



Veteran Integrated Care Services

***Providing Centralized Cloud-based Continuity of
Care during EHR modernization and beyond***

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November 8, 2019



VA
HEALTH
CARE

Defining
EXCELLENCE
in the 21st Century

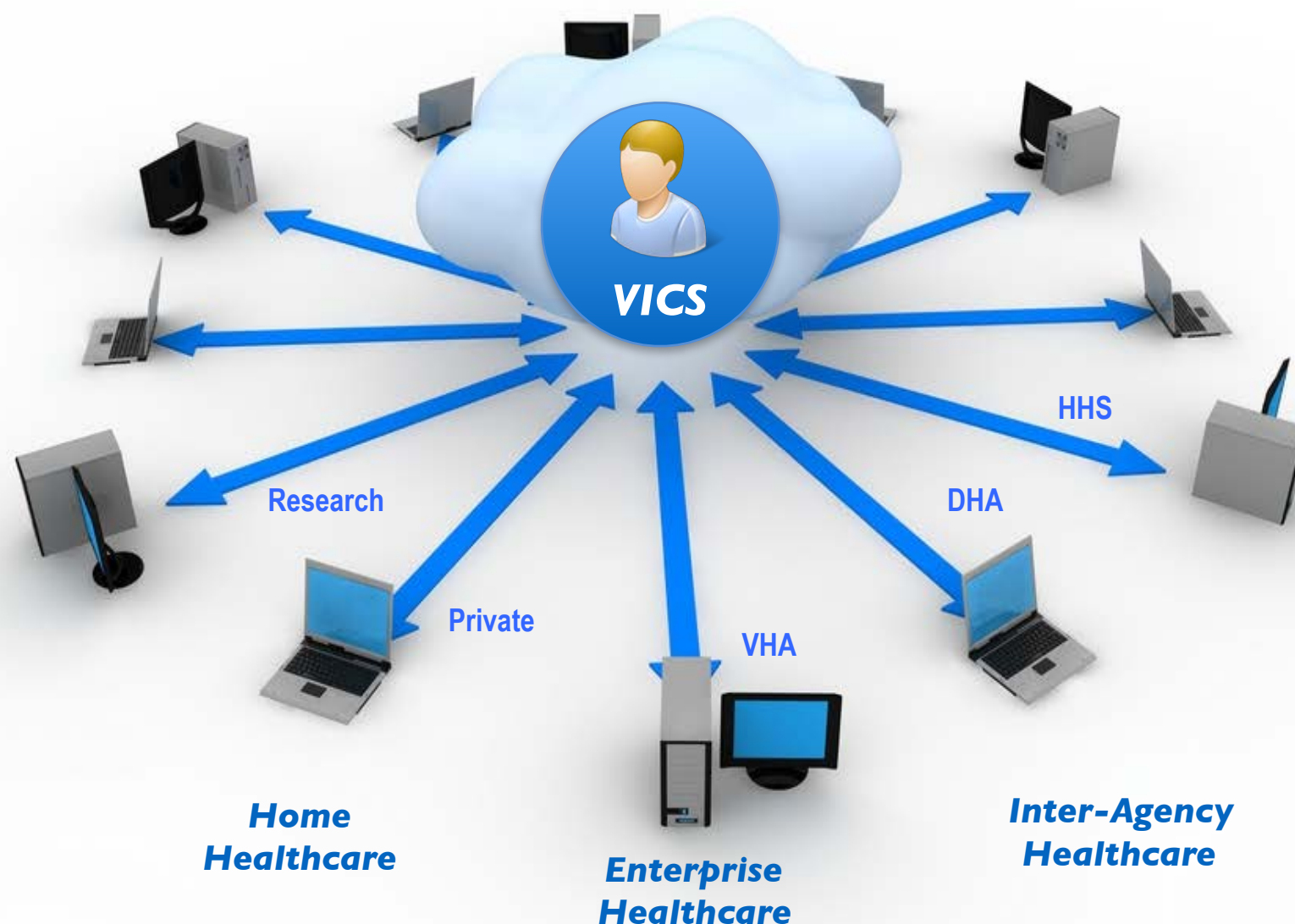
Veteran Integrated Care Services



*VISTA Adaptive
Maintenance*

*Centralized Cloud-based
Continuity of Veteran Care*

**One Cloud.
All Data.
Secure.
Accessible.
Integrated.**



Veteran-Integrated Care Services (VICS)

Migration of VA's current health information systems to the VA Enterprise Cloud, with VistA adaptive maintenance (VAM) enables centralized cloud-based Veteran Integrated Care Services (VICS), providing seamless continuity of care and services during EHR modernization and beyond.



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Evolution of VA Health IT



VA Health IT History



VISTA Adaptive Maintenance

The Decentralized Hospital Computer Program (DHCP)
is the common base system of VHA and DHA systems today

VHA: 151 hospitals; 820 clinics; 300 vet centers; + other (total 1700 care sites)
DHA: 57 hospitals; 350 clinics + other

VHA: 130 VISTA systems operational (since 1981)
DHA: 101 CHCS systems operational (since 1985)
Total: 231 DHCP-based systems across VHA-DHA

■ DHCP-based systems

■ Common technology projects

■ VHA-specific interface and workflow

■ DHA-specific interface and workflow

Veterans Health Administration (VHA)



VHA

operational client

operational database and workflow

CPRS

VISTA (x130)

VISTA Data: 3500 files; 65,000 fields



Decentralized Hospital Computer Program

DHCP (x231)

VHA-DHA joint technology projects

Janus

TAPS

VDP

JLV

iEHR

EHRM
GENISYS

Defense Health Administration (DHA)



DHA

operational database(s) and workflow

operational client

CHCS (x101)

CHCS Data: 1000 files; 25,000 fields

CDR / MDR

AHLTA

Before 1990, computing was decentralized and on-premises because there was no Internet.

While DHCP started the same in VHA and DHA originally, it has diverged over time. The first 'fork' in DHCP occurred in 1985 when DHA modified it to create CHCS. The next 'fork' occurred in 2004 when DHA centralized and migrated a large portion of CHCS data to the CDR / MDR systems. Today the variety, volume, and function of CHCS is approximately one-third that of VISTA.

Since 2010 most enterprises have adopted centralized cloud services

1980

1990

2000

2010

2017

VHA-specific

VISTA

CPRS

VICS / VAM

Common

DHCP

JLV

iEHR

TAPS

VDP

DHA-specific

CHCS

AHLTA / CDR

GENISYS

Commercial

1969 - Meditech
1979 - Epic
1979 - Cerner
1982 - Allscripts
1983 - Clinicomp

1981 - DHCP - Decentralized Hospital Computer Program - VA Fileman database and applications [VHA]
1985 - CHCS - (DHCP renamed to) Composite Health Care System; modified for DHA use [Leidos (SAIC)]
1994 - VISTA - (DHCP renamed to) Veterans Information Systems Technology Architecture [VHA]
1997 - CPRS - Computerized Patient Record System - graphical interface and workflow [VHA]
2004 - AHLTA/ CDR/ MDR - Armed Forces Health Longitudinal Technology Application [Northrup Grumman]

2003 - Janus (renamed to JLV in 2011) [DHA-VHA]
2011 - iEHR - Integrated Electronic Health Record [SMS]
2013 - TAPS - Transition Application Plan Support [DHA-VHA]
2016 - MHS Genesis (COTS EHR - Cerner)
2016 - VDP - VISTA Data Project
2018 - VAM - VISTA Adaptive Maintenance - VICS

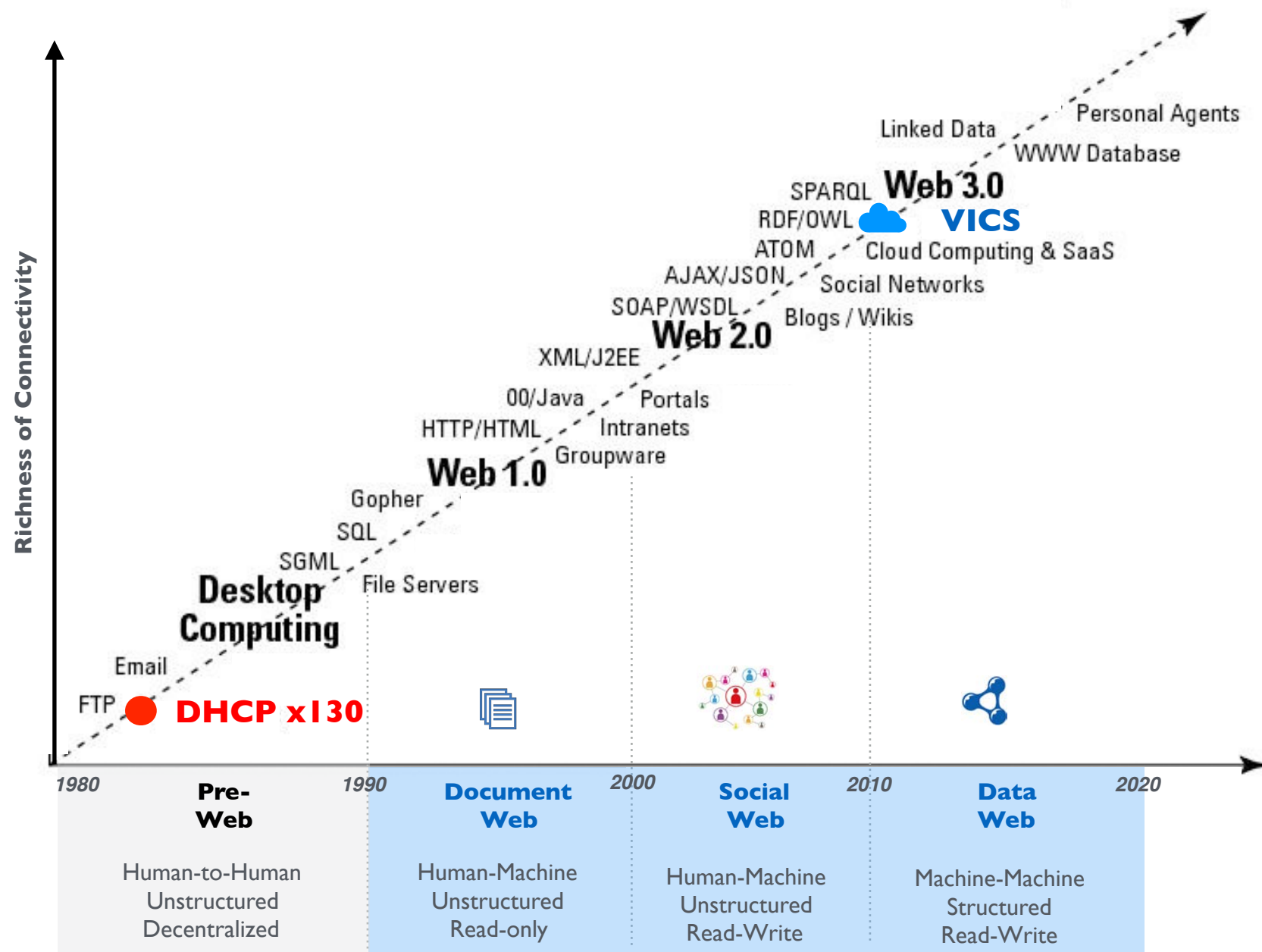


VA Health IT Evolution

The Internet: A Roadmap for Evolution

Evolution of the Web:

- From Decentralized (silos) to Centralized (clouds)
- From Documents (unstructured) to Data (structured)
- From Human-Human to Machine-Machine communication



Future: Veteran Integrated Cloud Services

Leveraging the 30 years of evolution of the Internet, VA has established the VA Enterprise Cloud, and is migrating and centralizing the VISTA systems to provide Veteran Integrated Cloud Services (VICS) through VISTA Adaptive Maintenance (VAM)



History: Decentralized Silos

Before the Internet, all computing was decentralized and on-premises. The Decentralized Hospital Care Program (DHCP), developed in 1981 by VA, was no exception. DHCP is comprised of 130 distinct systems (renamed VISTA) hosted on-premise in diverse locations throughout USA.

DHCP x130

Continuity of Care during EHR modernization

From 130 VISTAs to Centralized Cloud-based Veteran Integrated Care Services (VICS)



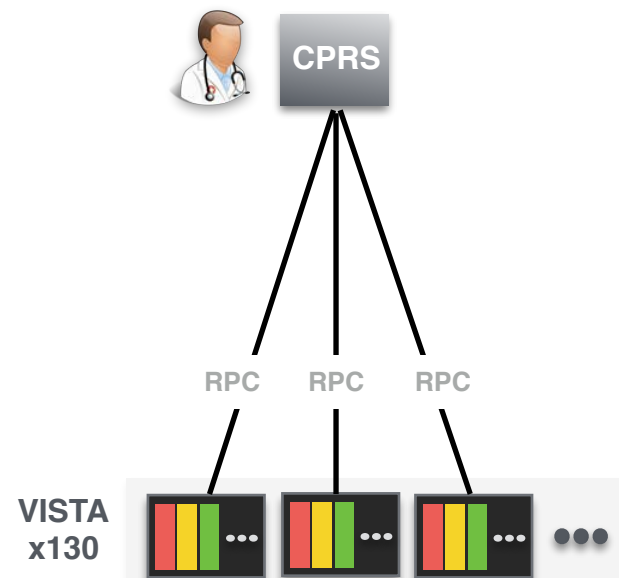
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VISTA Current State

Decentralized Care across 130 VISTAs

Today, care is delivered in VA using the CPRS user interface, which relies on 130 unique decentralized VISTA systems for its functionality via remote procedure calls (RPCs).

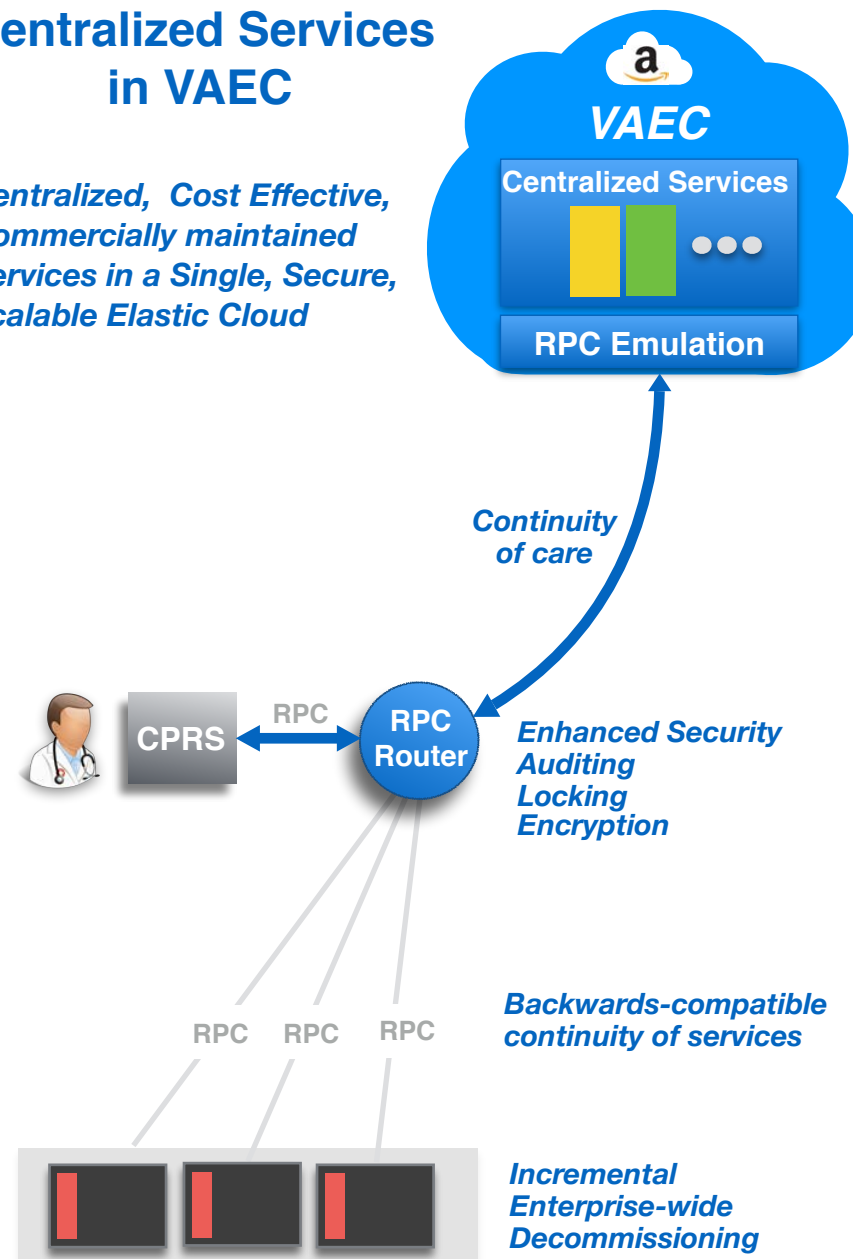


VISTA is comprised of many functional domains (colored bars) integrated within a single database (black).

