VA HEALTH CARE | Defining EXCELLENCE in the 21st Century

VISTA Data Project

A Metadata-Centric Approach to Web-scale integration

April 26, 2016
Health Information Technology/Informatics Steering Committee
Defense Health Agency, U.S. Department of Defense
Fairfax, VA

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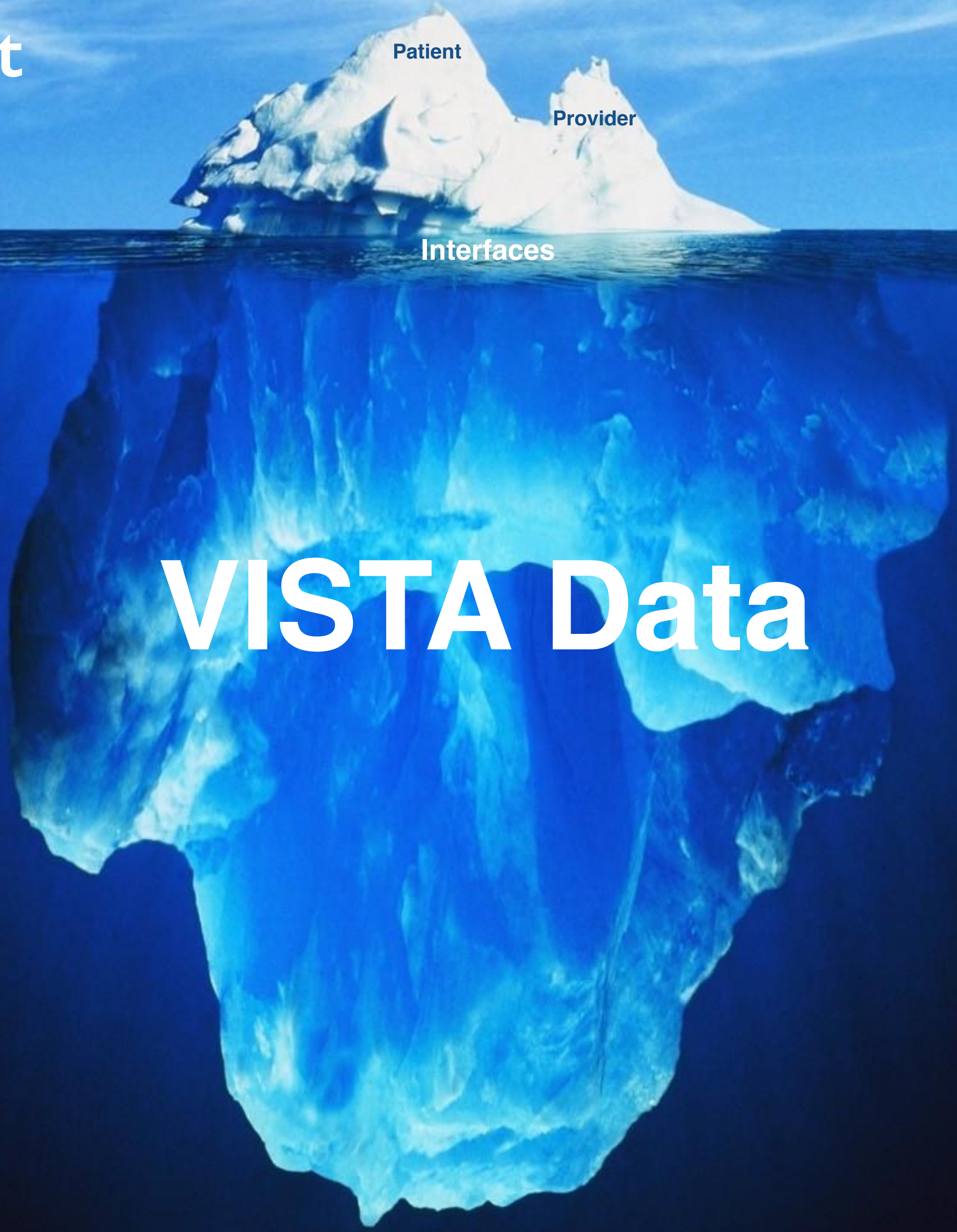
VISTA Data Project

Web-scale interfacing for VA's VISTA Data.

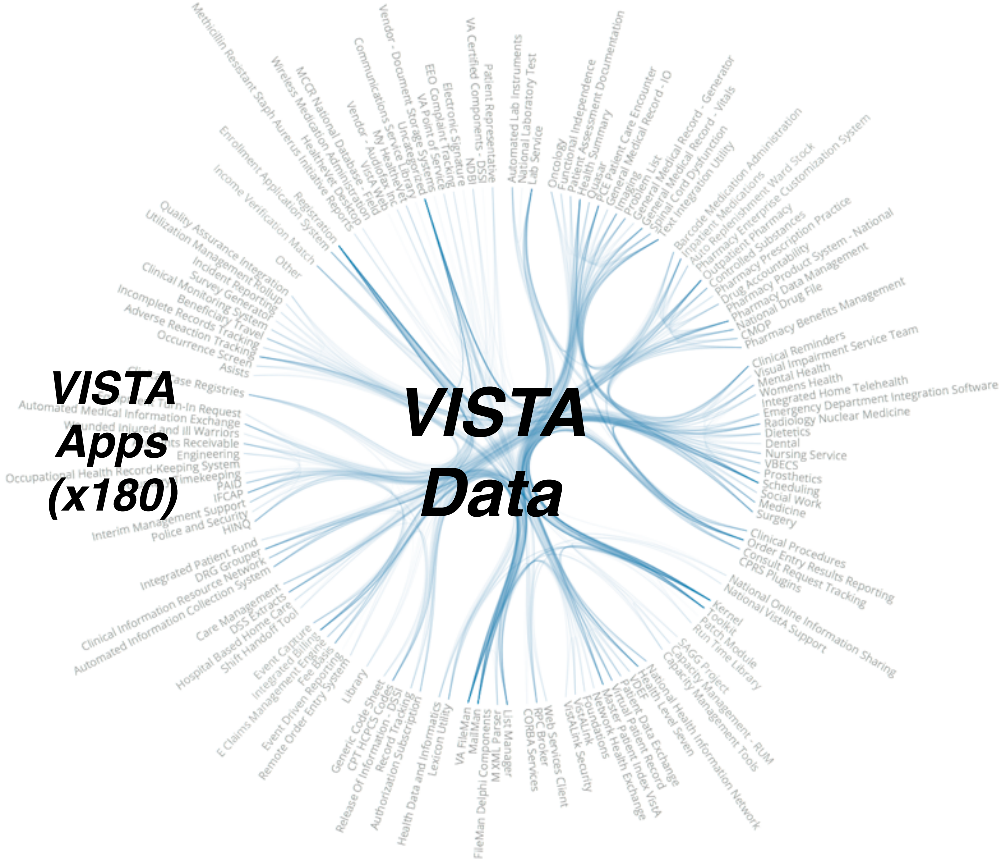


35 years of VA's institutional know-how and data comprising hundreds of billions of clinical facts *- and continuing to grow by over a million new lab tests, radiographs, and documents each day - hidden from patients and providers under a sea of interfacing code.*

VISTA Internal Integration

Fully integrated by design.

All Apps.
All Data.
Integrated.
Real-time.



