, global positioning systems, telecommunication links (telemetry), proximity transponders, and related applications.

VDI Standards

The purpose of the NAMA VDI standard is to establish transparent, non-proprietary interfaces that enable transportation of data among the main components of a vending system (e.g. vending machine, telemetry system, cashless payment system, specialty applications, and vending management software). The non-proprietary nature of NAMA VDI renders it an open standard. NAMA VDI relies on messaging standards to satisfy data interchange needs and is not concerned with the entity transmitting or receiving such messages. For example, a messaging standard governing the transmission of machine-level DEX data may originate from the vending machine, an advanced telemetry device, or the file server of another entity. NAMA VDI mandates that the message format conform to the technical specifications of the standard, regardless of the entity creating the message.

VDI Messaging

The NAMA VDI Task Force has identified the following seven elements as important to vending data messaging (interchangeable/exchangeable data files):

1- DEX data messaging – sent or requested captured DEX data file
2- Alert data messaging – may originate from the VMC, DEX, or MDB depending on telemetry provider.
3- Device Status -- device configuration and/or service request
4- Device Configuration – sent device configuration and/or status reporting
5- Security Authorization – defines cooperative agreement partners
6- Machine Message – reconfigures machine to EVA standards
7- Device Messaging - provides confirmation of download instructions

Cooperative Relationships

The NAMA VDI standard incorporates 'cooperative agreements' among competing vending technology suppliers so that interchanged data will be more meaningfully consumed and effectively applied. Cooperative agreements, often referred to as trading partner agreements, involve written documentation that informs both sender (producer) and receiver (consumer) of NAMA VDI messages the specifics of the message(s) being shared. Descriptive elements include such items as: company profile, security authorization, machine identification, location identification, and type of connectivity (server, web-service, email, etc.). For example, if Provider X is to pass a NAMA VDI data message to Provider Y then the cooperating parties must have transaction information to successfully distribute and utilize the desired data messages. User names, passwords, and web-based SSL encryption also can be used to help insure data transfers are secure and accessible by authorized entities.

Early Adopters

Seven major vending technology providers volunteered to implement and fine tune the VDI standards prior to release of Version 1.0. Cantaloupe Systems, CompuVend, Crane Merchandising, InOne Technology, MEI Group, USA Technologies, and Validata worked cooperatively to field test and validate VDI specifications and procedures. This is similar to the replacement of specialized railroad car connectors with non-specialized couplers that enable assembly of cars in any order or sequence (see Figure 2).

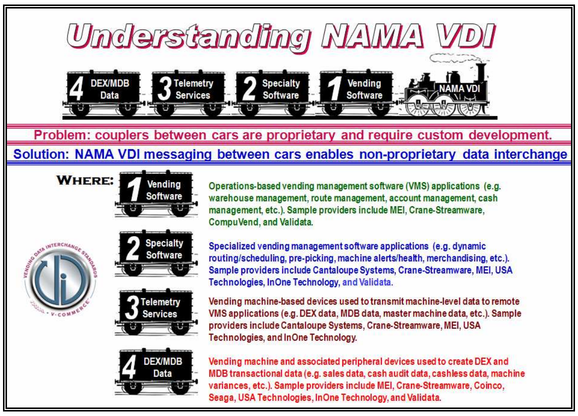

Figure 2. Understanding NAMA VDI Standards

The NAMA VDI standards are being released beginning in first quarter 2010 and are planned to have additional features added and released in sequential stages as developments are completed. Release

1.0 addresses the most critical area among data transactions: DEX messaging. It is anticipated that as the remaining data messages are developed, they will be released and labeled in ascending numerical order (e.g. Release 1.1, 1.2, and so forth).

VDI Benefits

The NAMA VDI standards afford several direct benefits to operators and bottlers, especially those embarking on technology decisions. When purchasing vending technology from a company adhering to NAMA VDI standards, the buyer can be assured that:

1. investment in the compliant technology will be compatible across major suppliers
2. there is no longer a need to rely on the success of a single supplier
3. multiple telemetry devices will work with a variety of VMS providers
4. selling or acquiring VDI compatible components simplifies continued operations

See Figure Three for an illustration of the NAMA VDI standards as applied to data for processing by a vending management software (VMS) program as well as transactional data for processing via a cashless gateway.

SUMMARY

Major vending technology providers participating in NAMA VDI development have created a tipping point for accelerating the implementation of vending technology. Increased interest in addressing operator concerns has resulted in an unprecedented cooperation among vending technology suppliers to enable harmonic data interchange. NAMA VDI ensures that operators can feel confident in technology investment, choice of suppliers, and be assured that hardware and software will work together now and in the future. There has never been a better or safer time to invest in cashless vending, remote machine monitoring, or VMS technology.

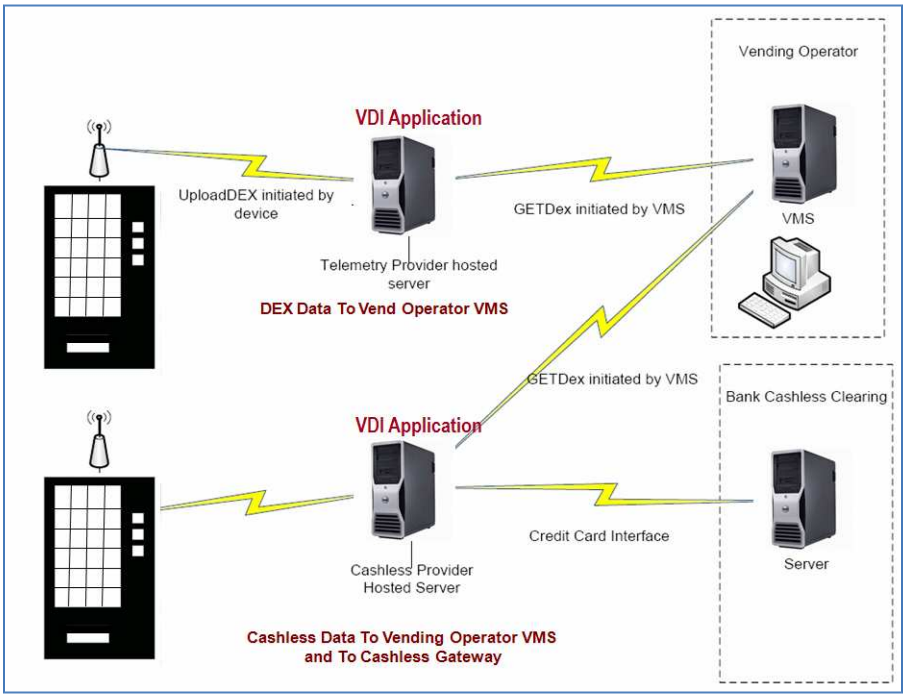

Figure 3. DEX Data transported via telemetry to multiple provider servers reporting into a VMS

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