VISTA Adaptive Maintenance

Centralized Services in VAEC

Centralized, Cost Effective, Commercially maintained Services in a Single, Secure, Scalable Elastic Cloud



VISTA Adaptive Maintenance

Veteran Integrated Cloud Services

Project V18-00154-000

Office of Information Technology

U.S. Department of Veterans Affairs

Architect: Rafael Richards MD MS

Initial Operating Capability: Q1 2020

• Minimized Maintenance

Deployed and managed using COTS tools available on Federally-approved Commercial Clouds.

• Continuity of Care

CPRS continues to work unchanged using the centralized services (via RPC Emulation) providing backwards-compatible continuity of care during centralization and decommissioning.

• Enhanced Security

VISTA interfaces are fully audited, locked down, and all traffic encrypted via interception and grooming provided by the RPC Router.

• Incremental Decommissioning

As functionality (colored bars) is incrementally centralized to the cloud following VA priorities, the corresponding functionality across **all 130 VISTA systems may be safely decommissioned enterprise-wide, with no loss of continuity of care.**

Veteran Integrated Cloud Services

Continuity of care during EHR modernization



From 130 VISTAs to Single Integrated Cloud Service

*Centralizes 130 VISTA system functionality to **integrated cloud services**.*



Federally-Certified Commercial Cloud solution

- * *Highest security and availability in the industry*
- * *No infrastructure to maintain*



Preserves VA and Veteran-specific services

- * *These are not available in generic COTS EHR / ERP solutions*



Enterprise-wide VISTA retirement

- * *Retires functionality across all 130 VISTAs (not one-by-one)*
- * *No disruption of VA- or Veteran-specific services*
- * *No residual and redundant legacy technology to maintain*



Minimizes cost of VISTA maintenance

VA leadership stated to Congress in 2017 - based on the estimate by Grant Thornton LLC - that operating VISTA unchanged for the next ten years would cost \$19 Billion. Centralized cloud services with VistA adaptive maintenance (VAM) would eliminate much of this cost.



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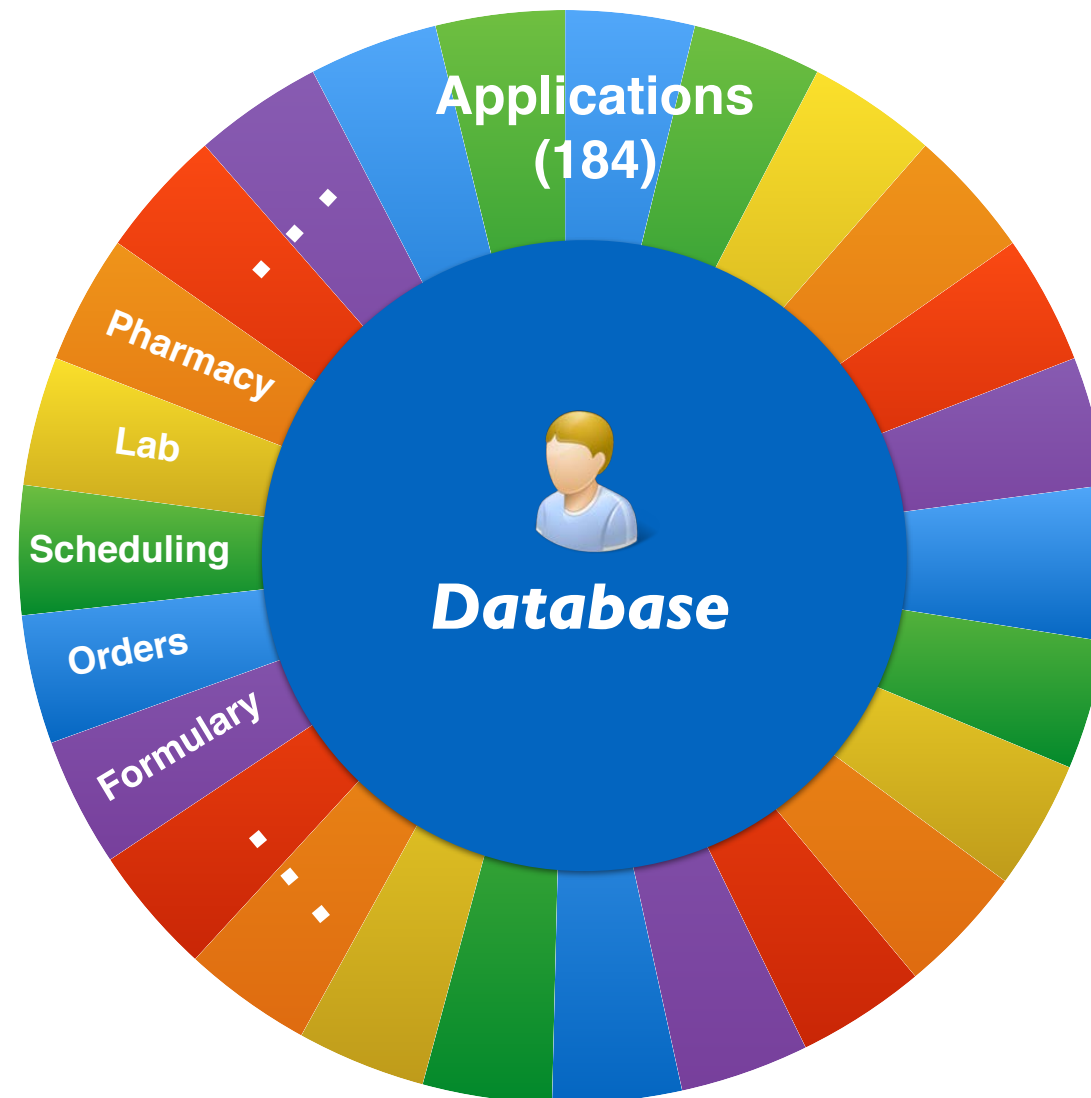
What is VISTA?



The Veterans Information Systems Technology Architecture

Integrated Lifelong Veteran-centric Health Information System

**All Apps.
All Data.
Integrated.
Lifelong.**



Single integrated database

The architecture of VISTA consists of 184 applications for clinical care, benefits, finance, administration, and infrastructure all integrated within a single common database.

VISTA applications (outer ring) all share the same, single common database (inner circle) through VISTA's application-data integration engine (internal connections).

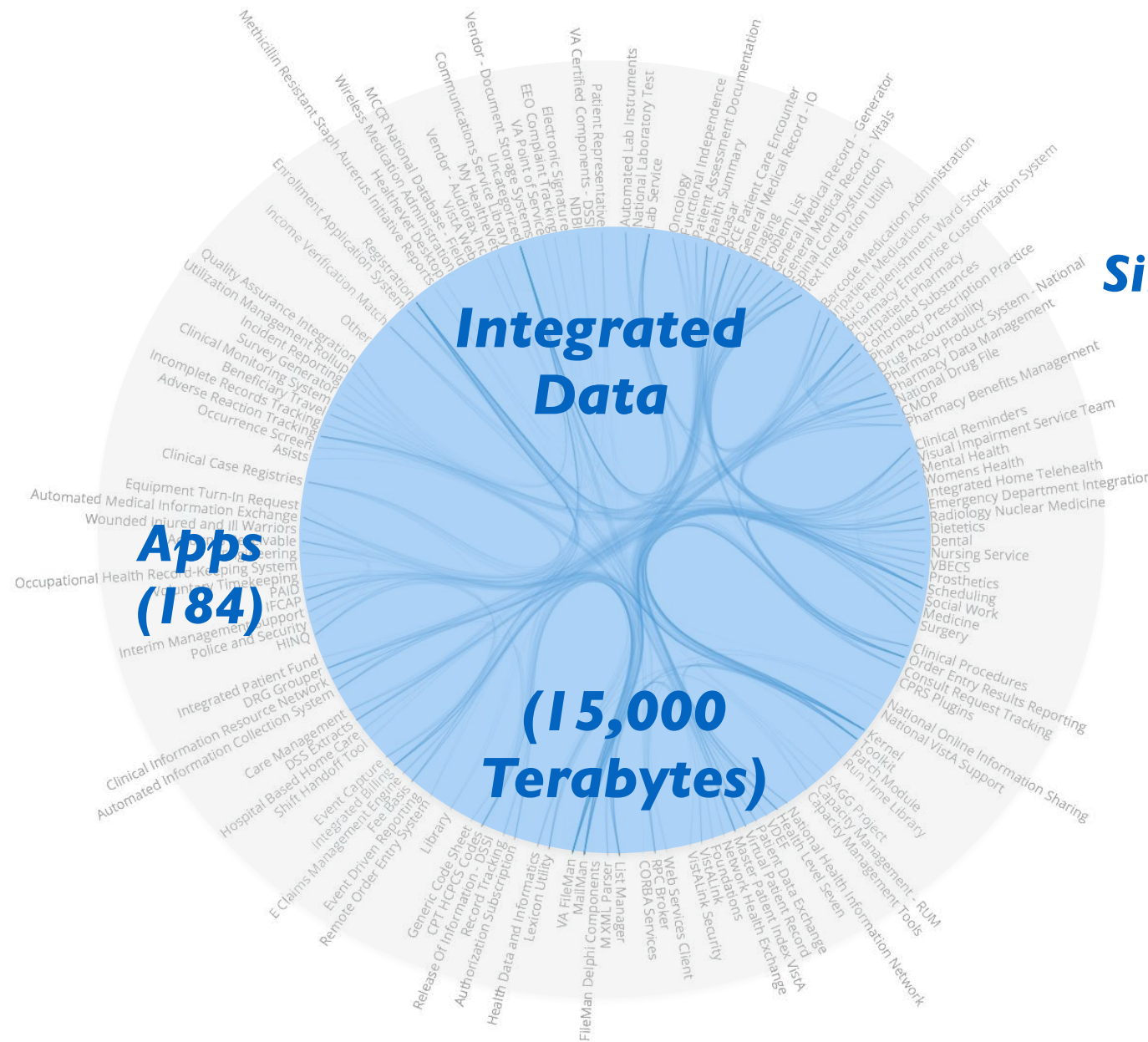
This enables an integrated, lifelong patient-centric view of all Veteran data.

<https://en.wikipedia.org/wiki/VistA>

In this simplified view of VISTA, the highly integrated nature of the applications with each other and with the data is not visible. Applications (incorrectly) appear as discrete 'lego' modules as if they could be readily separated or replaced. In reality all applications and their data are integrated with all the other applications in the system, making any such application replacement challenging without disturbing the entire system.



**All Apps.
All Data.
Integrated.**



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VISTA applications (outer ring) all share the same, single common database (inner circle) through VISTA's application-data integration engine (internal connections).

This enables an integrated, lifelong patient-centric view of all Veteran data.

This more technically correct representation of VISTA shows how applications are integrated with each other and with their associated data within the system. This involves tens of thousands of internal integrations between all applications and their data (inter-application connections). This application-data integration is essential to preserve the integrity of veteran health information with its associated business logic. This high level of integration and inter-dependencies make it challenging to replace any application or functionality by an external application without disturbing the entire system.

VISTA is more than an EHR



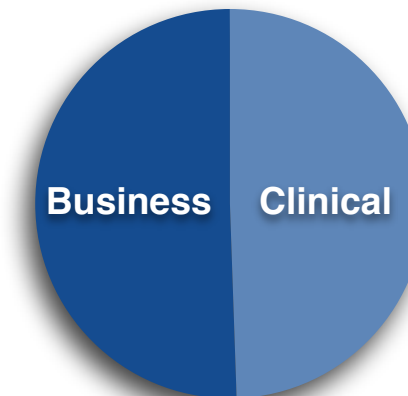
VISTA Adaptive
Maintenance

Over 50% of VISTA data and function is Business workflow

Content of largest 30 files in a VISTA system

	#	File	Count
Clinical	P1	IMAGE (2005)	5,728,923
Business	P2	AR TRANSACTION (433)	5,595,597
Clinical	P3	GMRV VITAL MEASUREMENT (120.5)	5,582,099
Clinical	P4	V CPT (9000010.18)	5,533,193
Business	P5	ENROLLMENT/ELIGIBILITY UPLOAD AUDIT	5,525,976
Clinical	P6	ORDER (100)	5,243,872
Clinical	P7	TIU DOCUMENT (8925)	4,588,982
Clinical	P8	VISIT (9000010)	4,465,018
Clinical	P9	OUTPATIENT ENCOUNTER (409.68)	4,385,585
Business	P10	BCMA MEDICATION LOG (53.79)	3,901,198
Clinical	P11	V POV (9000010.07)	3,640,303
Clinical	P12	V PROVIDER (9000010.06)	3,446,623
Business	P13	ACRP TRANSMISSION HISTORY (409.77)	3,122,925
Business	P14	TRANSMITTED OUTPATIENT ENCOUNTER	2,697,388
Business	P15	IMAGE ACCESS LOG (2006.95)	2,524,259
Business	P16	PATIENT ENROLLMENT (27.11)	2,386,762
Business	P17	IB COPAY TRANSACTIONS (354.71)	2,291,380
Business	P18	BCMA REPORT REQUEST (53.69)	2,119,037
Business	P19	INTEGRATED BILLING ACTION (350)	2,065,742
Business	P20	CLAIMS TRACKING (356)	1,989,049
Business	P21	ADT/HL7 PIVOT (391.71)	1,987,001
Clinical	P22	PRESCRIPTION (52)	1,863,696
Business	P23	ORDER CHECK INSTANCES (100.05)	1,486,470
Business	P24	UNIT DOSE EXTRACT DATA (728.904)	1,475,497
Business	P25	ACCOUNTS RECEIVABLE (430)	1,466,346
Clinical	P26	V HEALTH FACTORS (9000010.23)	1,462,325
Business	P27	IVM FINANCIAL QUERY LOG (301.62)	1,439,880
Business	P28	IVM TRANSMISSION LOG (301.6)	1,285,905
Business	P29	IB BILL/CLAIMS DIAGNOSIS (362.3)	1,264,869
Business	P30	BCMA UNABLE TO SCAN LOG (53.77)	1,239,098

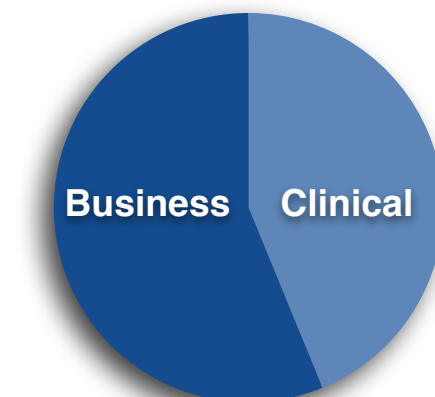
Total files	91,804,998
Clinical files	40,211,696
Business files	51,593,302



VISTA
Packages
(total 184)



VISTA
Files
(largest 30)



VISTA
Data
(>90 million)

VISTA provides the business function and data to support over 100,000 operational, finance, regulatory, clinical, Congressional, and Federally-mandated safety, quality, and efficiency reports each year to ensure the highest quality of VA- and Veteran-specific care and benefits.



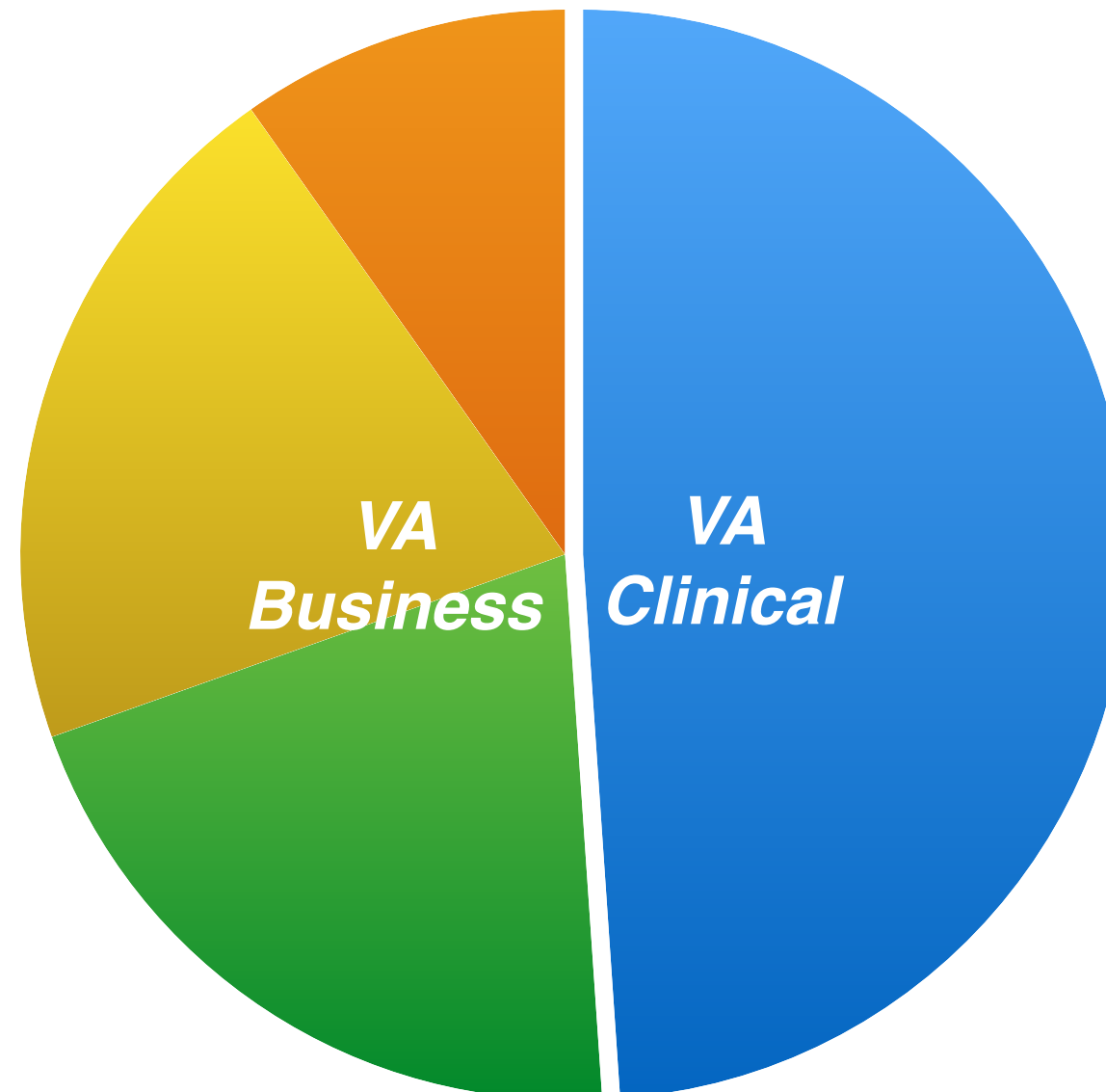
VISTA is more than an EHR



VISTA Adaptive
Maintenance

Over 50% of VISTA applications are VA Business workflow

VISTA is comprised of 184 Applications. Over half are for VA Business functions (administrative, financial, infrastructure, and regulatory compliance). The remaining half are VA Clinical functions (enterprise integrated inpatient/outpatient electronic health information system).