VISTA Apps (x180)

VISTA Data

Methicillin Resistant Staph Aurerus Initiative Reports
Wireless Medication Administration
MCCR National Database - Field
HealtheVet Desktop
Vendor - Audiofax Inc
VistA Web
My HealtheVet
Communications Service Library
Vendor - Document Storage Systems
Uncategorized
VA Point of Service
EEO Complaint Tracking
Electronic Signature
NDBI
VA Certified Components - DSSI
Patient Representative
Automated Lab Instruments
National Laboratory Test
Lab Service
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Functional Independence
Patient Assessment Documentation
Health Summary
Quasar
PCE Patient Care Encounter
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General Medical Record - Vitals
Spinal Cord Dysfunction
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Barcode Medication Administration
Inpatient Medications
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Pharmacy Enterprise Customization System
Outpatient Pharmacy
Controlled Substances
Pharmacy Prescription Practice
Drug Accountability
Pharmacy Product System - National
Pharmacy Data Management
National Drug File
CMOP
Pharmacy Benefits Management
Clinical Reminders
Visual Impairment Service Team
Mental Health
Womens Health
Integrated Home Telehealth
Emergency Department Integration Software
Radiology Nuclear Medicine
Dietetics
Dental
Nursing Service
VBECS
Prosthetics
Scheduling
Social Work
Medicine
Surgery
Clinical Procedures
Order Entry Results Reporting
Consult Request Tracking
CPRS Plugins
National Online Information Sharing
National VistA Support
Kernel
Toolkit
Patch Module
Run Time Library
SAGG Project
Capacity Management - RUM
Capacity Management Tools
National Health Information Network
Health Level Seven
VDEF
Patient Data Exchange
Virtual Patient Record
Master Patient Index VistA
Network Health Exchange
Foundations
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VistALink Security
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CORBA Services
List Manager
M XML Parser
FileMan Delphi Components
MailMan
VA FileMan
Lexicon Utility
Health Data and Informatics
Authorization Subscription
Record Tracking
Release Of Information - DSSI
CPT HCPCS Codes
Generic Code Sheet
Library
Remote Order Entry System
Event Driven Reporting
Fee Basis
E Claims Management Engine
Integrated Billing
Event Capture
Shift Handoff Tool
Hospital Based Home Care
DSS Extracts
Care Management
Automated Information Collection System
Clinical Information Resource Network
DRG Grouper
Integrated Patient Fund
HINQ
Police and Security
Interim Management Support
IFCAP
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Voluntary Timekeeping
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Wounded Injured and Ill Warriors
Automated Medical Information Exchange
Equipment Turn-In Request
Clinical Case Registries
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Occurrence Screen
Adverse Reaction Tracking
Incomplete Records Tracking
Beneficiary Travel
Clinical Monitoring System
Survey Generator
Incident Reporting
Utilization Management Rollup
Quality Assurance Integration
Other
Income Verification Match
Enrollment Application System
Registration

Comprehensive Patient-Centric Integrated EHR

The data architecture of VISTA consists of 180+ modules for clinical care and administrative functions integrated within a single, shared, integrated database.

VISTA applications (outer ring) all share the same, single, authoritative data (inner circle). All data between applications is integrated within this single multidimensional database (connecting lines).

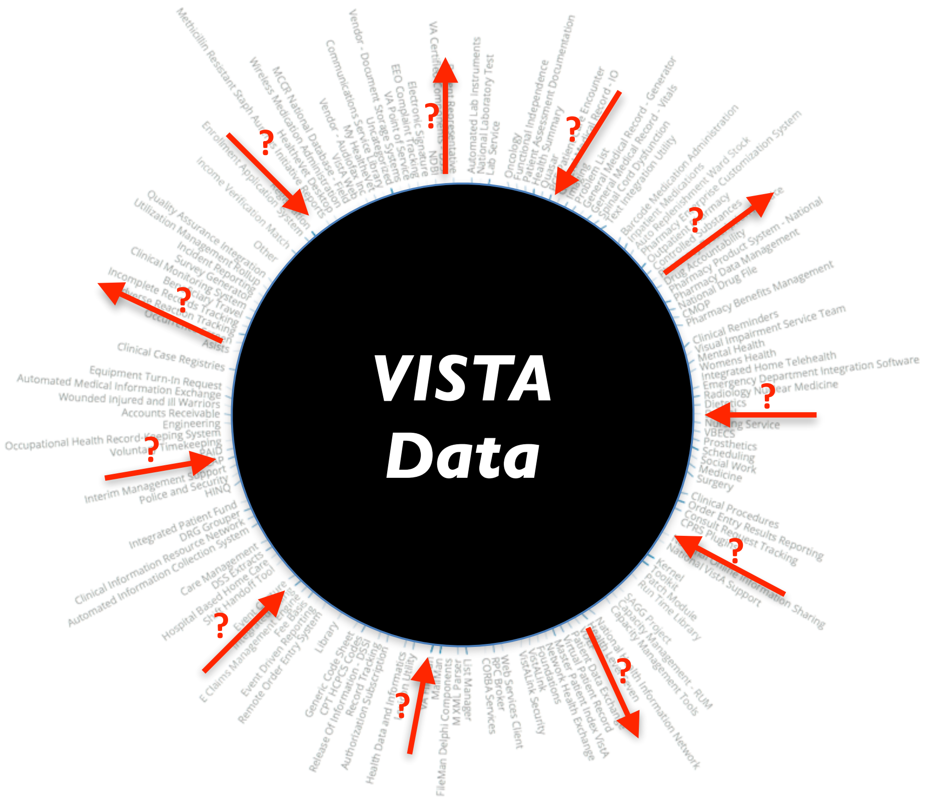
Caveat: Data remains integrated only so long as it remains within to the VISTA/ M environment.

RM Richards MD MS 2016-04-26

VISTA External Interfacing

Code-centric Interfacing

Opaque. Brittle. Inconsistent. Insecure.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Code-centric interfacing manages VISTA as a "Black Box"

Code-centric interfacing has no logical connection to the internal structures, context, or definition of the data within VISTA. Rather, the code obfuscates the native data model and structures by encapsulation.

As a result, code-centric interfacing lacks any uniform method to comprehensively or securely interface to VISTA data. There are infinite permutations of hard-coded interfaces possible.

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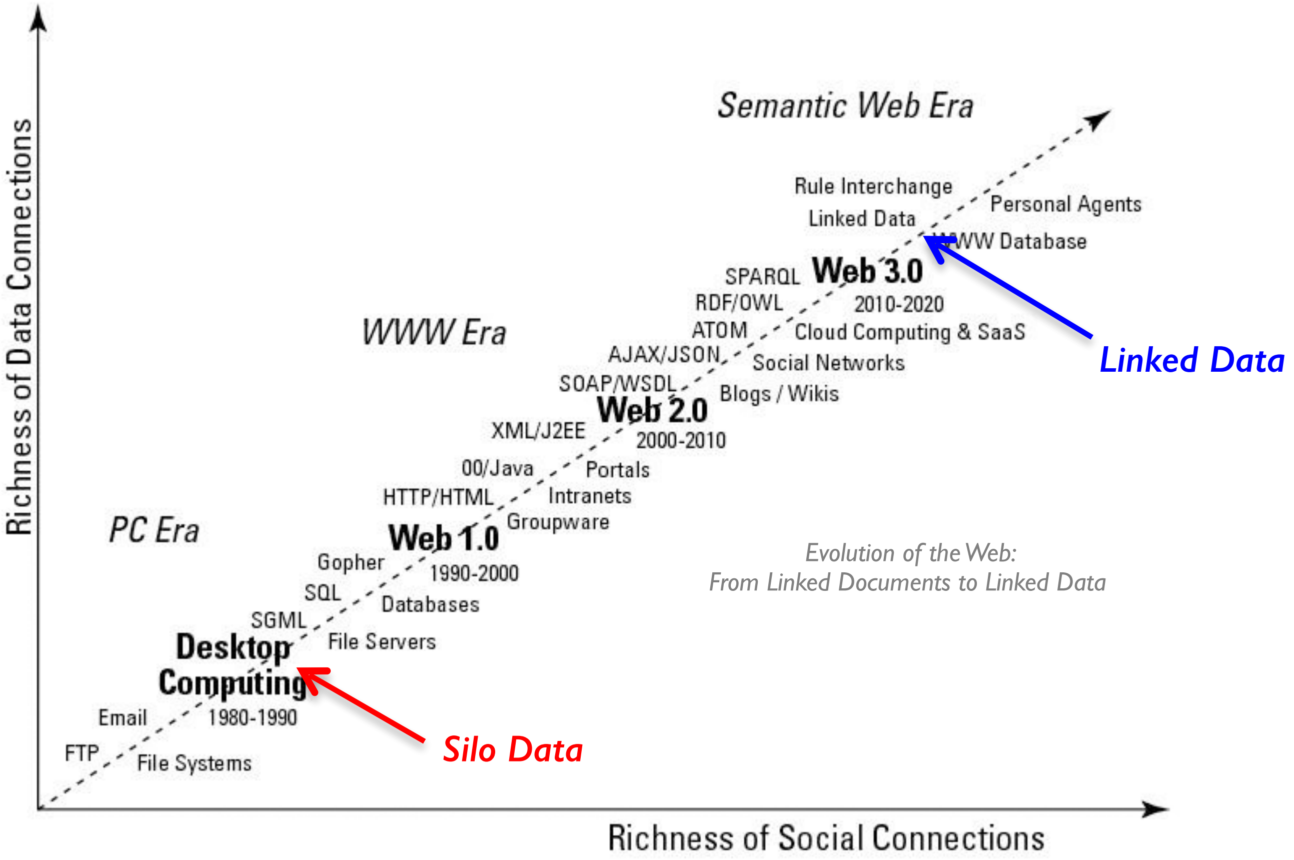
Evolution of Data: Increased Connectivity

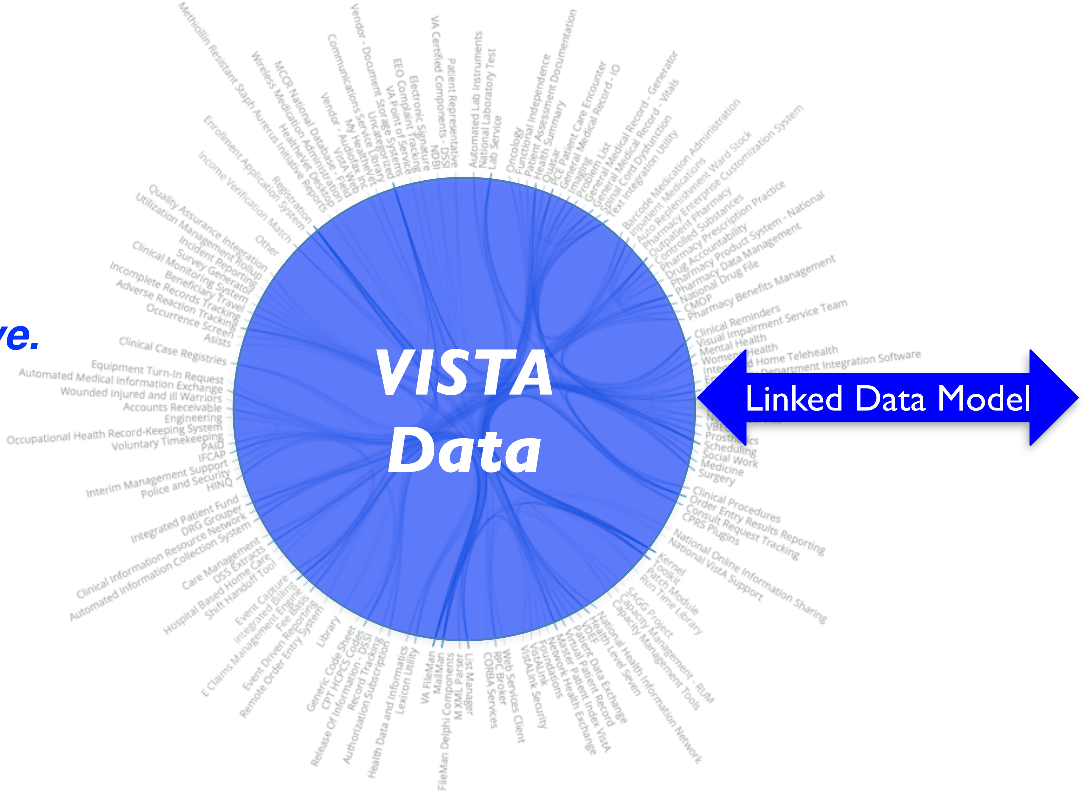


VA adopted and deployed VISTA nationwide in 1981 as its national health information system, before the advent of the Internet. In the pre-internet era (PC Era) databases ran on internal ad-hoc Intranets (Silo Data, red arrow). After the invention of the Internet Protocol in 1982, web technologies rapidly evolved over the past three decades (WWW Era). By adopting the WWW Data model to represent VISTA's native data model (Linked VISTA) - this would allow web-standard, web-scale semantic integration and interfacing of VISTA data across the enterprise and across the Internet.

VISTA External Interfacing

Model-centric Interfacing

Comprehensive.
Transparent.
Standard.
Secure.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Model-centric interfacing makes __all__ VISTA data accessible.

The web-standard Linked Data model logically connects to all data and structures internal to VISTA, allowing secure read-write external to VISTA with one web-standard mechanism.

Representing VISTA's internal data model as Linked Data Model model enables web-scale external interfacing and integration.

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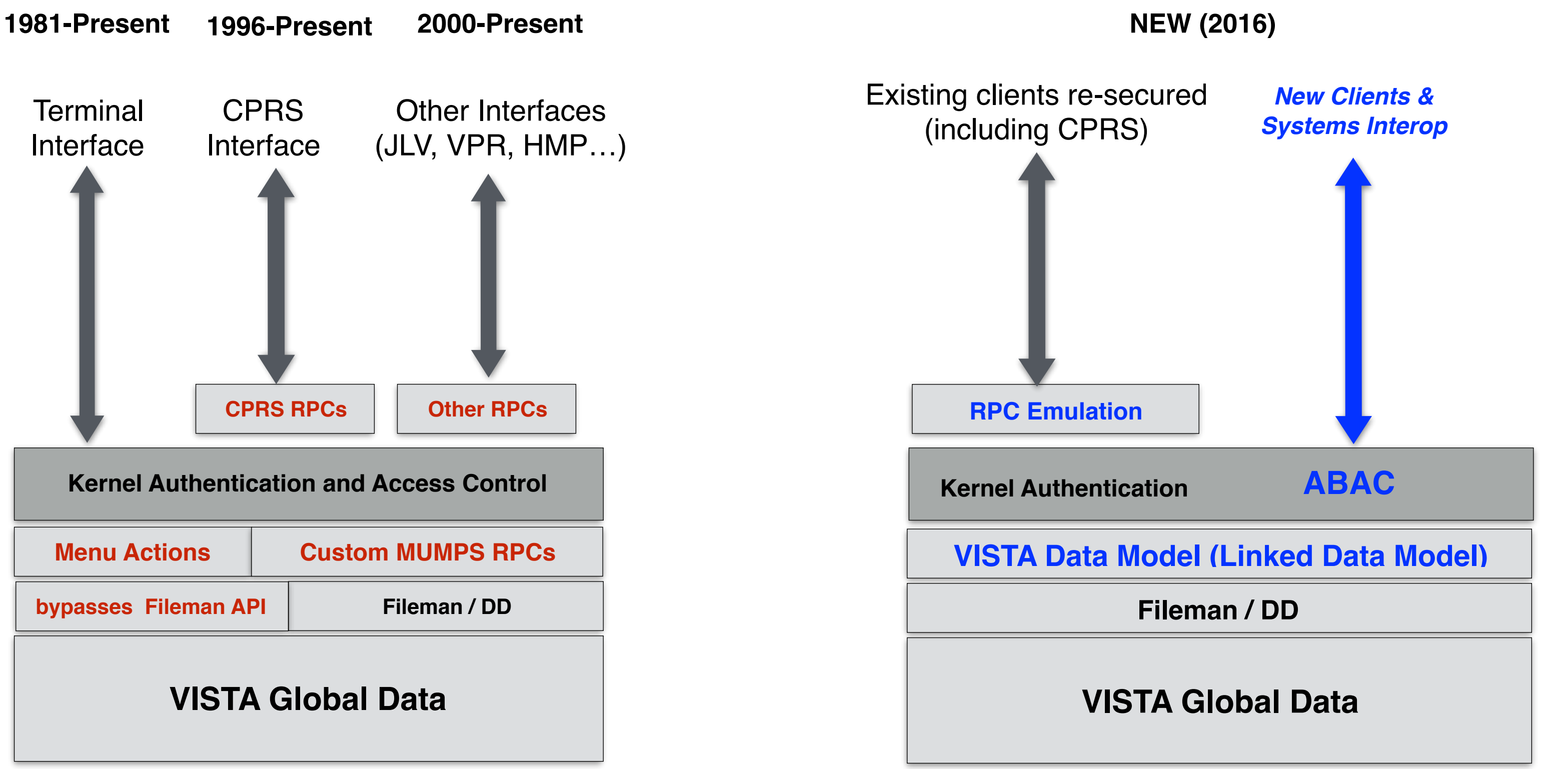
VISTA Interfacing Evolution