Half of VISTA's functionality supports VA's Business, administrative, financial, infrastructure, and regulatory compliance ("ERP")

Half of VISTA's functionality is clinical - providing the VA's enterprise integrated inpatient/outpatient electronic health information system ("EHR")

For details on VISTA applications,
see the VISTA Documentation Library:

<http://www.va.gov/vdl>

Functional Domains	# Apps
Clinical ("EHR")	90
Financial/Admin	38
Infrastructure	38
Extensions (HEV)	18

VISTA is specialized for Veteran Care



35 Years of Veteran-Specific Care and Services



*VISTA Adaptive
Maintenance*

VISTA contains Veteran-specific clinical and business packages

- Blind Rehabilitation
- *Wounded Injured and Ill Warriors*
- *Functional Independence* Measurement
- Patient Assessment Documentation Package
- Patient Record Flags
- *Compensation and Pension* Record Interchange
- Decision Support System Extracts (Veteran Workload)
- Enrollment Application System
- Fugitive Felon Program
- Health Eligibility Center
- Personnel and Accounting Integrated Data
- Police and Security
- Veterans Identification Card
- *Voluntary Service System*
- *Prosthetics*
- Visual Impairment Service Team
- *Spinal Cord Injury* and Disorders Outcomes
- Quality Audiology and Speech Analysis and Reporting
- Registries *Airborne Hazard Open Burn Pit*
- Registries Clinical Case
- Registries *Embedded Fragments*
- Registries *Military Eye Vision Injury*
- Registries Multiple Sclerosis Surveillance
- Registries *Traumatic Brain Injury*
- Spinal Cord Dysfunction
- Patient Advocate Tracking System
- Veterans Authorization and Preferences
- VA Enrollment System
- Veterans Personal Finance System

The above is a subset of VISTA's 100+ packages that are clearly labeled as specialized for VA- and Veteran-specific clinical and business workflows

VISTA is specialized for Veteran Care



35 Years of Veteran-Specific Care and Services



VISTA Adaptive
Maintenance

**Even generic-sounding packages
contain Veteran-specific workflow**

VHA National Care Directives

drives

Clinical Reminders package

Department of Veterans Affairs
Veterans Health Administration
Washington, DC 20420

VHA DIRECTIVE 2010-012

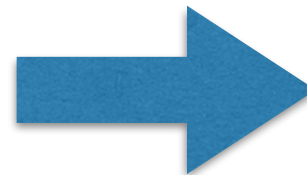
March 8, 2010

SCREENING AND EVALUATION OF POSSIBLE TRAUMATIC BRAIN INJURY IN OPERATION ENDURING FREEDOM (OEF) AND OPERATION IRAQI FREEDOM (OIF) VETERANS

1. PURPOSE: This Veterans Health Administration (VHA) Directive updates policies and procedures for screening and evaluation of possible traumatic brain injury (TBI) in Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF) Veterans.

2. BACKGROUND

a. TBI is a common injury found in servicemembers serving in OEF and OIF. Details on the screening and management of TBI can be found in the Employee Education System Veterans Health Initiative (VHI) module (see paragraph 5). As occurrences of this condition in OEF and OIF Veterans increased, screening for possible TBI in OEF and OIF Veterans could contribute to ensuring that individuals with TBI are identified and treated.



REMINDER DEFINITION > VA-TBI SCREENING (793)

Name

VA-TBI SCREENING

Print Name

TBI Screening

Description

Reminder is applicable once in a lifetime of all patients whose date of separation from the service is 9/11/01 or later and have had service in OEF/OIF. If Service Date of Separation is more recent than last TBI Screening, then reminder will be due again for patient.

Reminder is resolved by completing the screen.

Reminder creation requested by the Office of Patient Care Services. Designed by the TBI Screening Workgroup chaired by Dr. Barbara Sigford and based on a reminder from Minneapolis built by Ronald Patire and Dr. Brian Neil.

Revisions June 2007:

1. Refusal can be entered
2. URLs added for information
3. Screening done at another VA option added.
4. Additional choices for head injury added.

**Many VISTA packages that are generic-sounding
also contain Veteran-specific care and business workflow**

VISTA is specialized for Veteran Care



35 Years of Veteran-Specific Care and Services



VISTA Adaptive
Maintenance

Current VISTA functionality by type

	Clinical Services ("EHR")	Business Services ("ERP")	
Commodity functionality	Pharmacy Lab ...	Billing ...	Only the generic clinical and business functionality of VISTA is available in commercial products.
Veteran-specific functionality	Traumatic Brain Injury Military Eye Vision C&P Exams ...	VA Enrollment VA Eligibility ...	It is necessary for VA to provide these Veteran-specific services during EHR modernization, and beyond.



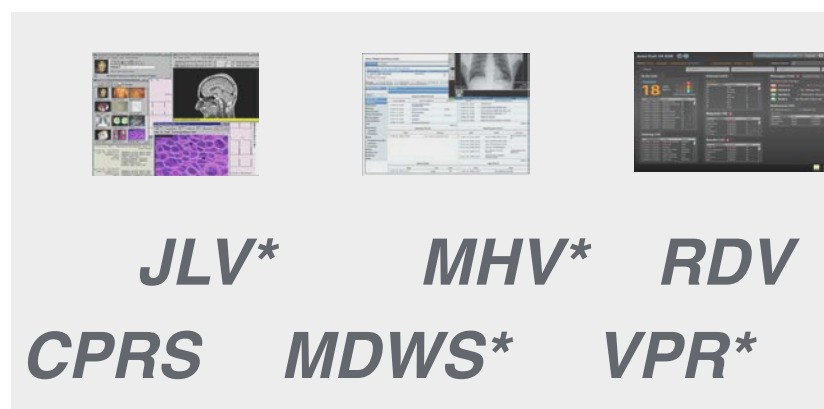
VISTA Interfacing



VISTA Adaptive
Maintenance

VISTA Interfacing: Opaque

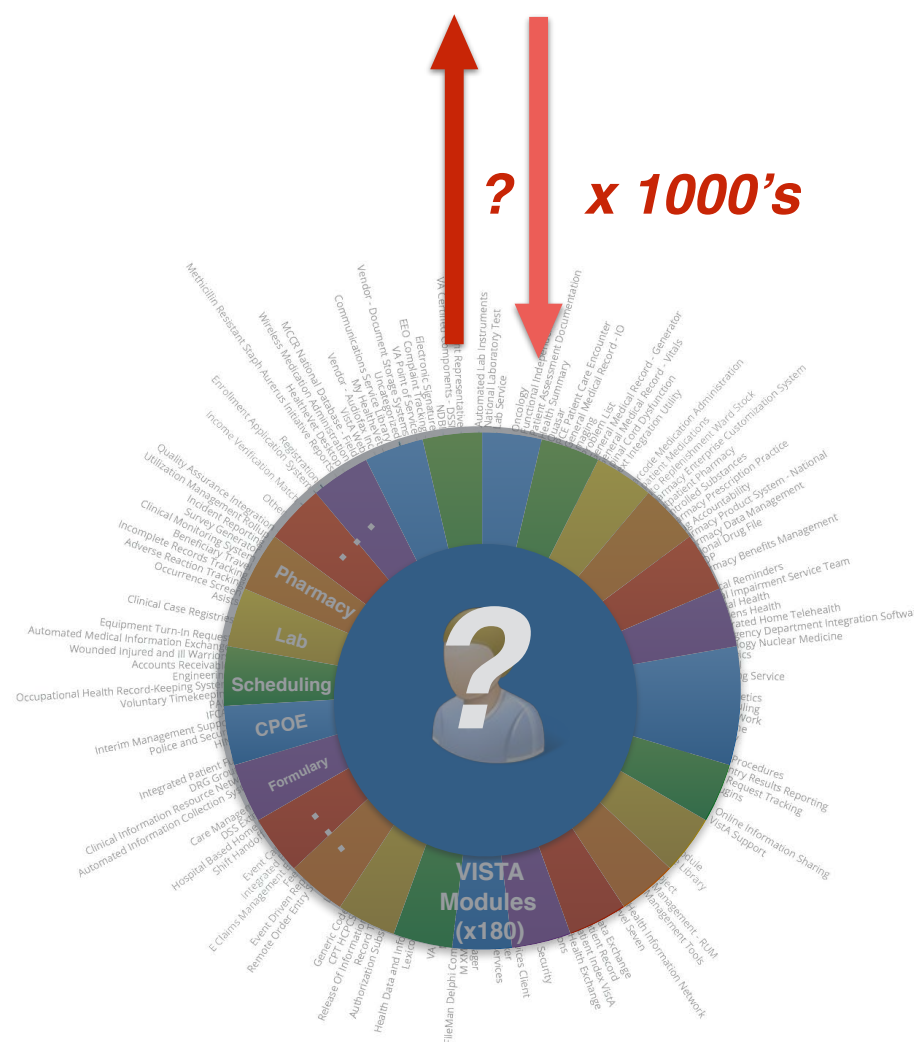
CLIENTS



**And many
others ...**

**Thousands of
Opaque
Interfaces**

VISTA



**Patient-Centric Integrated
Application-Data Engine**

MHV - myHealtheVet - Patient Portal [read-only]
MDWS - Medical Domain Web Services [RPC wrapper]
Janus /JLV - Joint Legacy Viewer [read-only]
iEHR - integrated EHR (VA-DoD) - [DOA]
RDV - Remote Data Viewer [read-only]
VPR - Virtual Patient Record [read-only]
HMP - Health Management Platform 1.0 [read-only]



VISTA Interfacing: Master Model-driven



Supports the current...

Enables the new...



JLV

MHV

RDV

CPRS

MDWS

VPR



*web
mobile
cloud
commercial*

CLIENTS

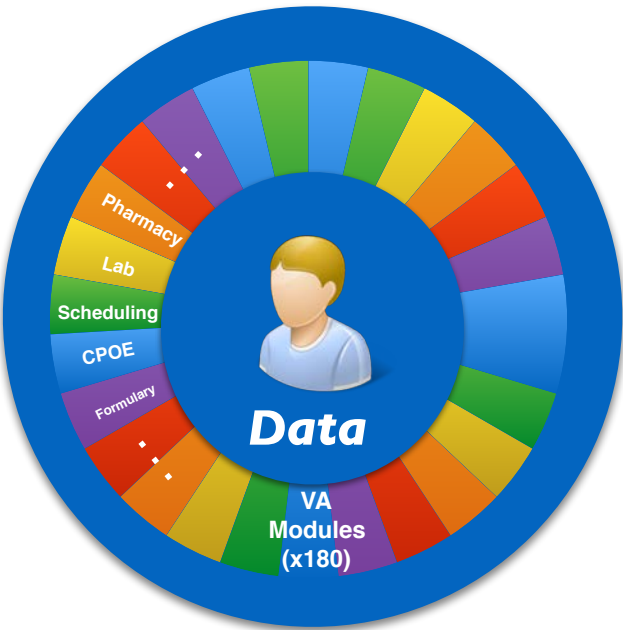
MVDM

*Secure
Symmetric
Modern Node.js
Model-driven
Interface*



VISTA

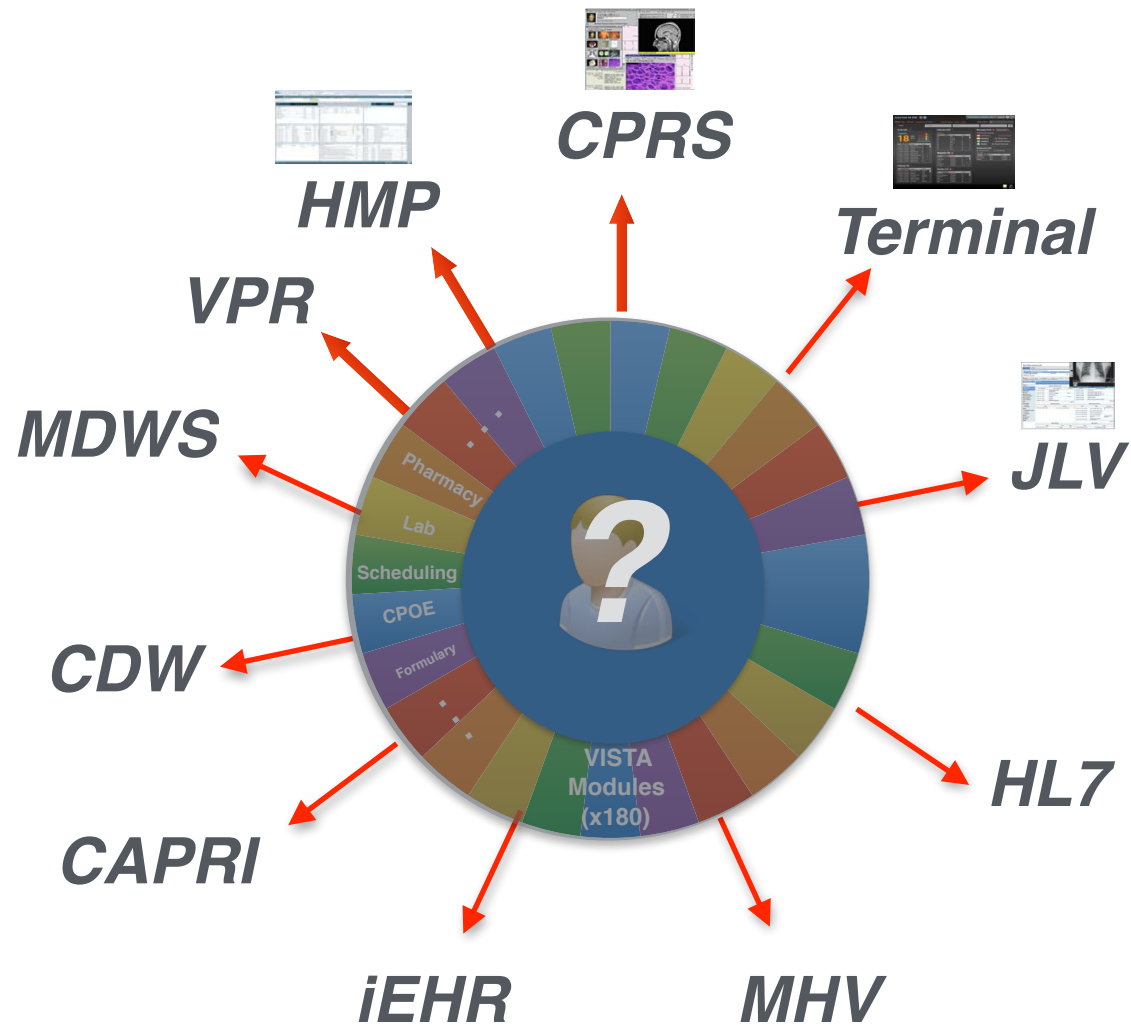
*Patient-Centric Integrated
Application-Data Engine*





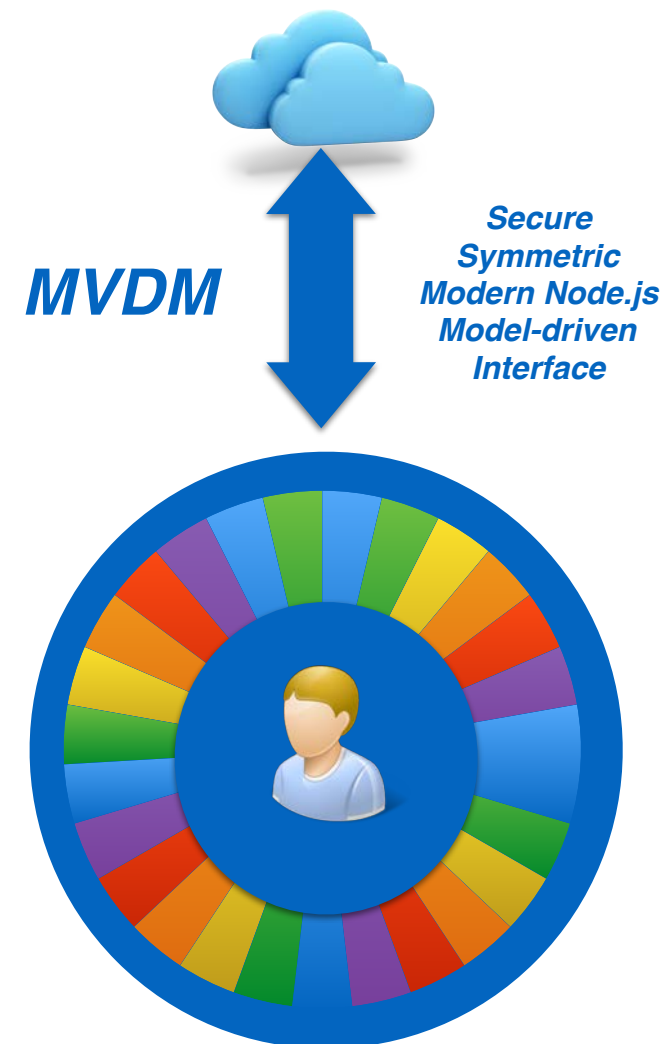
VISTA Interfacing: From Legacy to Model

Legacy VISTA



*Thousands of
Nonstandard
Undocumented
Single-Purpose
Client-specific
Asymmetric
Read-only / read-mostly
Non-transactional
Code-driven
Interfaces*

Model VISTA



*Secure
Symmetric
Modern Node.js
Model-driven
Interface*

*Single
Web-Standard
Documented
Multi-Purpose
Client-agnostic
Symmetric
Read-Write
Transactional
Data-Driven
Interface*



VISTA Interfacing: From Silo to Cloud

Decentralized Code-based Interfacing

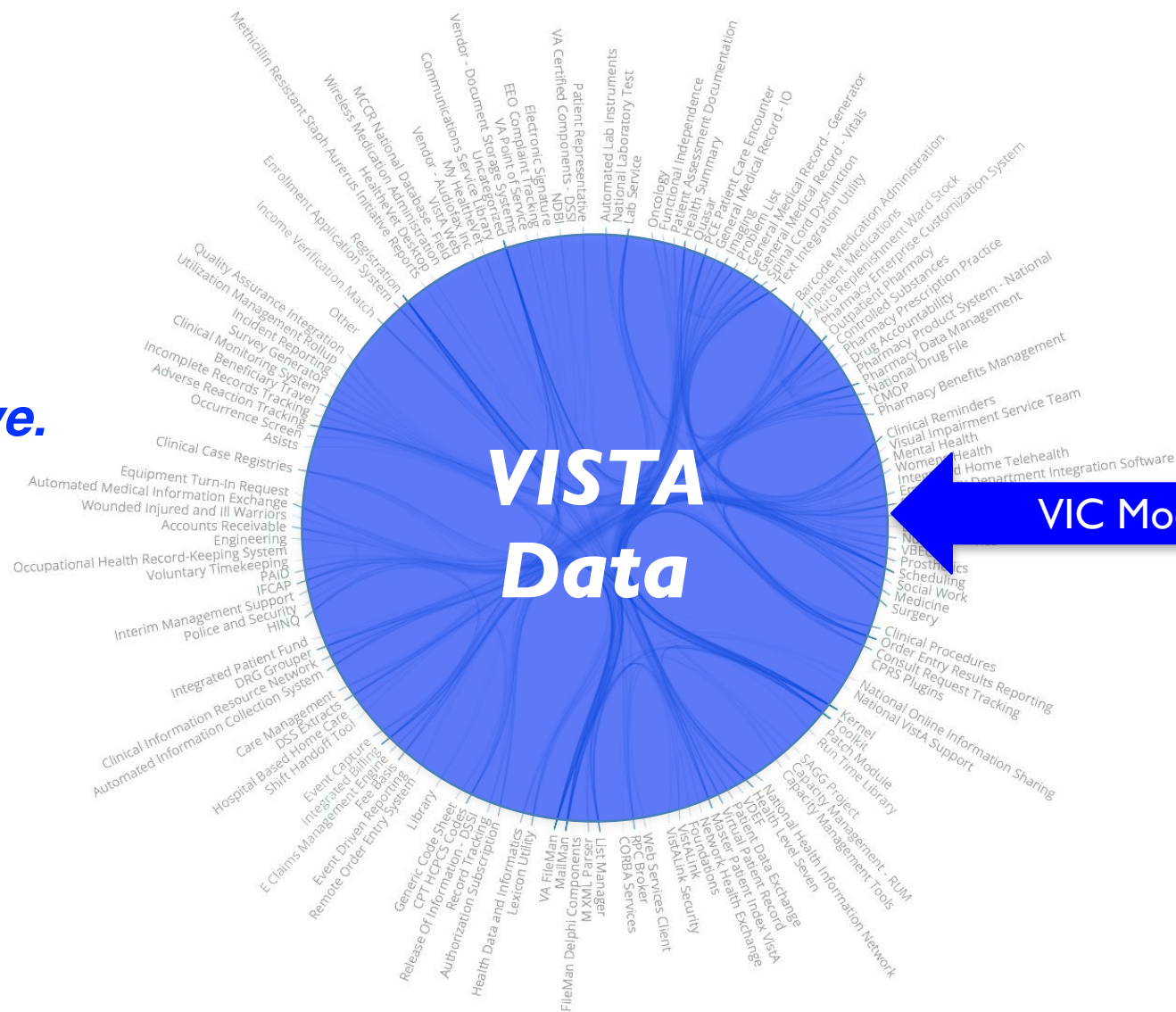
Centralized Model-based Interfacing

Thousands	Single
Local	Enterprise
Legacy	Cloud-centric
Opaque	Transparent
Code-driven	Data-driven
Nonstandard	Web standard
Opaque	Documented
Unaudited, Unverified	Audited, Verified
Unsecure	Secure
Single Purpose	Universal use
Client-specific	Client agnostic
Asymmetric (read-mostly)	Symmetric (read-write)
Non transactional	Transactional



VISTA Interfacing

Comprehensive.
Transparent.
Standard.
Secure.



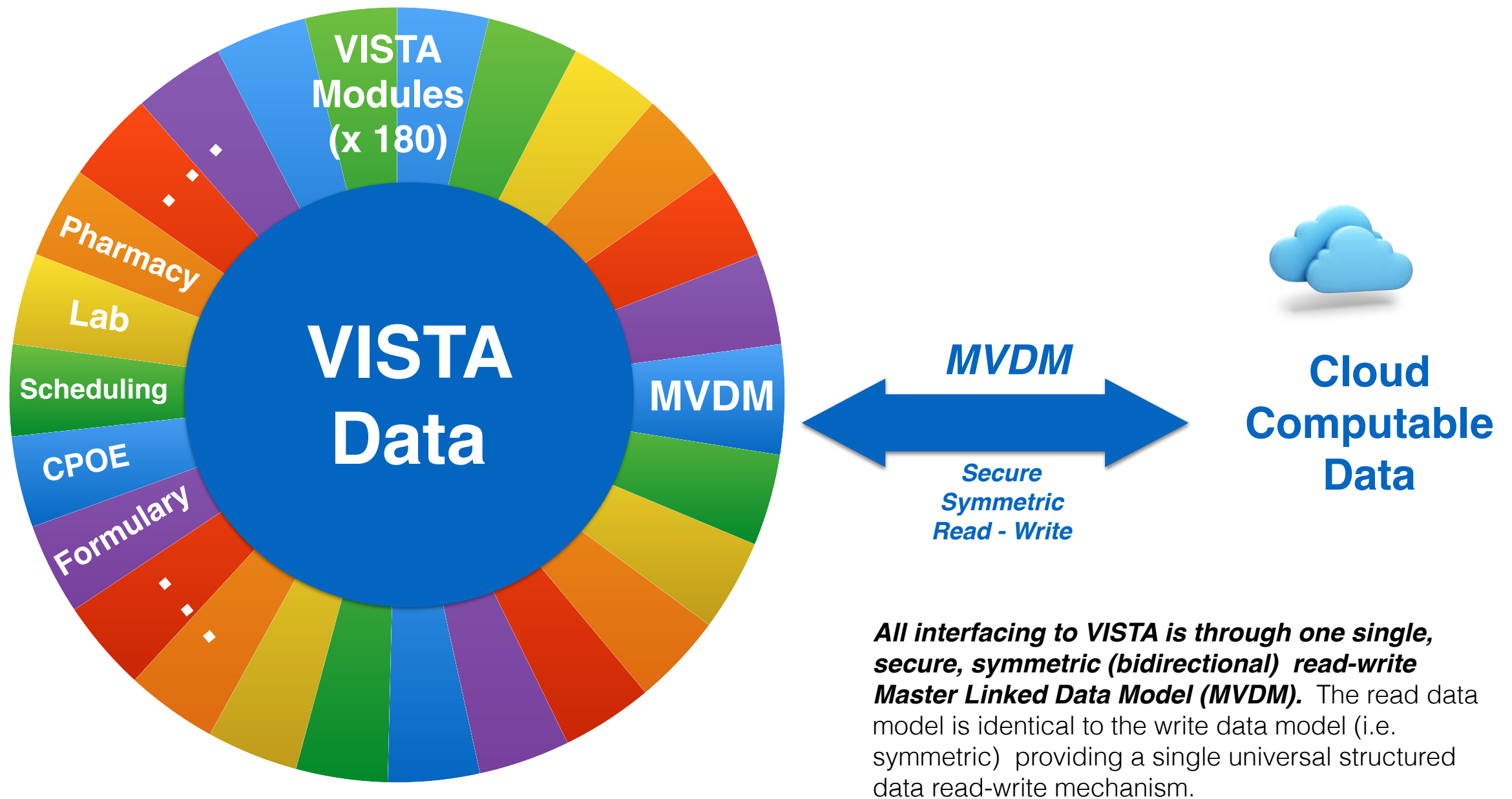
**Model-centric
interfacing makes all
▶ VISTA data accessible.**

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 transactional data model in computable form enables web-standard external interfacing and integration.



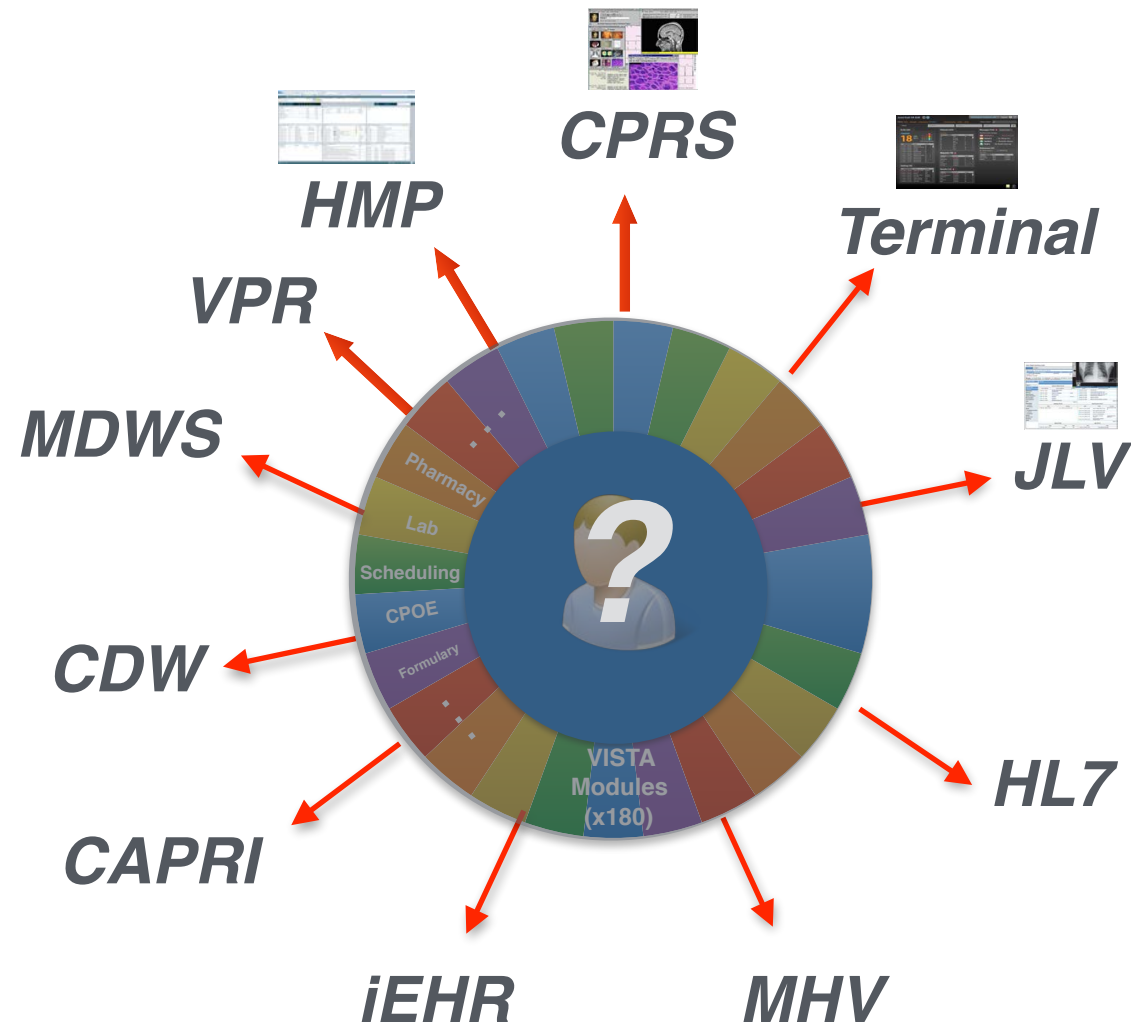
VISTA Interfacing: Veteran Integrated Care Model





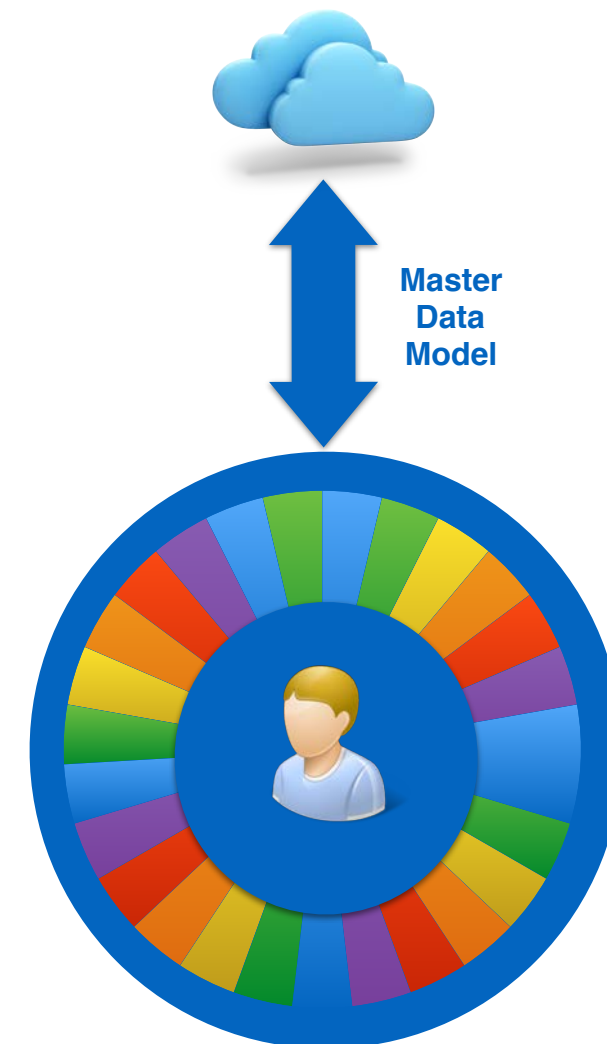
VISTA Interfacing: From Silo to Cloud

Legacy Interfacing



*Thousands of
Nonstandard
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Code-driven
Interfaces*

Cloud Interfacing



*Single
Web-Standard
Documented
Multi-Purpose
Client-agnostic
Symmetric
Read-Write
Transactional
Data-Driven
Interface*



VISTA Interfacing: From Documents to Data



Current

Cloud

	Standard “Information Exchange”	Structured, Linked Data Integration
Data Resolution	Document-centric	Data-centric
Data Representation	Documents (XML) Images (Fax,PDF)	Web model (RDF)
Data Storage	Binary (PDFs, scans)	Structured data
Machine Processable	NO	YES
Computable Data	NO	YES
Clinical Decision Support	NO	YES
Supports Analytics	NO	YES
Integrated in Clinical Workflow (Client GUI)	NO (external viewer required)	YES
Integrated into Clinical Health Record (VISTA)	NO (separate data)	YES (data fully integrated)