Code-based Interfaces (x 3500, unique)

Model-based Interface (x1, standard)



1981-Present

1996-Present

2000-Present

Terminal Interface

CPRS Interface

Other Interfaces (JLV, VPR, HMP…)

CPRS RPCs

Other RPCs

Kernel Authentication and Access Control

Menu Actions

Custom MUMPS RPCs

bypasses Fileman API

Fileman / DD

VISTA Global Data

NEW (2016)

Existing clients re-secured (including CPRS)

New Clients & Systems Interop

RPC Emulation

Kernel Authentication

ABAC

VISTA Data Model (Linked Data Model)

Fileman / DD

VISTA Global Data

Current external interfacing to VISTA is exclusively through MUMPS-based RPCs. These are hard-coded in MUMPS code for specific clients only and not interchangeable to other clients due to embedded business logic within the custom MUMPS and client code. Security for all RPCs is based on the Terminal (roll-and-scroll) interface and its Menu Actions. This is a terminal-only legacy security mechanism, and not applicable to external, Web-, or GUI-based interfaces.

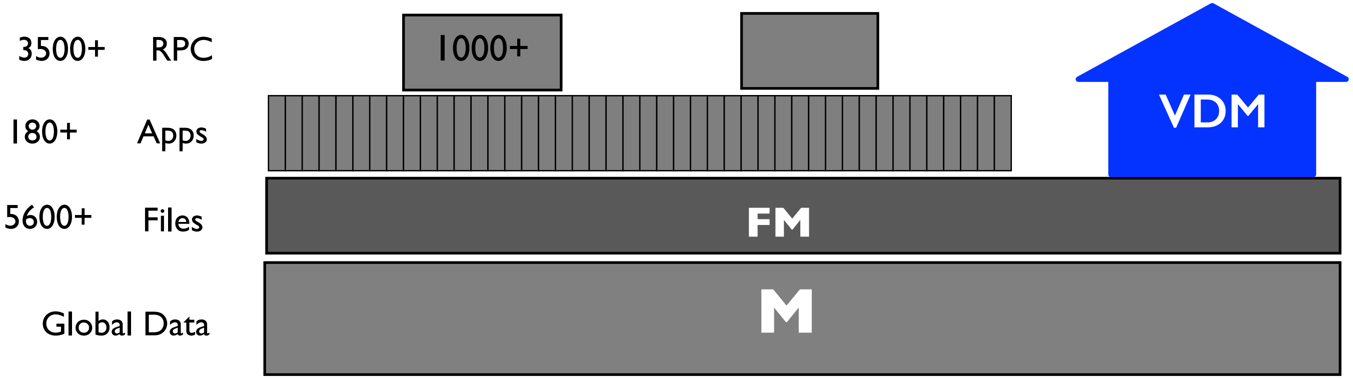
Many of the 3500 RPCs bypass the Fileman API and Data Dictionary, writing direct to MUMPS global storage. Bypassing the FM API means that Fileman security and auditing measures are bypassed, creating a significant security gap. In addition, this makes the data inaccessible to any other applications or by any other method other than by writing yet more custom MUMPS RPCs (The read and write RPCs are completely distinct from each other). The only means to access or interface to new data is to write new MUMPS RPCs using the Terminal-based Actions-centric security, in addition to custom RPC MUMPS security code.

All external interfaces and functionality are Model-driven, language-agnostic, client-agnostic, Fileman API compliant, and secured with both existing Kernel authentication, in addition to new modern, industry-standard, patient-centric, attribute-based access control (ABAC).

All interfacing is through a single, secure, symmetric read-write Master VISTA Data Model using modern, web-standard languages and tools. The read data model is identical to the write data model, making client access simpler. Secure access to all VISTA data is through an ABAC security-enhanced Master VISTA Data Model (MVDM).

VISTA Interfacing Evolution

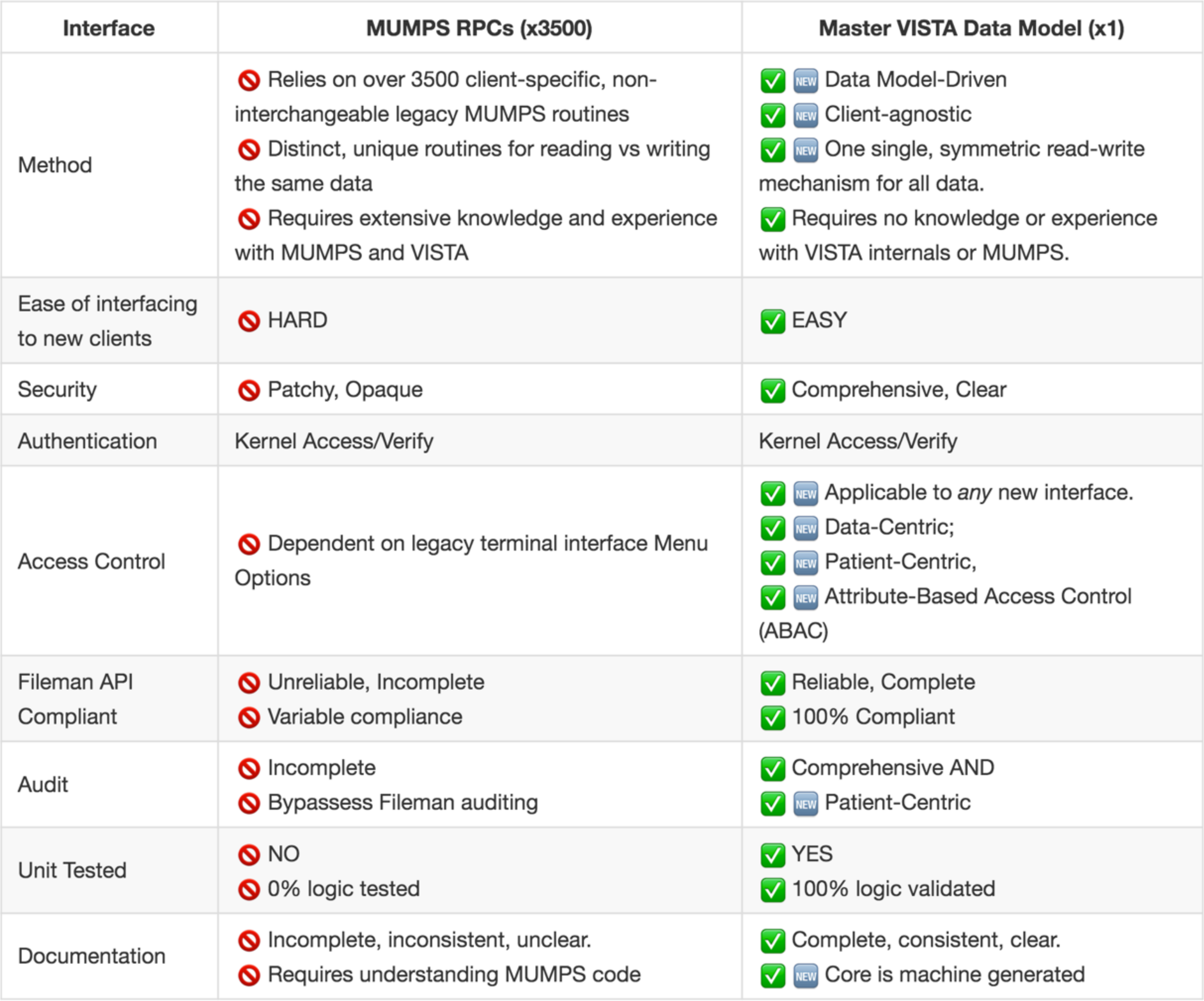
	CPRS	**JLV**	**VDM**
View	Delphi	HTML	HTML
Controller	Delphi	Java	Javascript
Model	Undefined	Undefined	**Full VISTA Model**
Read/Write	Asymmetric	Read-only	Symmetric
Format	proprietary	proprietary	JSON-LD
Method	MUMPS code	MUMPS code	Query
VISTA Data	Fixed slices	Fixed slices	Full, flexible, granular