VISTA Interfacing: From Silo to Cloud



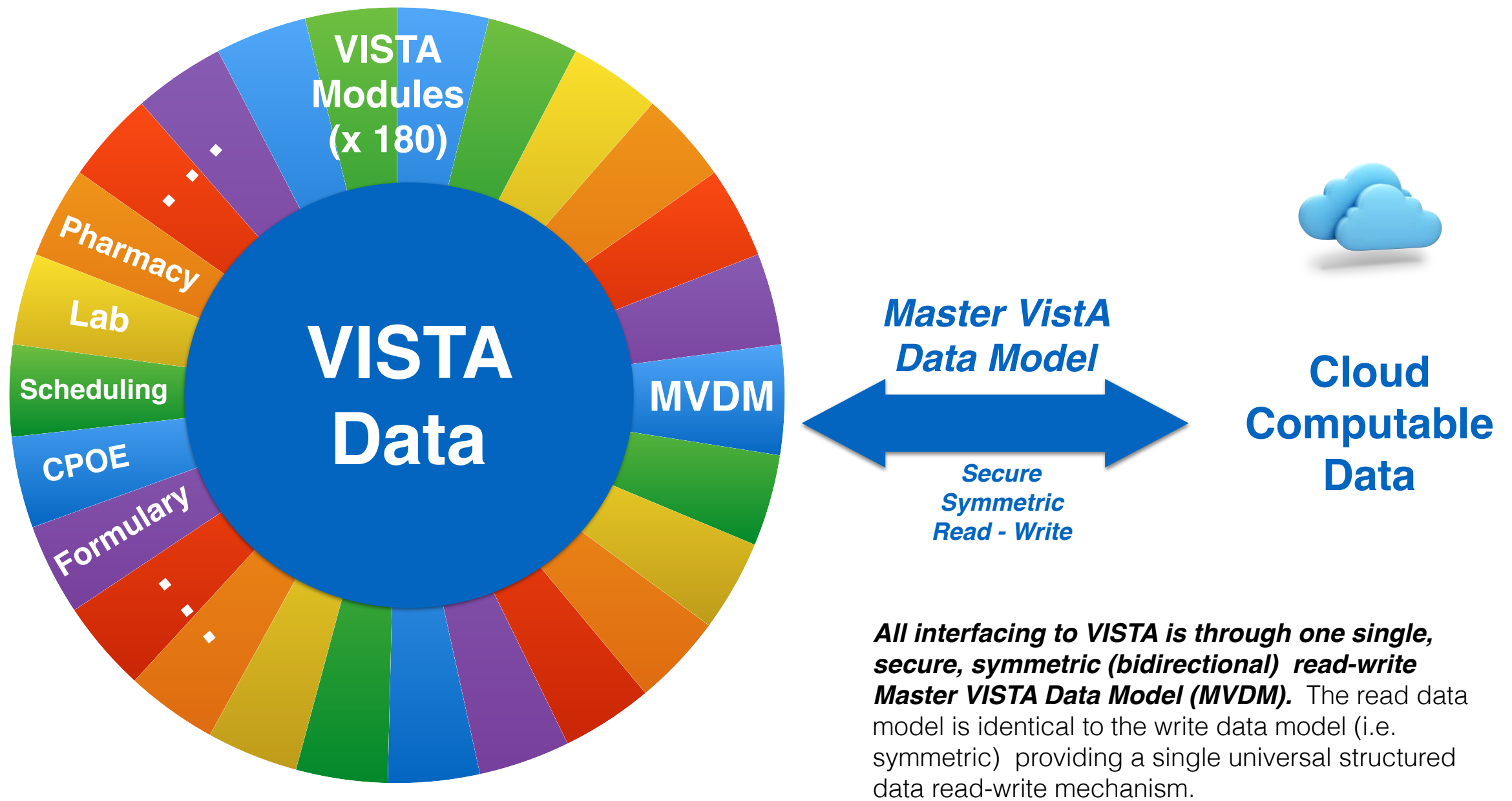
Silo Interfaces

Cloud Interface

Thousands	Single
Local	Enterprise
Legacy	Cloud-centric
Opaque	Transparent
Code-driven	Data-driven
Nonstandard	Web standard
Opaque	Documented
Unaudited, Unverified	Audited, Verified
Insecure	Secure
Single Purpose	Universal use
Client-specific	Client agnostic
Asymmetric (read-mostly)	Symmetric (read-write)
Non transactional	Transactional



VISTA Interfacing: Master Linked Data Model



Community Care

Continuity of Care during EHR Modernization

From 130 VISTAs to Centralized Cloud-based Veteran Integrated Care Services (VICS)



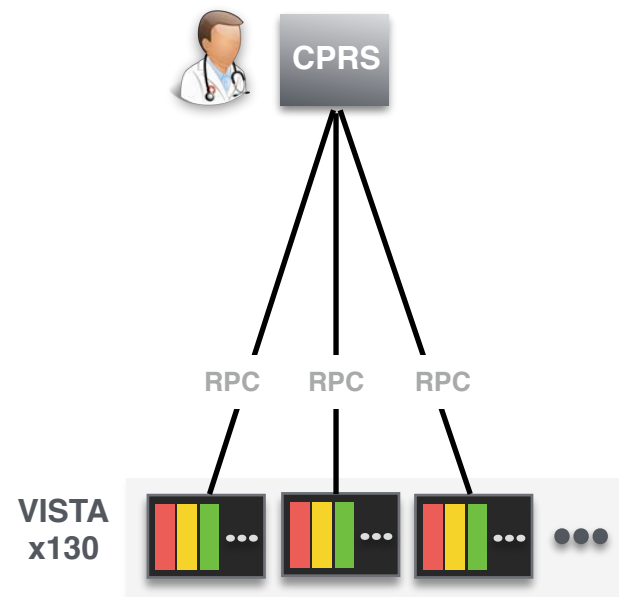
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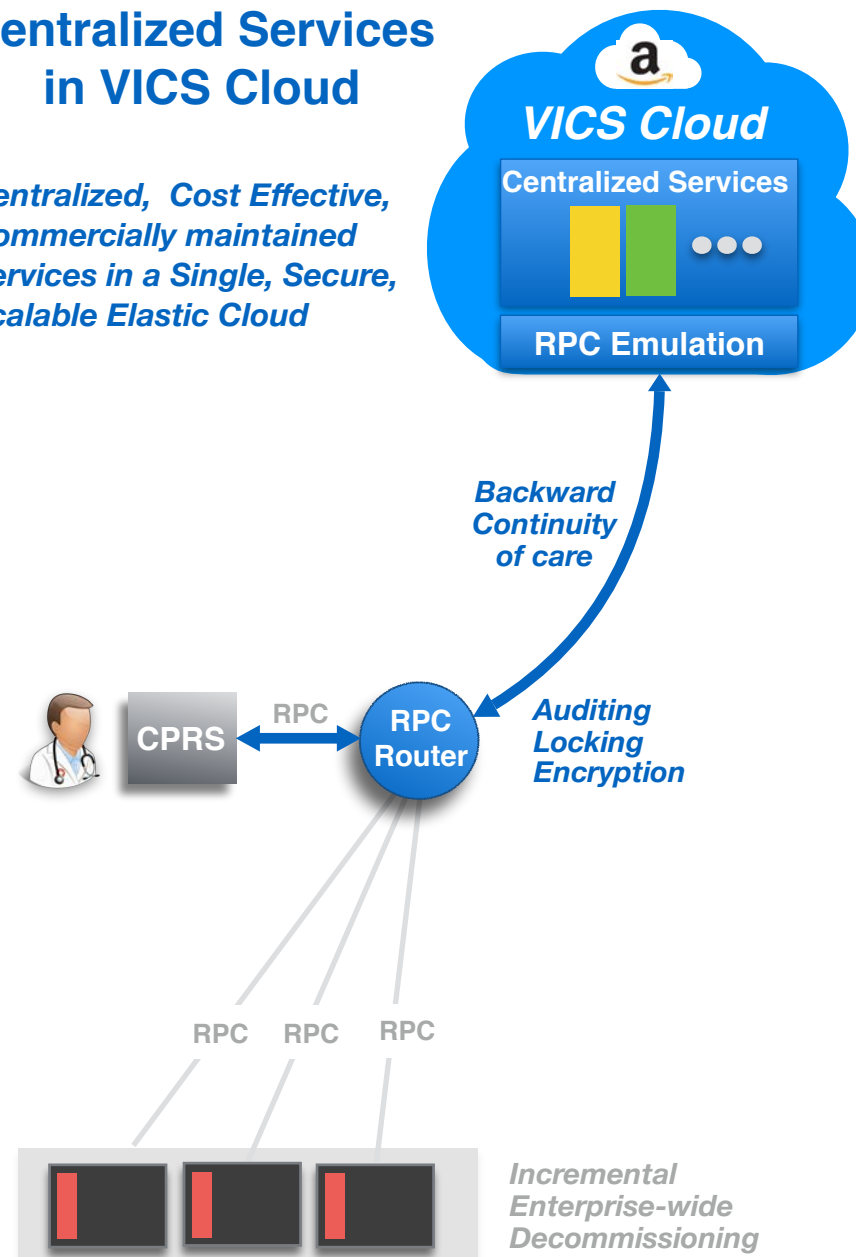


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VISTA Adaptive Maintenance

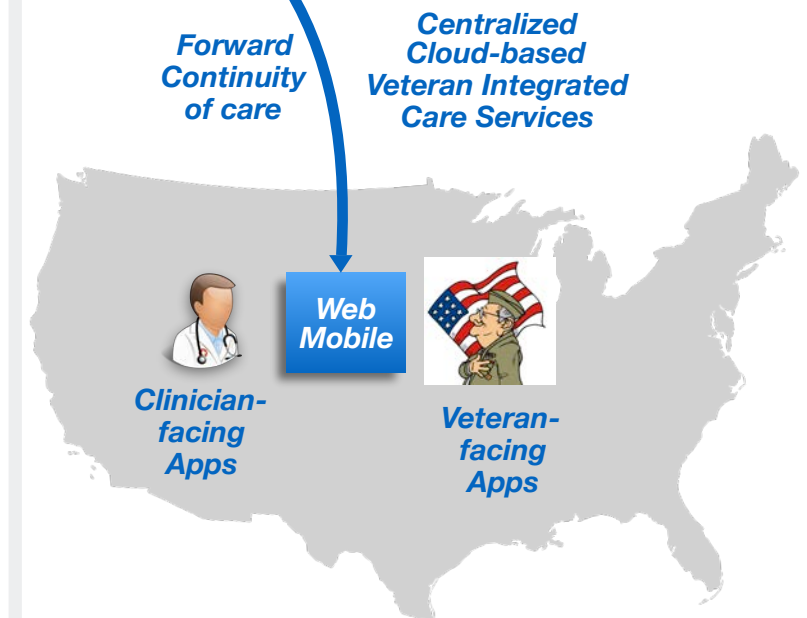
Centralized Services in VICS Cloud

Centralized, Cost Effective, Commercially maintained Services in a Single, Secure, Scalable Elastic Cloud



As functionality (colored bars) is incrementally centralized to the cloud following VA priorities, the corresponding functionality across all 130 VISTA systems may be safely decommissioned enterprise-wide, with no loss of continuity of care.

Veteran Integrated Care Services (VICS)
Veteran Integrated Program V18-00154-000
VISTA Adaptive Maintenance
Office of Information Technology
U.S. Department of Veterans Affairs
Initial Operating Capability: Q4 2018
VA Palo Alto Health Care System



Veteran Care Everywhere

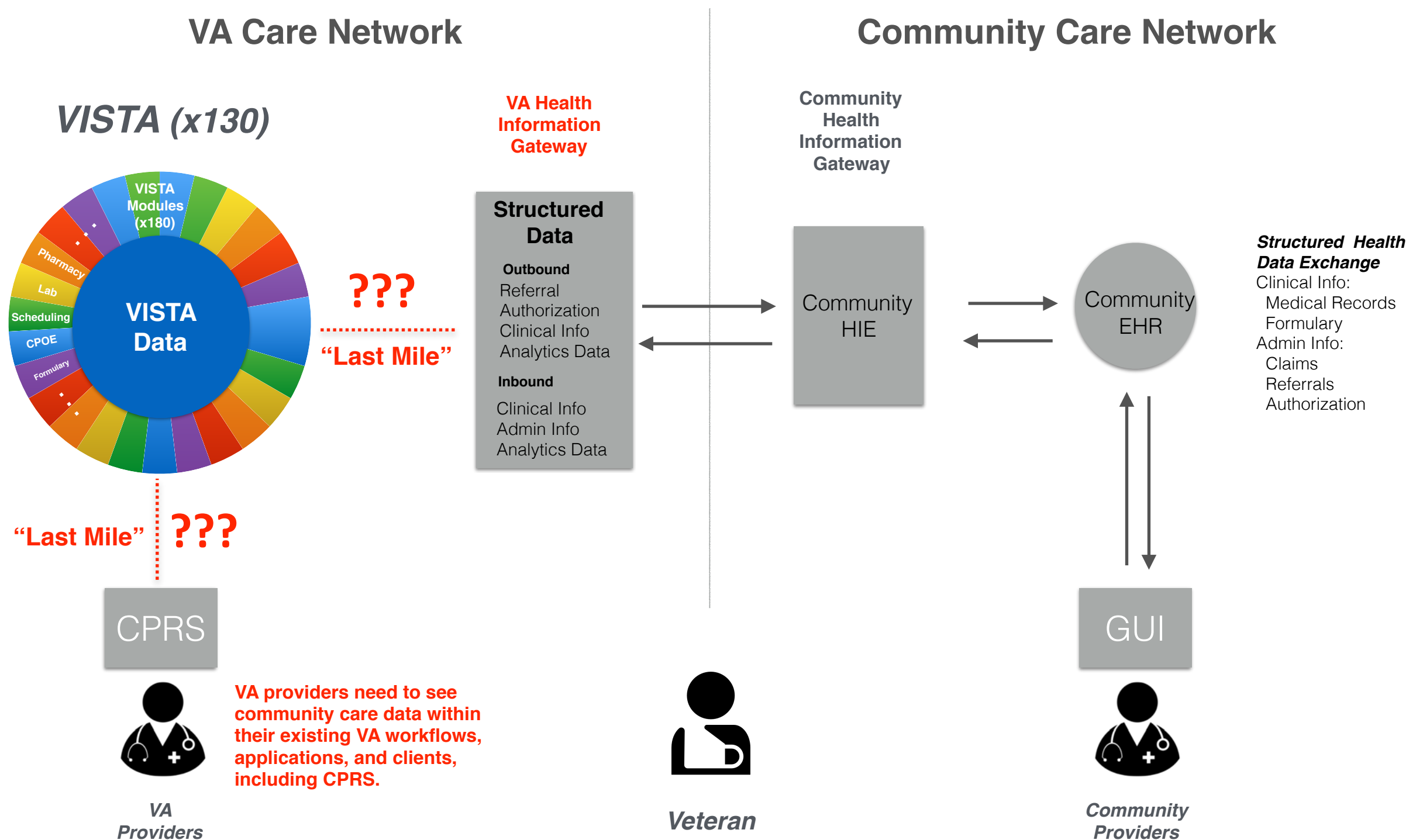
Integrated care is delivered between any VA clinician and any Community clinician to any veteran, anywhere, any time, through common, centralized, secure, cloud-based Veteran Integrated Care Services (VICS)



Linked VISTA: Community Care Coordination

Problem

The “Last Mile”. After intake of Community Care data into the VA environment (gateways or repositories) how can structured data be securely integrated the “last mile” to VISTA and leverage all existing, proven, fully-deployed VA clinical workflows, applications, business logic, and clients (including CPRS) so all VA Providers can *immediately* benefit and coordinate care?