VISTA Data Model (VDM) can access all data spanning 180+ applications with full granularity and definition because the fully exposed VISTA Data model logically bridges all applications through their native data dictionaries. No legacy APIs, HL7, RPCs, or MUMPS code. Just data. All of it. Defined. Structured. Secure.

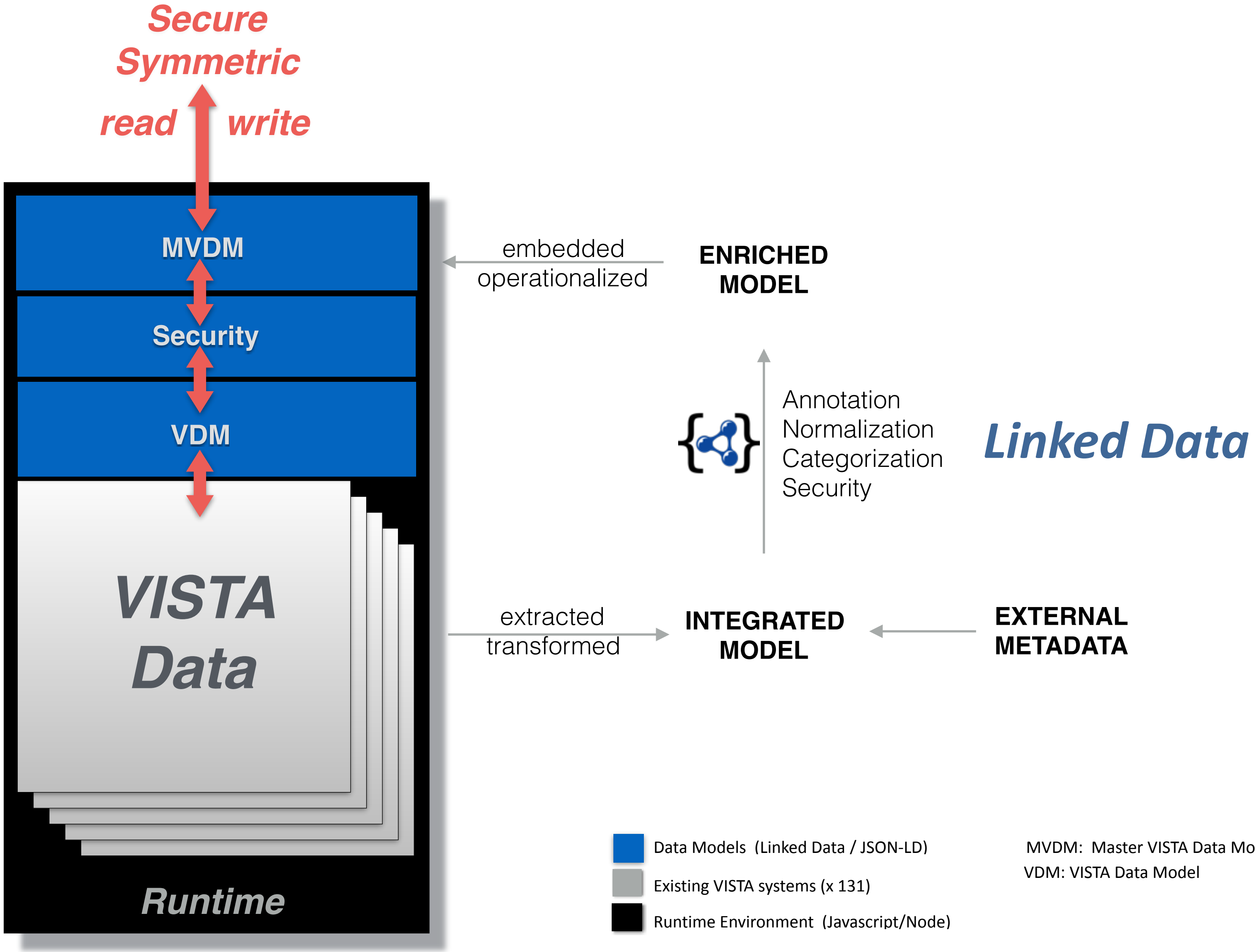
RM Richards MD MS 2015-02-23

VISTA Interfacing Evolution



Interface	MUMPS RPCs (x3500)	Master VISTA Data Model (x1)
Method	🚫 Relies on over 3500 client-specific, non-interchangeable legacy MUMPS routines 🚫 Distinct, unique routines for reading vs writing the same data 🚫 Requires extensive knowledge and experience with MUMPS and VISTA	✅ 🆕 Data Model-Driven ✅ 🆕 Client-agnostic ✅ 🆕 One single, symmetric read-write mechanism for all data. ✅ Requires no knowledge or experience with VISTA internals or MUMPS.
Ease of interfacing to new clients	🚫 HARD	✅ EASY
Security	🚫 Patchy, Opaque	✅ Comprehensive, Clear
Authentication	Kernel Access/Verify	Kernel Access/Verify
Access Control	🚫 Dependent on legacy terminal interface Menu Options	✅ 🆕 Applicable to *any* new interface. ✅ 🆕 Data-Centric; ✅ 🆕 Patient-Centric, ✅ 🆕 Attribute-Based Access Control (ABAC)
Fileman API Compliant	🚫 Unreliable, Incomplete 🚫 Variable compliance	✅ Reliable, Complete ✅ 100% Compliant
Audit	🚫 Incomplete 🚫 Bypassess Fileman auditing	✅ Comprehensive AND ✅ 🆕 Patient-Centric
Unit Tested	🚫 NO 🚫 0% logic tested	✅ YES ✅ 100% logic validated
Documentation	🚫 Incomplete, inconsistent, unclear. 🚫 Requires understanding MUMPS code	✅ Complete, consistent, clear. ✅ 🆕 Core is machine generated

VISTA Data Model Development



Secure Symmetric

read write

MVDM

Security

VDM

VISTA Data

Runtime

embedded operationalized

ENRICHED MODEL

Annotation
Normalization
Categorization
Security

Linked Data

extracted transformed

INTEGRATED MODEL

EXTERNAL METADATA

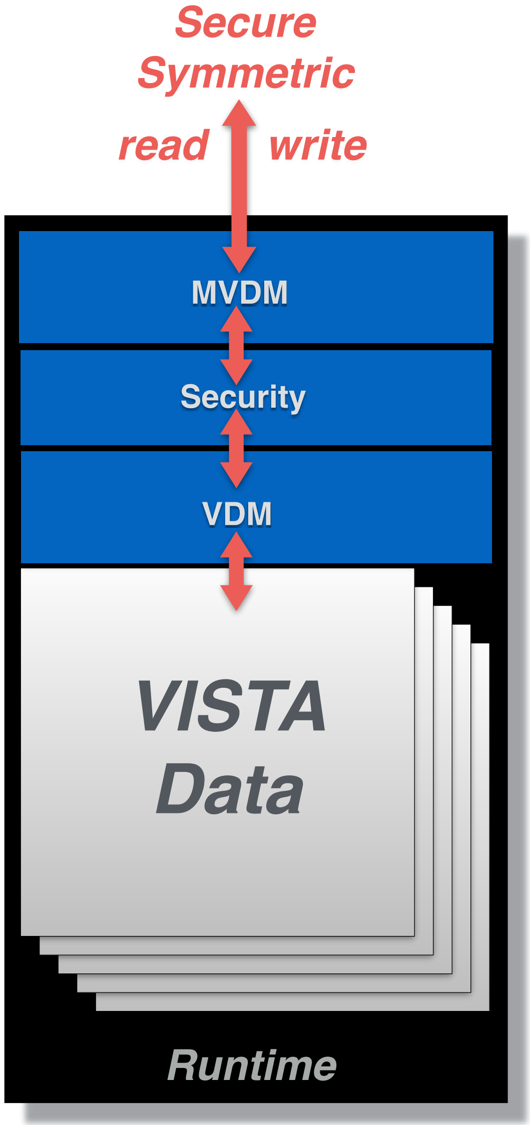
🟦 Data Models (Linked Data / JSON-LD)

⬜ Existing VISTA systems (x 131)

⬛ Runtime Environment (Javascript/Node)

MVDM: Master VISTA Data Model
VDM: VISTA Data Model

VISTA Data Model Detail



Linked Data Model

- Industry-standard machine-processable web data model
- Uses schema-backed JSON with Linked Data extensions (JSON-LD)
- All VISTA data models are expressed, processed, and enriched as JSON-LD.

Master VISTA Data Model (MVDM) (x1)

- A subset of VDM that is normalized across all VDMs
- Incorporates all functionality of the Security Model
- Incorporates all functionality of the VDM
- Supports remote secure read-write across all VISTA instances
- Supports Master Data Management across all VISTA instances for any specified data category

Security Model (x1)

- Provides data-centric logical security model for all VA VISTA data.
- Provides data-centric security based on data attributes and categories
- Specifically provides “on-the-data” granular patient-centric data security.

VISTA Data Model (VDM) (x131)

- Represents the full native operational data model of any local VISTA
- Enables comprehensive access to all VISTA data (all 65,000+ data fields)
- Is enriched by additional metadata and logic to support write back
- Provides native symmetric read-write to any local VISTA
- Eliminates need to know anything about VISTA code or internals

⬜ **VISTA Systems** (x131)

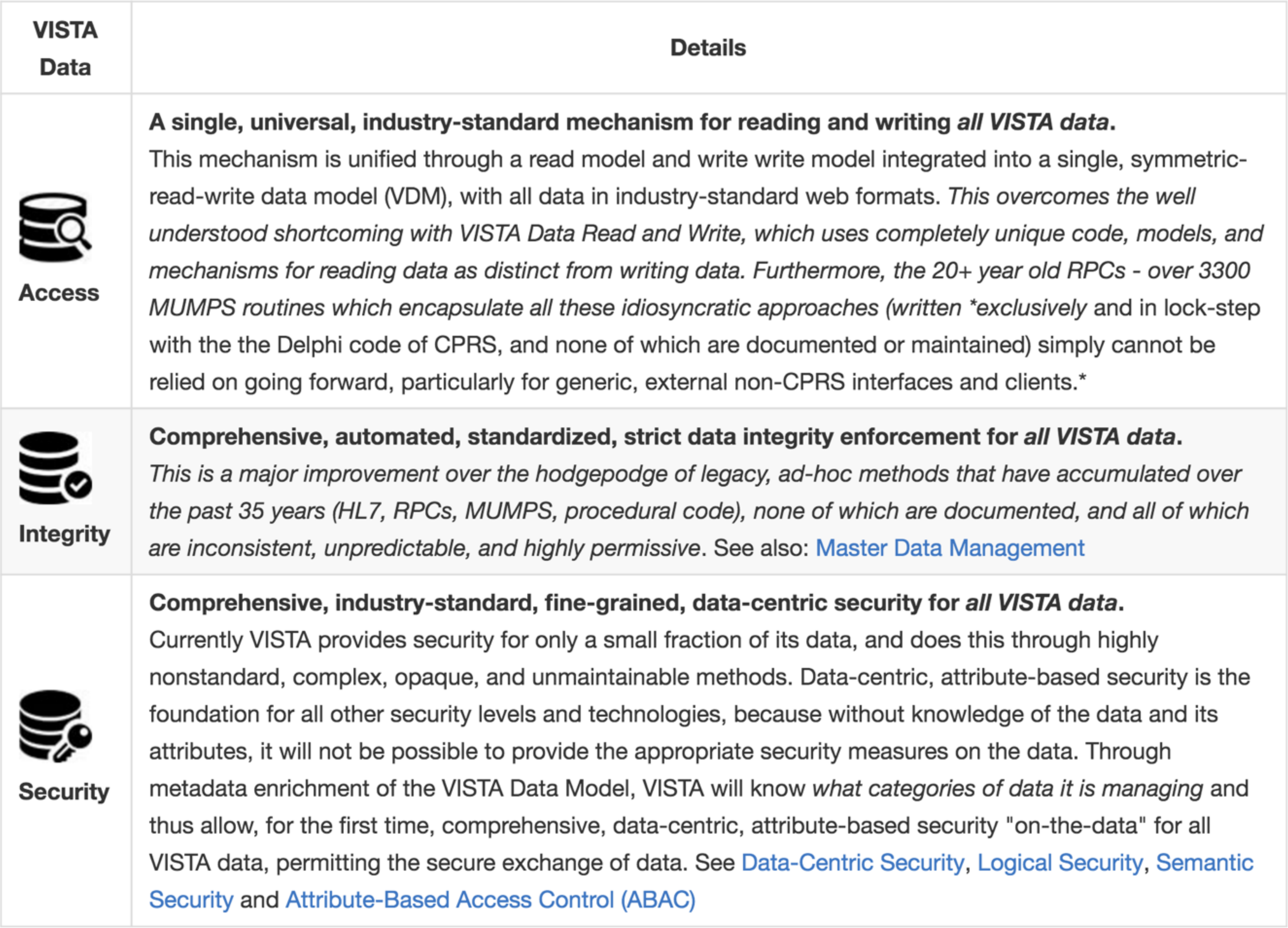
- Each contains over 35 years of VA clinical and institutional data

⬛ **Runtime Environment** (Javascript / Node)

- Industry-standard Node.js server-side runtime environment
- All data models and data transformation run in-process, server-side
- All read-write transactions run in-process, server side