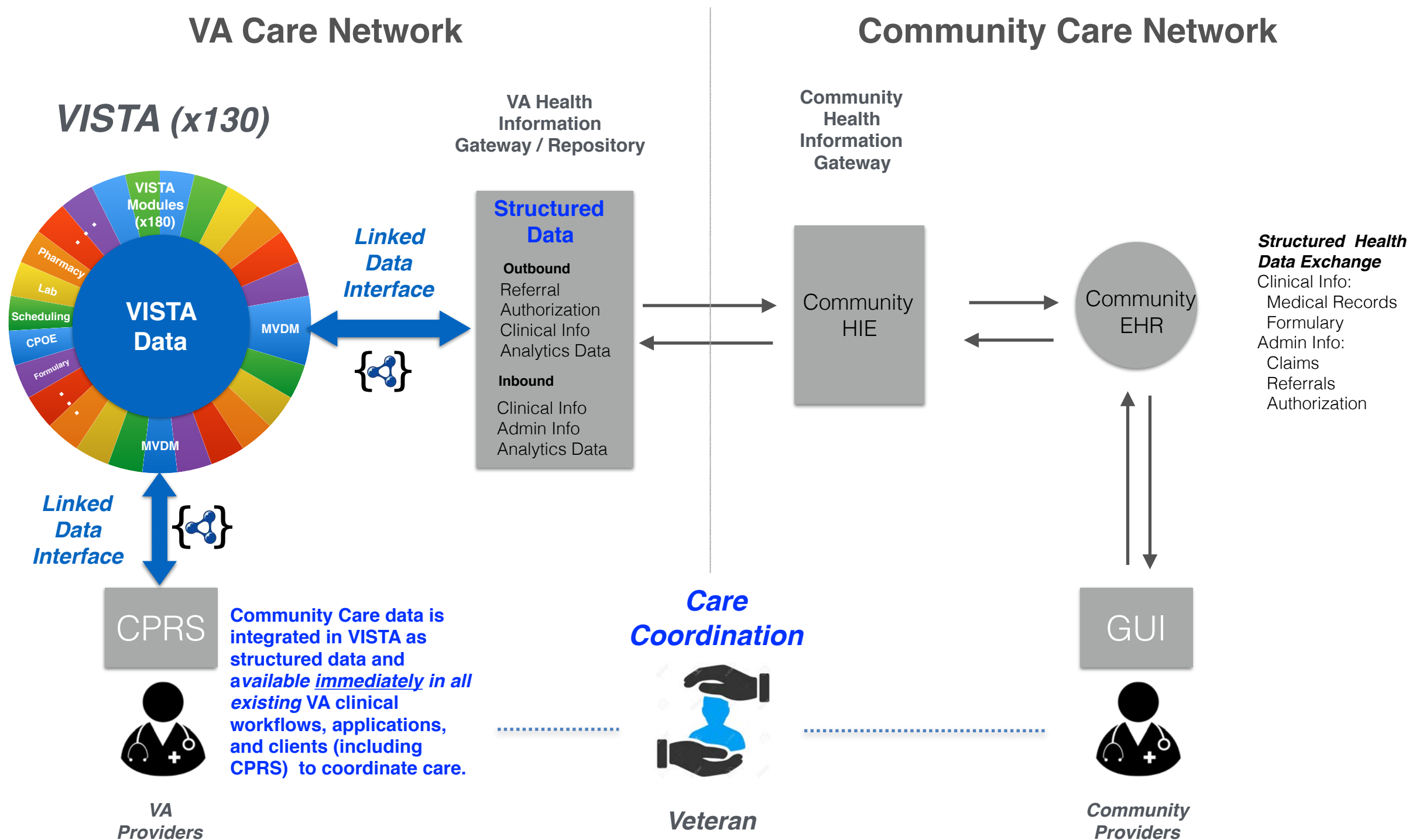




Linked VISTA: Community Care Coordination

Solution

Linked Data Interface. Merge structured Community Care data into all VA VISTA systems through one single secure structured Linked Data Interface (Master VISTA Data Model), making Community Care data available immediately in computable form in all exiting VA VISTA applications, workflows, and clients (including CPRS).



VA Modernization with Continuity of Veteran Care

From 130 VISTAs to Centralized Cloud-based Veteran Integrated Care Services



VA
HEALTH
CARE

Defining
EXCELLENCE
in the 21st Century

VISTA Adaptive Maintenance

Veteran Integrated Program V18-00154-000

Office of Information Technology

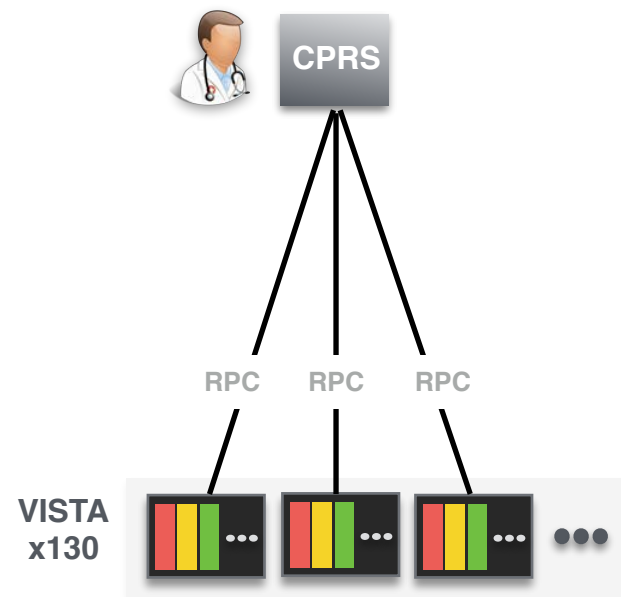
U.S. Department of Veterans Affairs

Initial Operating Capability: Q4 2018

ViSTA Current State

Decentralized Care across 130 VISTAs

Today, care is delivered in VA using the CPRS user interface, which relies on 130 unique decentralized VISTA systems for its functionality via remote procedure calls (RPCs).

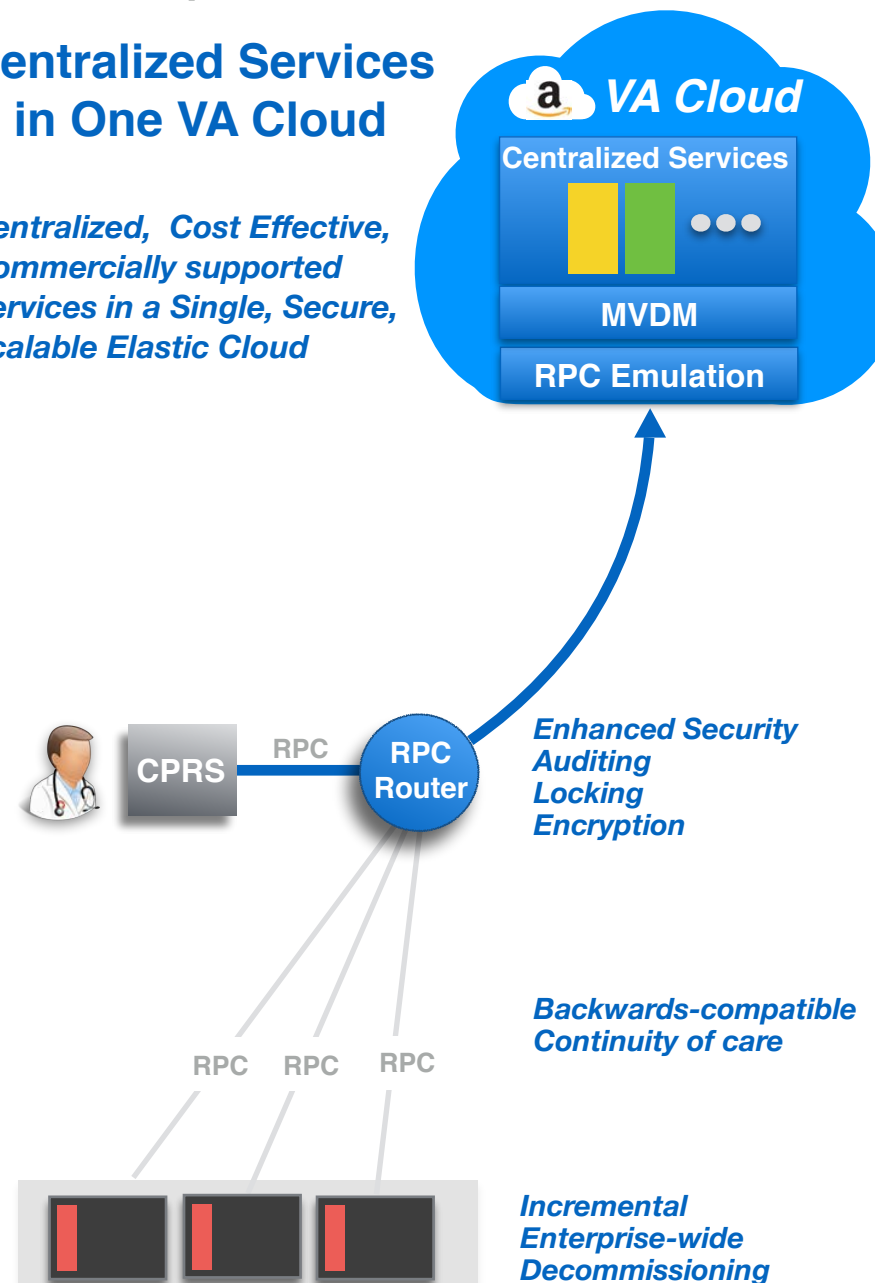


VISTA is comprised of many functional domains (colored bars) integrated within a single database (black).

VISTA Adaptive Maintenance

Centralized Services in One VA Cloud

Centralized, Cost Effective, Commercially supported Services in a Single, Secure, Scalable Elastic Cloud



• Continuity of Care

CPRS continues to work unchanged using the new centralized services (via RPC Emulation) providing backwards-compatible continuity of care during centralization and decommissioning.

• Master Veteran Care Model

Master Veteran Data Model (MVDM) captures and normalizes the veteran-specific care model across all 130 VISTAs.

• Commercially maintained

Deployment and management using COTS tools available on Federally-approved commercial clouds.

• Enhanced Security

VISTA RPC interfaces are fully audited, locked down, and all traffic encrypted via interception and grooming provided by the RPC Router.

• Incremental Decommissioning

As functionality (colored bars) is incrementally centralized to the cloud following VA priorities, the corresponding functionality across **all 130 VISTA systems may be safely decommissioned enterprise-wide, with no loss of continuity of care.**

Veteran Integrated Care Services

Integrating VA and Community Care
through Centralized, Cloud-based
Veteran Integrated Care Services

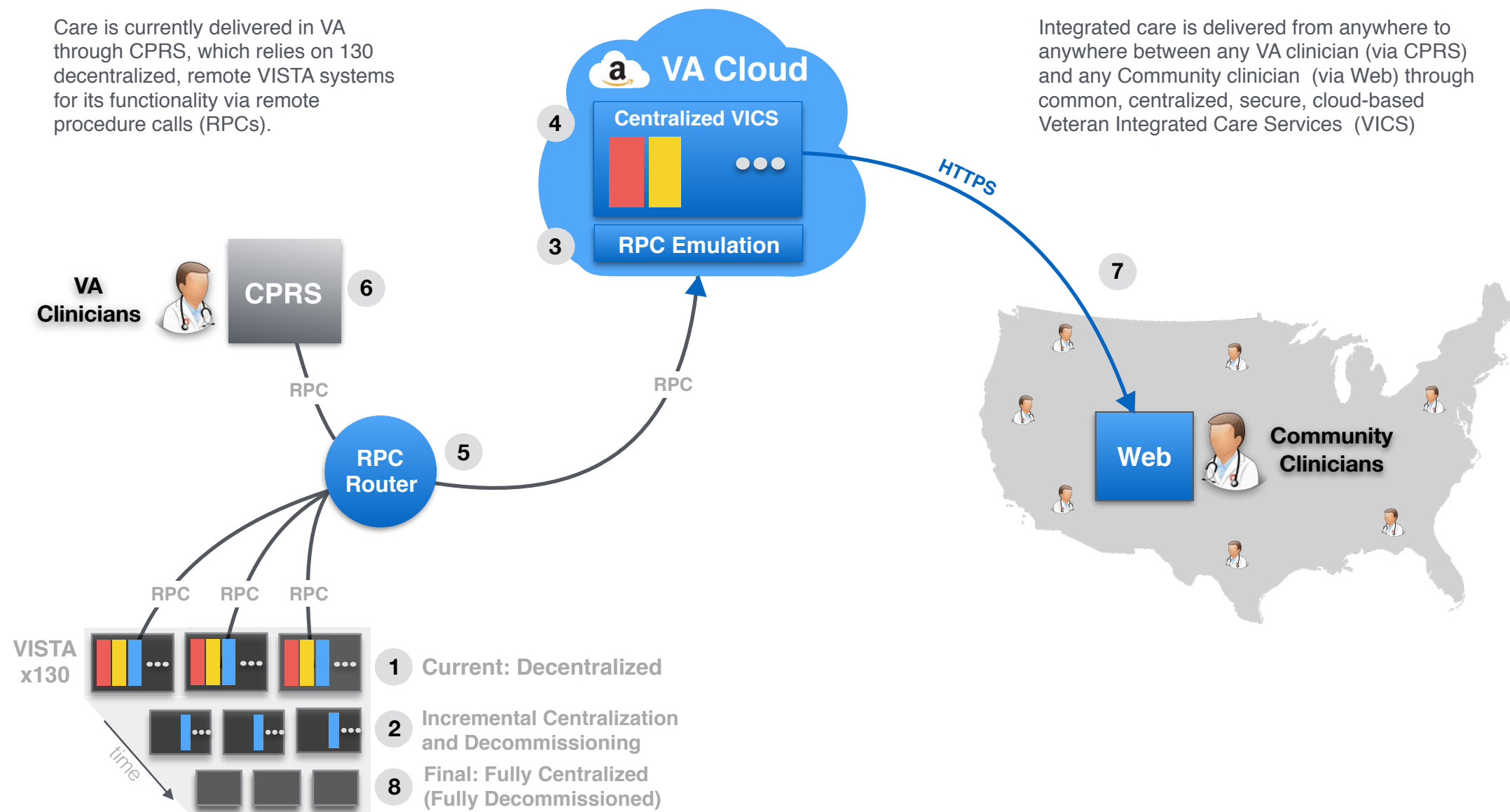
VA Care Decentralized

Care is currently delivered in VA through CPRS, which relies on 130 decentralized, remote VISTA systems for its functionality via remote procedure calls (RPCs).

Veteran Integrated Care Centralized

Community Care Anywhere-to-Anywhere

Integrated care is delivered from anywhere to anywhere between any VA clinician (via CPRS) and any Community clinician (via Web) through common, centralized, secure, cloud-based Veteran Integrated Care Services (VICS).



1. Decentralized VISTA x130 is comprised of over 100 functional domains (colored bars) integrated within a single database (gray).

2. Incremental Centralization and Decommissioning: As functionality is moved to the VA cloud as centralized services (red, yellow bars), the corresponding functionality across all VISTA systems may be safely decommissioned ("go dark") with no loss of functionality.

3. RPC Emulation incrementally normalizes and standardizes the business logic across all VISTA systems.

4. Centralized, Veteran Integrated Care Services (VICS) provides the same functionality as in the original function of the decentralized 130 VISTA systems (red, yellow bars).

5. RPC Routing incrementally redirects (centralizes) CPRS to the cloud while providing backwards compatibility to all 130 VISTA systems

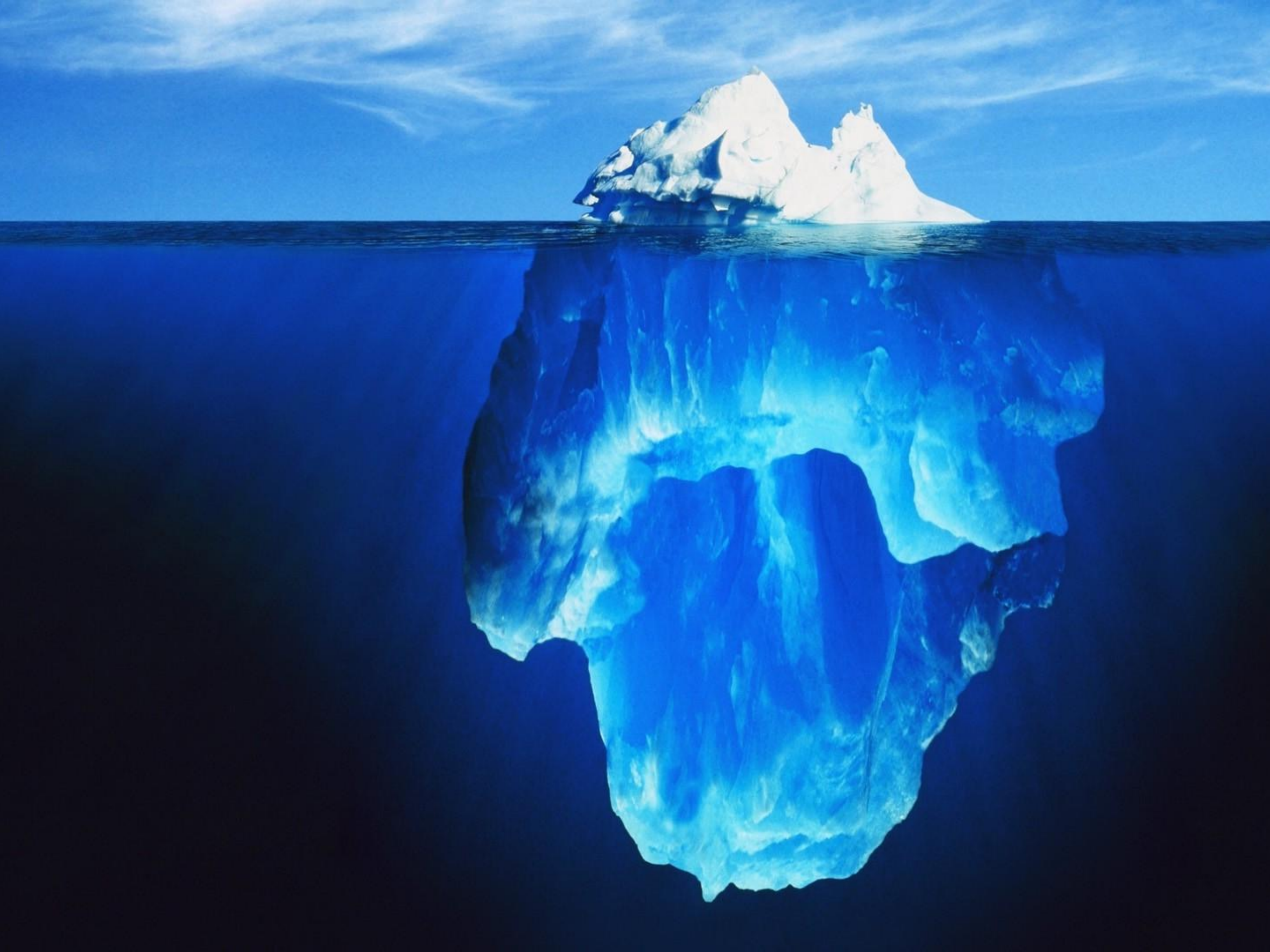
6. Continuity of Care: CPRS continues to work unchanged using the new Centralized Services (via RPC Routing and Emulation) providing continuity of care for veterans during centralization.