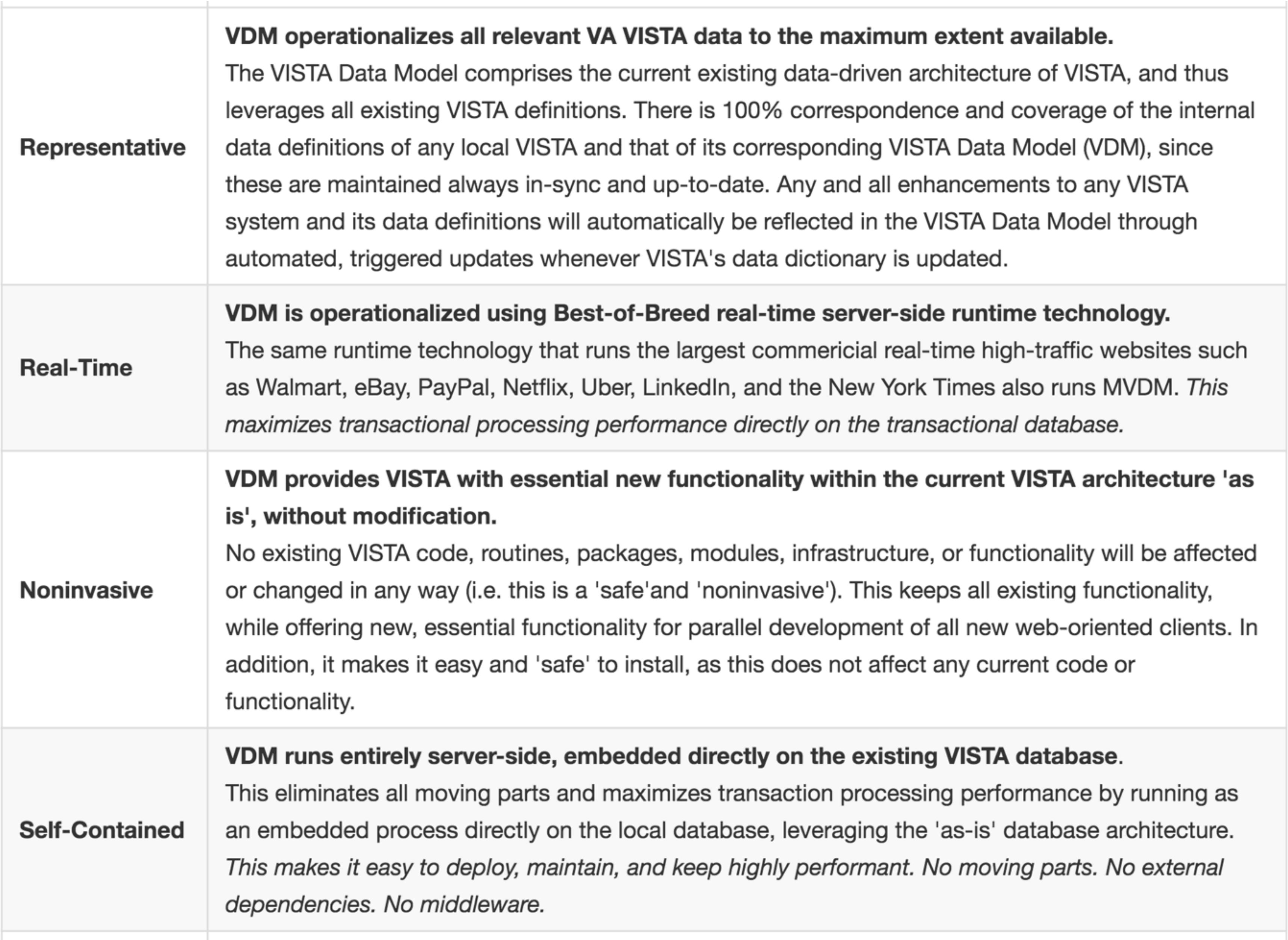
🟦 **Data Models** (Linked Data / JSON-LD)

VISTA Data Model Features



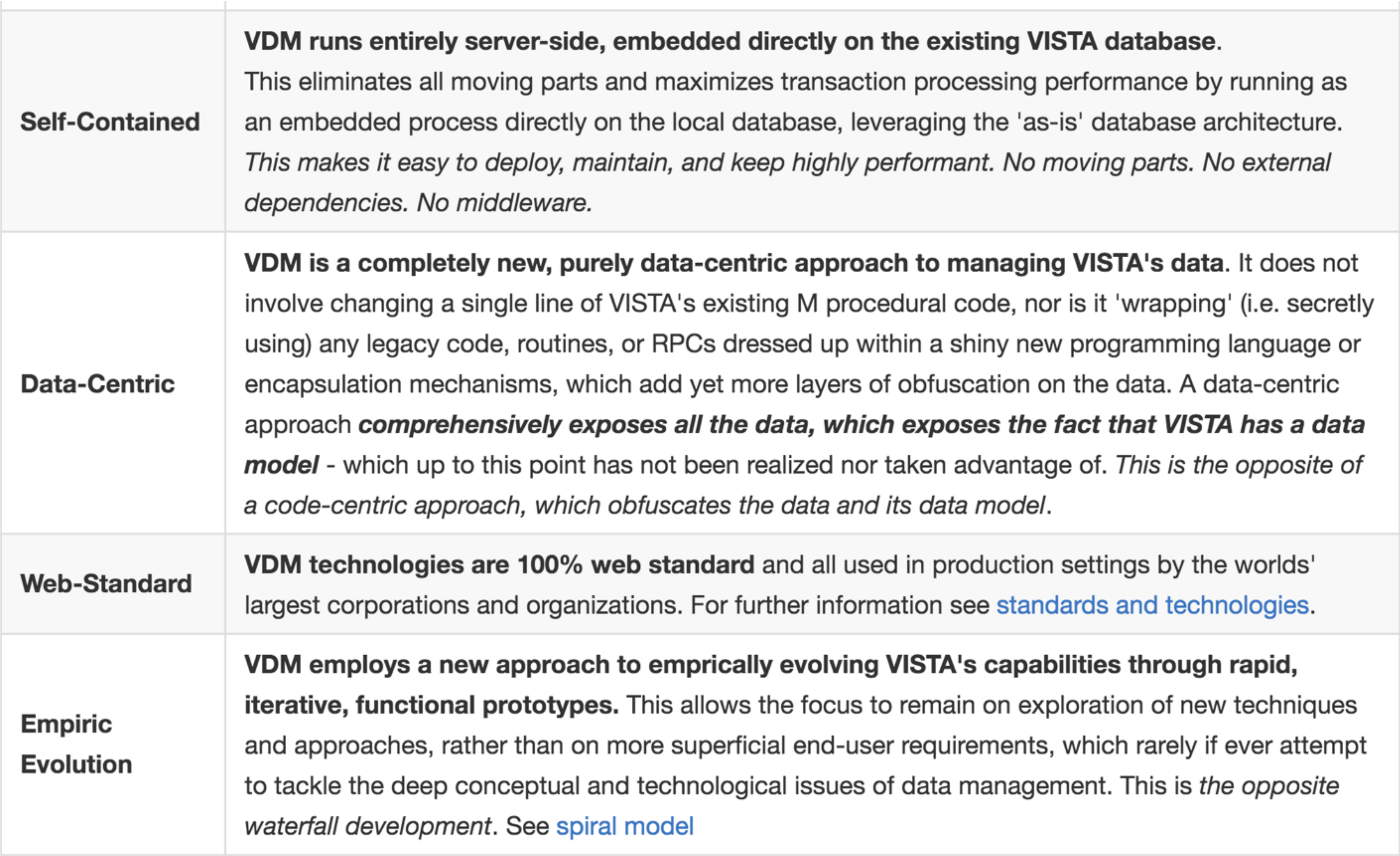
VISTA Data	Details
Access	**A single, universal, industry-standard mechanism for reading and writing *all VISTA data*.** This mechanism is unified through a read model and write write model integrated into a single, symmetric-read-write data model (VDM), with all data in industry-standard web formats. *This overcomes the well understood shortcoming with VISTA Data Read and Write, which uses completely unique code, models, and mechanisms for reading data as distinct from writing data. Furthermore, the 20+ year old RPCs - over 3300 MUMPS routines which encapsulate all these idiosyncratic approaches (written *exclusively* and in lock-step with the the Delphi code of CPRS, and none of which are documented or maintained) simply cannot be relied on going forward, particularly for generic, external non-CPRS interfaces and clients.*
Integrity	**Comprehensive, automated, standardized, strict data integrity enforcement for *all VISTA data*.** *This is a major improvement over the hodgepodge of legacy, ad-hoc methods that have accumulated over the past 35 years (HL7, RPCs, MUMPS, procedural code), none of which are documented, and all of which are inconsistent, unpredictable, and highly permissive*. See also: Master Data Management
Security	**Comprehensive, industry-standard, fine-grained, data-centric security for *all VISTA data*.** Currently VISTA provides security for only a small fraction of its data, and does this through highly nonstandard, complex, opaque, and unmaintainable methods. Data-centric, attribute-based security is the foundation for all other security levels and technologies, because without knowledge of the data and its attributes, it will not be possible to provide the appropriate security measures on the data. Through metadata enrichment of the VISTA Data Model, VISTA will know *what categories of data it is managing* and thus allow, for the first time, comprehensive, data-centric, attribute-based security "on-the-data" for all VISTA data, permitting the secure exchange of data. See Data-Centric Security, Logical Security, Semantic Security and Attribute-Based Access Control (ABAC)