7. Integrated Community Care: Anywhere-to-Anywhere care between any **VA Clinician** (using the CPRS interface) and any **Community Clinician** (using a Web interface) **both using the same, single, centralized cloud VICS.**

8. VISTA Decommissioning: As VISTA functionality is incrementally centralized, all 130 VISTA systems may be safely decommissioned enterprise-wide with no loss of continuity of care.



VISTA Data





VISTA Data Model (VDM)

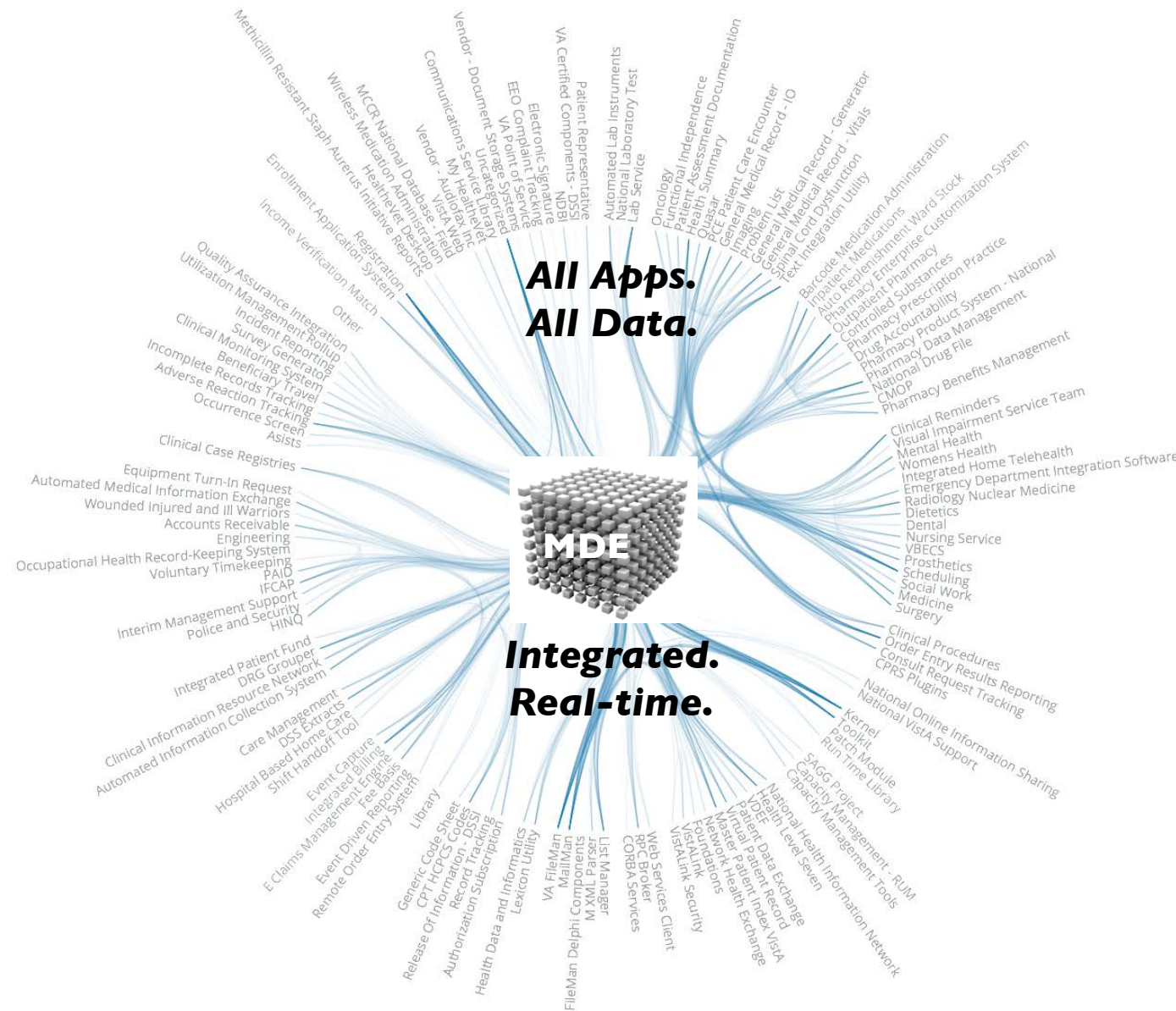
A Path to VISTA Data Management:

- VISTA's Database
- VISTA's Data Model
- VISTA's Data Model Exposed
- Benefits of Leveraging VISTA's Data Model:
 - Master Metadata Management
 - Centralized Knowledge Management
 - Master Data Definition
 - Patient-Centric Security Model
 - Separating Business logic from Data
 - Query Access



Review: VISTA's Database

The foundation of VISTA is a high performance Multidimensional Data-integrated Application Engine in which all data and all applications are fully integrated in real-time with each other and to one single authoritative data source.



VISTA's integrated application data engine. All 180+ applications are integrated with their data and logic inside the multidimensional data engine (MDE). This keeps transactional patient data and logic highly integrated for real-time use within one single data store.

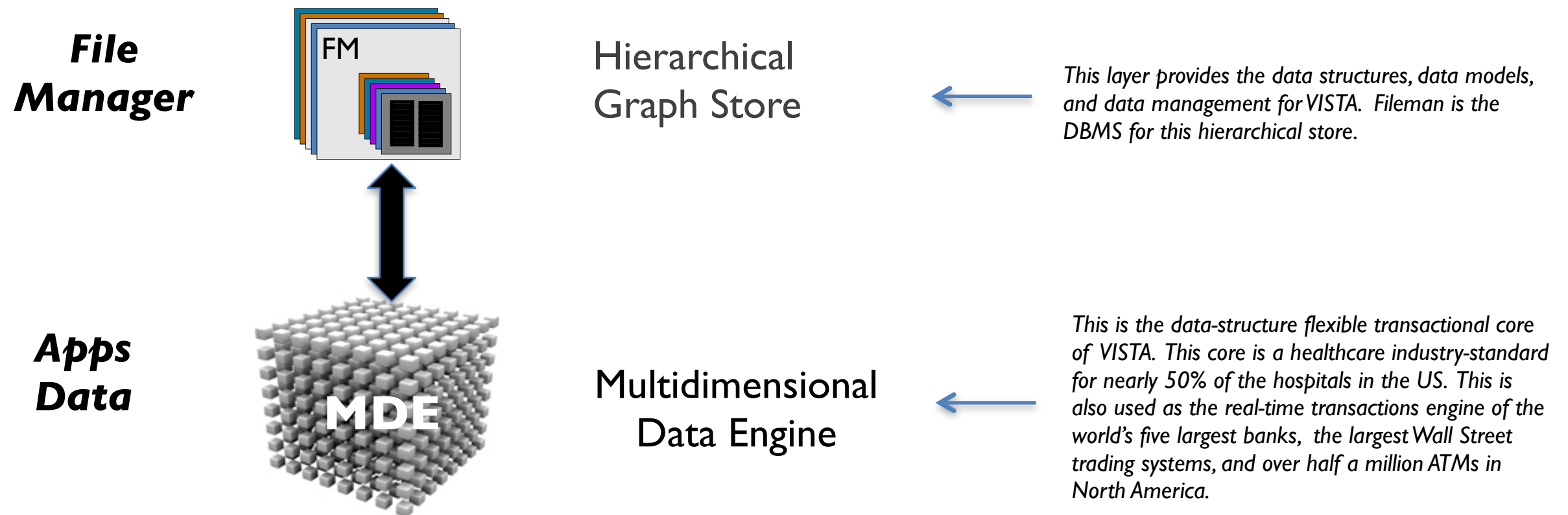
VA uses the same healthcare industry-standard data engine that nearly 50% of hospitals in the US currently use as their core EHR database.

This same multidimensional data engine is also used as the real-time transaction engine of the world's five largest banks, the largest Wall Street trading systems, and over half a million ATMs in North America.



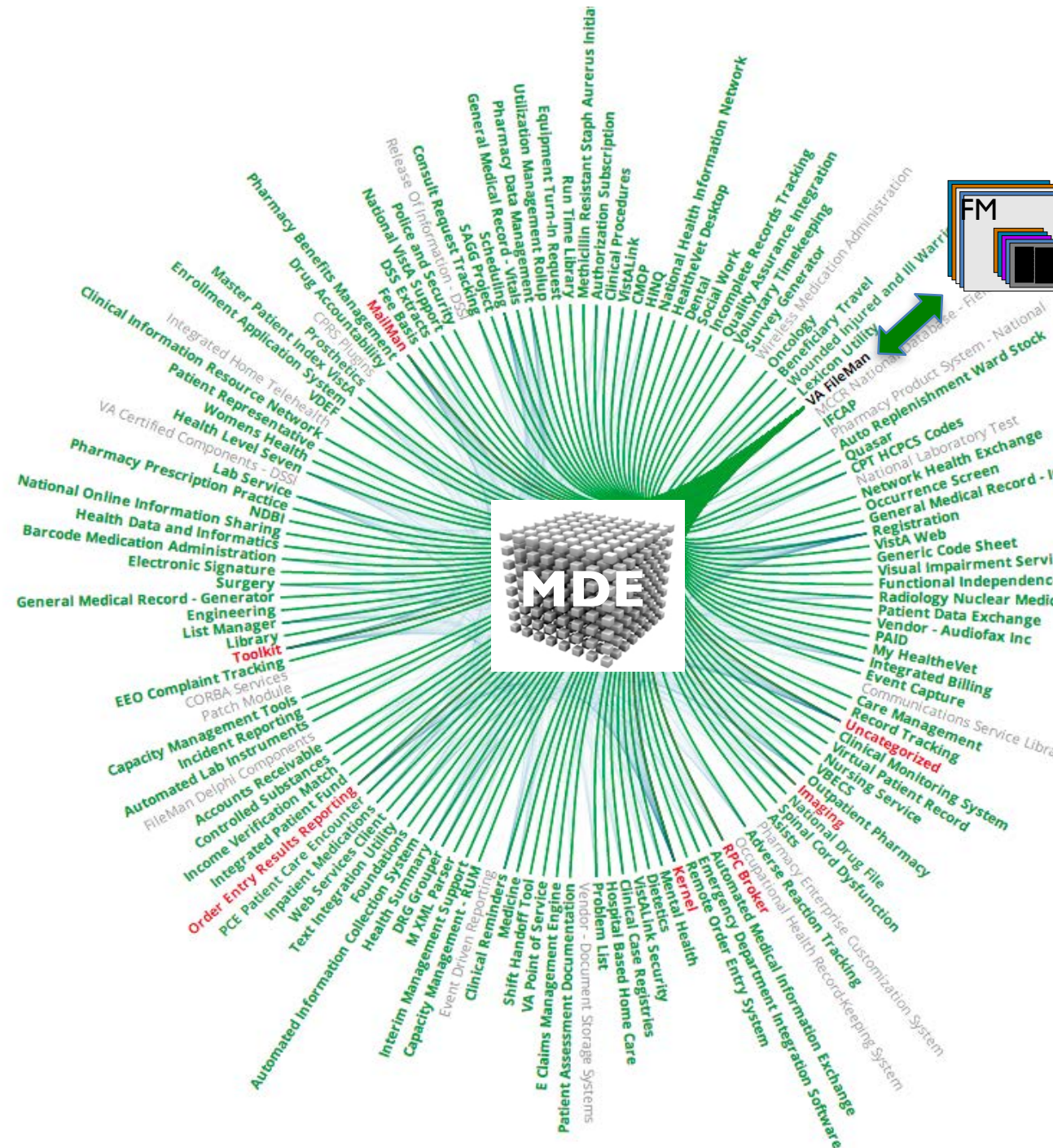
Review: VISTA's Data Model (VDM)

All real-time transactional operations in VISTA take place within the multidimensional data engine (MDE). To provide consistent structure and model for the data, a data dictionary driven hierarchical data storage system is overlaid on top of the MDE. All VISTA applications read and write data to this hierarchical store using a file manager called Fileman.



Review: VISTA's Data Model (VDM)

All VISTA applications read and write data to VISTA's data engine through the NoSQL hierarchical data manager, Fileman (FM). Unlike many NoSQL databases, VISTA's database is not schema-less, but schema-driven. VISTA's schema is self-documenting through data dictionaries in Fileman. *Surprisingly, this fact has not yet been leveraged to expose and modernize the data model.*



All VISTA data is organized through its data model, managed by Fileman.

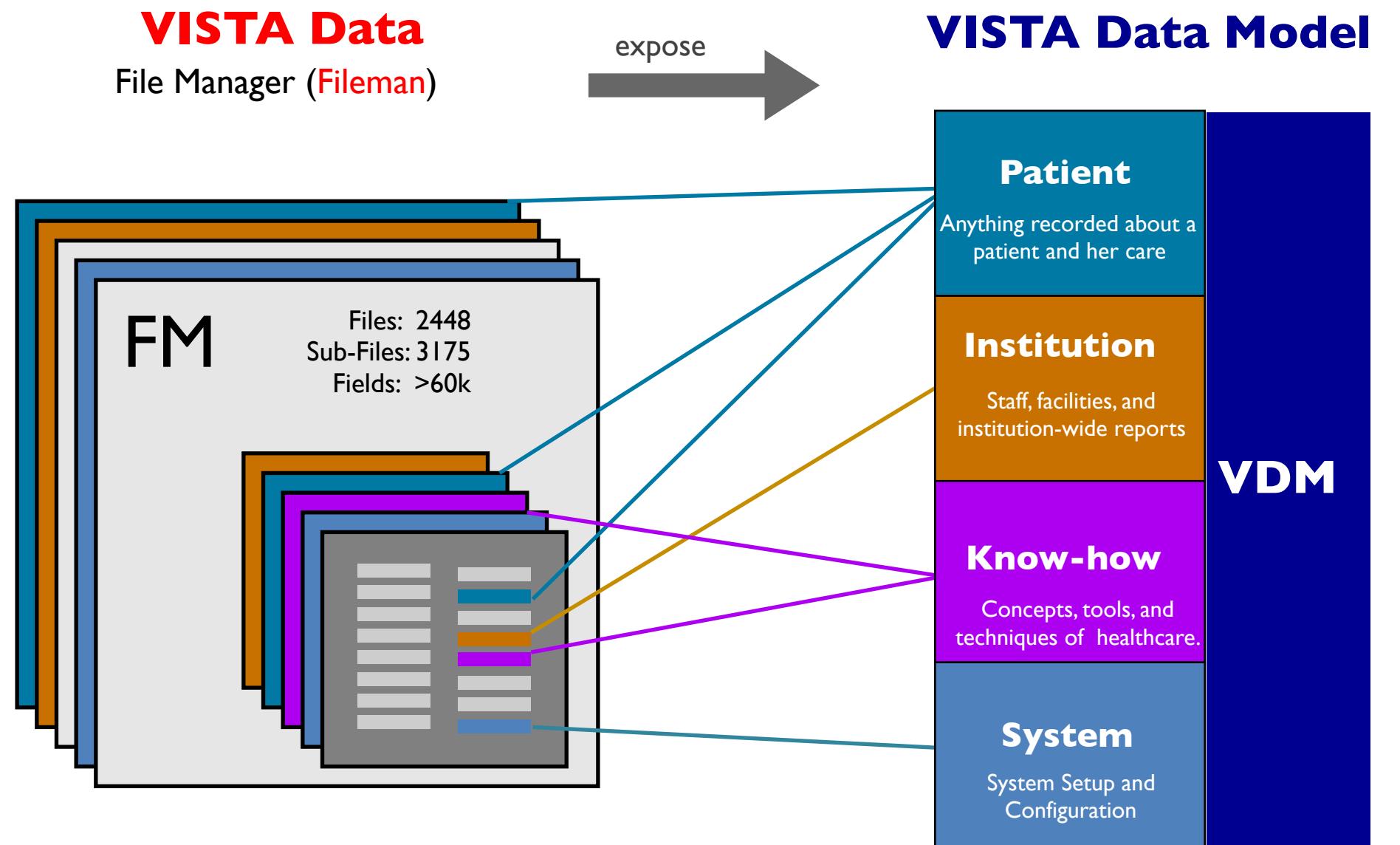
All VistA applications use Fileman to access, structure, and query all data in VistA.