VISTA Data Model Attributes



Representative	**VDM operationalizes all relevant VA VISTA data to the maximum extent available.** The VISTA Data Model comprises the current existing data-driven architecture of VISTA, and thus leverages all existing VISTA definitions. There is 100% correspondence and coverage of the internal data definitions of any local VISTA and that of its corresponding VISTA Data Model (VDM), since these are maintained always in-sync and up-to-date. Any and all enhancements to any VISTA system and its data definitions will automatically be reflected in the VISTA Data Model through automated, triggered updates whenever VISTA's data dictionary is updated.
Real-Time	**VDM is operationalized using Best-of-Breed real-time server-side runtime technology.** The same runtime technology that runs the largest commericial real-time high-traffic websites such as Walmart, eBay, PayPal, Netflix, Uber, LinkedIn, and the New York Times also runs MVDM. *This maximizes transactional processing performance directly on the transactional database.*
Noninvasive	**VDM provides VISTA with essential new functionality within the current VISTA architecture 'as is', without modification.** No existing VISTA code, routines, packages, modules, infrastructure, or functionality will be affected or changed in any way (i.e. this is a 'safe'and 'noninvasive'). This keeps all existing functionality, while offering new, essential functionality for parallel development of all new web-oriented clients. In addition, it makes it easy and 'safe' to install, as this does not affect any current code or functionality.
Self-Contained	**VDM runs entirely server-side, embedded directly on the existing VISTA database**. This eliminates all moving parts and maximizes transaction processing performance by running as an embedded process directly on the local database, leveraging the 'as-is' database architecture. *This makes it easy to deploy, maintain, and keep highly performant. No moving parts. No external dependencies. No middleware.*

VISTA Data Model Attributes (continued)



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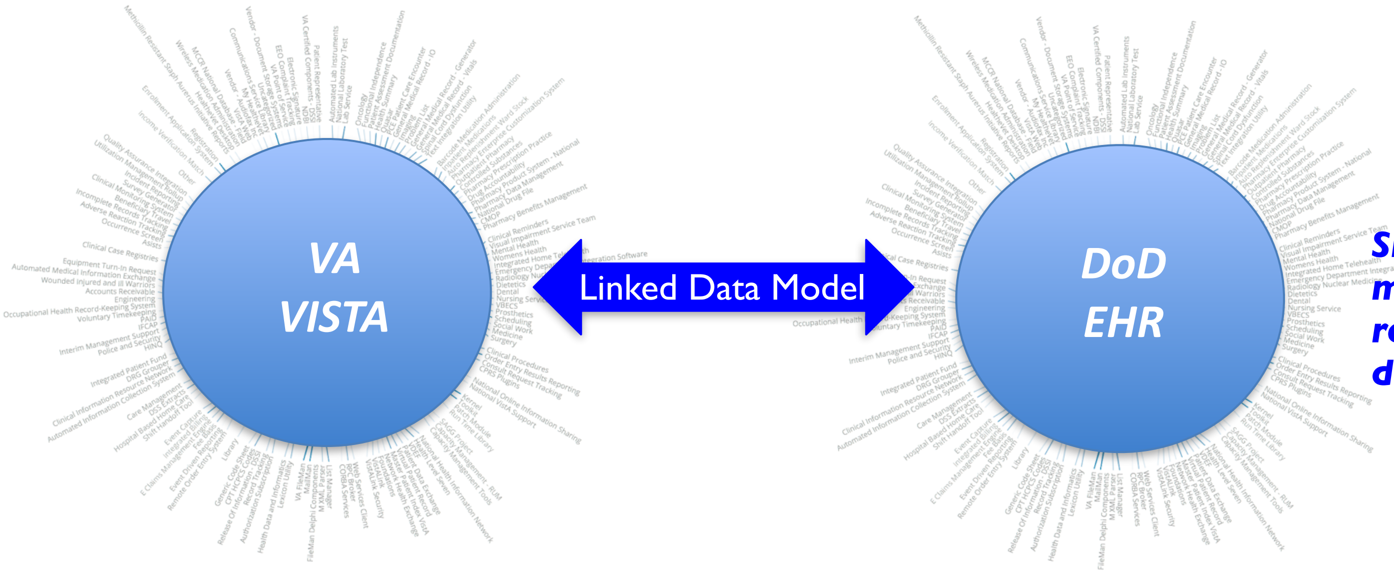
Data-Centric	**VDM is a completely new, purely data-centric approach to managing VISTA's data**. It does not involve changing a single line of VISTA's existing M procedural code, nor is it 'wrapping' (i.e. secretly using) any legacy code, routines, or RPCs dressed up within a shiny new programming language or encapsulation mechanisms, which add yet more layers of obfuscation on the data. A data-centric approach ***comprehensively exposes all the data, which exposes the fact that VISTA has a data model*** - which up to this point has not been realized nor taken advantage of. *This is the opposite of a code-centric approach, which obfuscates the data and its data model*.
Web-Standard	**VDM technologies are 100% web standard** and all used in production settings by the worlds' largest corporations and organizations. For further information see standards and technologies.
Empiric Evolution	**VDM employs a new approach to emprically evolving VISTA's capabilities through rapid, iterative, functional prototypes.** This allows the focus to remain on exploration of new techniques and approaches, rather than on more superficial end-user requirements, which rarely if ever attempt to tackle the deep conceptual and technological issues of data management. This is *the opposite waterfall development*. See spiral model

Application: Interagency Health Integration

Comprehensive. Computable. Standard. Secure.



Model-centric Interfacing

Single web-standard model to securely read and write any data

Representing the VA and DoD health information systems as Linked Data Model would support computable semantic interfacing and integration between federal agencies and the private sector using a web-standard, web-scale model.

RM Richards MD MS 2016-04-26

Reference

Web:	*vistadataproject.info*
Github:	*github.com/vistadataproject*
Email:	*rafael.richards@va.gov*