The green lines represent the data flow of all VISTA application to Fileman for all read and write operations to the Multidimensional Data Engine (MDE).



VDM: *Expose and Leverage the Model*

The first stage of data modernization is to expose and leverage VISTA's real, live operational data model. Since this is just metadata, there is no patient data involved. Unlike many NoSQL databases which are schema-less, VISTA's NoSQL database model is self-documenting through Fileman. This allows us to render this in a standard definition format. In this new web-standard medium, data can be sorted, tagged, searched, and organized by data categories such as by patient, institution, know-how, or system information.



Access: **Thousands of RPCs, API's, HL7**
Model: **Unknown**

Access: **Single query access**
Model: **Consistent, Transparent**

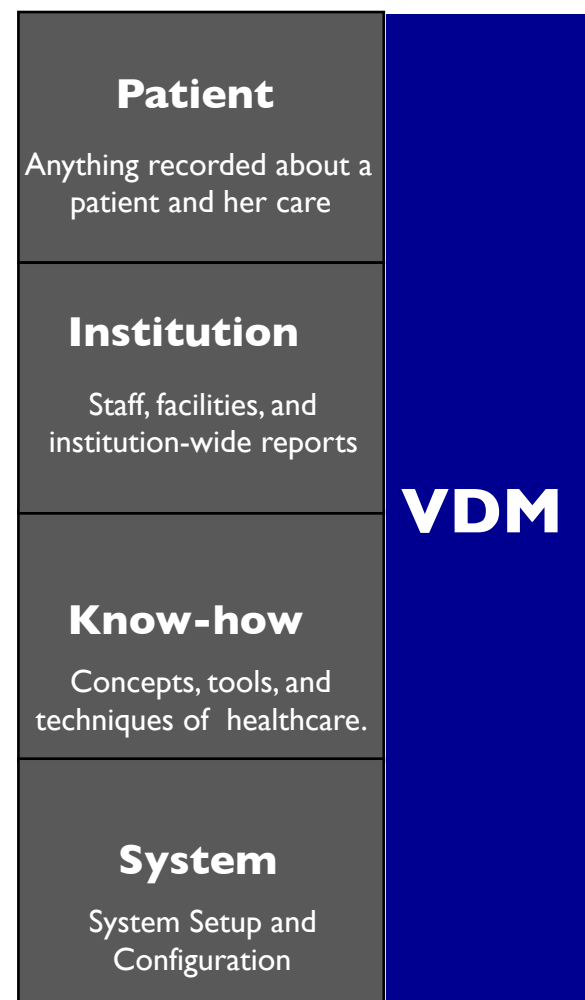


VDM: Master Data Management

A benefit of a VISTA data model allows one to manage data logically across all VISTA application boundaries independent of the source of the data. This lets one manage data with much flexibility, including logically partitioning and managing the data using metadata tagged categories (such as Patient, Institution, Know-how, and Systems information).

VISTA Data Model

- **One may logically partition data by any class of data**, such as Patient data, Institution data, re-usable Know-how, and System configuration data.
- **One may extract and move all patient data from system to system with one operation**, making system configuration migration and patient record movement far more efficient.
- **One may apply security metadata or protocols to any of these logical classes** of data. For example a patient-centric security model for patient data, and thus enforce patient-centric controls on information exchanged.



Benefits:

Patient Data Management

Extract and manage patient data with patient-specific security and metadata, allowing patient-centric controls on data access and exchange.

Institutional Data Management:

Institution specific data can be exchangeable and centrally manageable

Knowledge Management:

Common medical concepts, standards, and know-how may be identified and managed as a clearly defined class of VISTA data.

System Management:

The entire configuration of a system can be identified, extracted, and transported, and inserted from system to system



VDM: Patient-Centric Data Security

An exposed VISTA data model allows one to tag and partition certain classes of data separately from all other data in VistA. Specifically, this allows one to granularly partition any and all Patient data from all other kinds of data in VistA. This provides true, direct, “on the metal” security on patient data itself.

VISTA Data Model

- The most important class of data to apply security is the Patient data category. This will allow very granular patient-centric security on the data itself.
- Current VISTA security is based on actions one can take using a legacy menu system - which has no relationship to the data.
- With a data-centric security model, we can specify not just what type of data (“Mental Health Record”...) but whose data (“For patient X”).
- This is much more specific and secure than the prior VistA security model.



Patient-centric security model

Extract and manage patient data with patient-specific security and metadata, allowing patient-centric controls on data access and exchange.

This is compatible with security notions in Meaningful use Data Exchange: it can suppress even data that exists if there is no access permission.

It is essential to improve precision in data security to permit access to VISTA data securely. Otherwise one will have to reverse-engineer 3300 legacy RPCs and their one-off use of Kernel’s menu options for each payload.

A patient-centric security model is much more appropriate, flexible, and secure as a foundation for patient data security than the current VistA security model. The current VistA security model provides security only indirectly, through legacy controls of a menu system for a legacy roll and scroll terminal interface – which has nothing to do with the type of data at all (!).



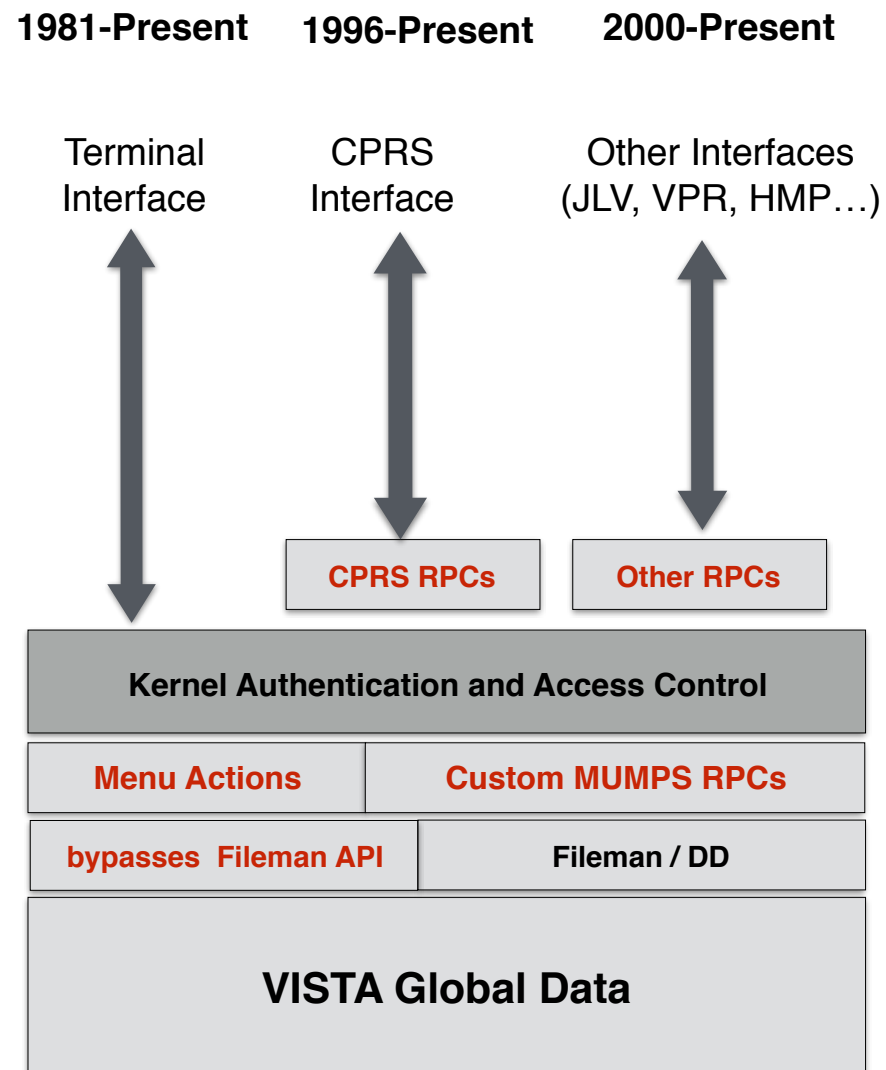
VDM: Analytics Driving Interoperability

Comprehensive exposure and analytics of the VISTA Data Model will drive enhanced data use and interoperability as well as a major improvement in the structure of the database itself. To address these and other areas, focused reports could be generated from the model including:

Report	Activity	
Inconsistencies between VistA data models	Drive dictionary and code fixes in various centers so that every center is running the same consistent model	➡ Enterprise Data Model
Isolate centrally and locally managed “know-how”	Enables the next generation of enterprise knowledge services that seamlessly synchronize Vistas and other applications	➡ Centralized Knowledge Management
Under-definition in the model	Too many ill-defined string values and not enough nuance (“zip code”, “telephone number”) can be defined, and provided additional metadata (“home”, “work”, “mobile”) leading to a plan for incremental dictionary improvement	➡ Enterprise Data Definition
Key logic performed within FileMan	The barrier between the data store and business logic will be laid bare. This report will encourage the movement of certain types of logic into FileMan and out of less maintainable procedural code.	➡ Clean separation of business logic from data
Overlooked but highly valuable types of patient data (Some of this may have been hard-set by the application logic, and overlooked by Fileman or DD)	Improve VistA Data mining (for CDW etc.) and interoperability (more comprehensive electronic patient records). Without a complete model, how do you know what you’re leaving behind?	➡ Clinical Research ➡ Interoperability
VistA model/ FHIR comparison (key types)	Show how a direct from VistA transformation can remove the need for redundant intermediate, hard to maintain procedural code	➡ Accelerate Data Exchange
Isolate patient from other types of data	Enable patient-data access control rather than the crude option/API security now in VistA	➡ Patient-centric Security Model

VISTA Interfacing Evolution

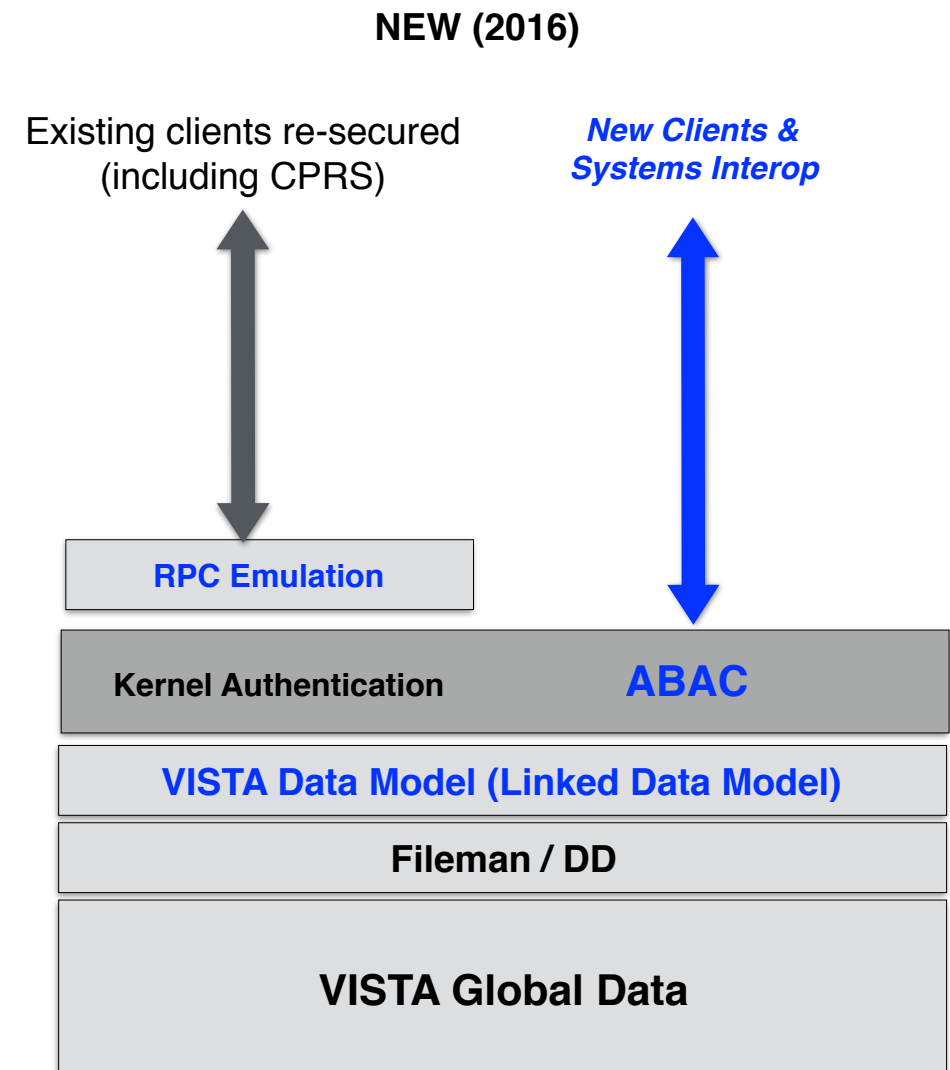
Code-based Interfaces (x 3500, unique)



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.

Model-based Interface (x1, standard)

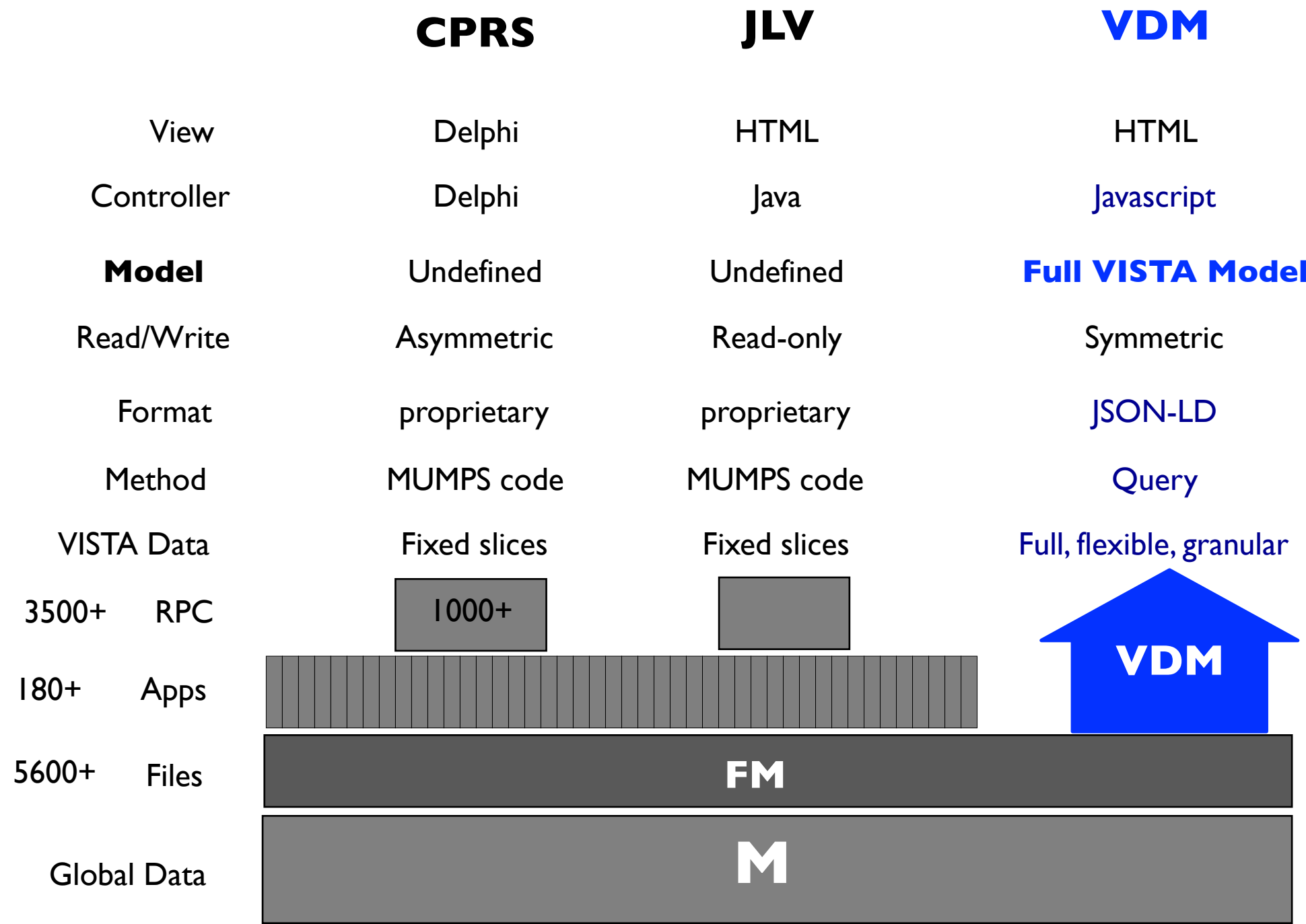


All external interfaces and functionality are Model-driven, language-agnostic, client-agnostic, Fileman API compliant, and secured with both existing Kernel authentication, in addition to new modern, industry-standard, patient-centric, attribute-based access control (ABAC).

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

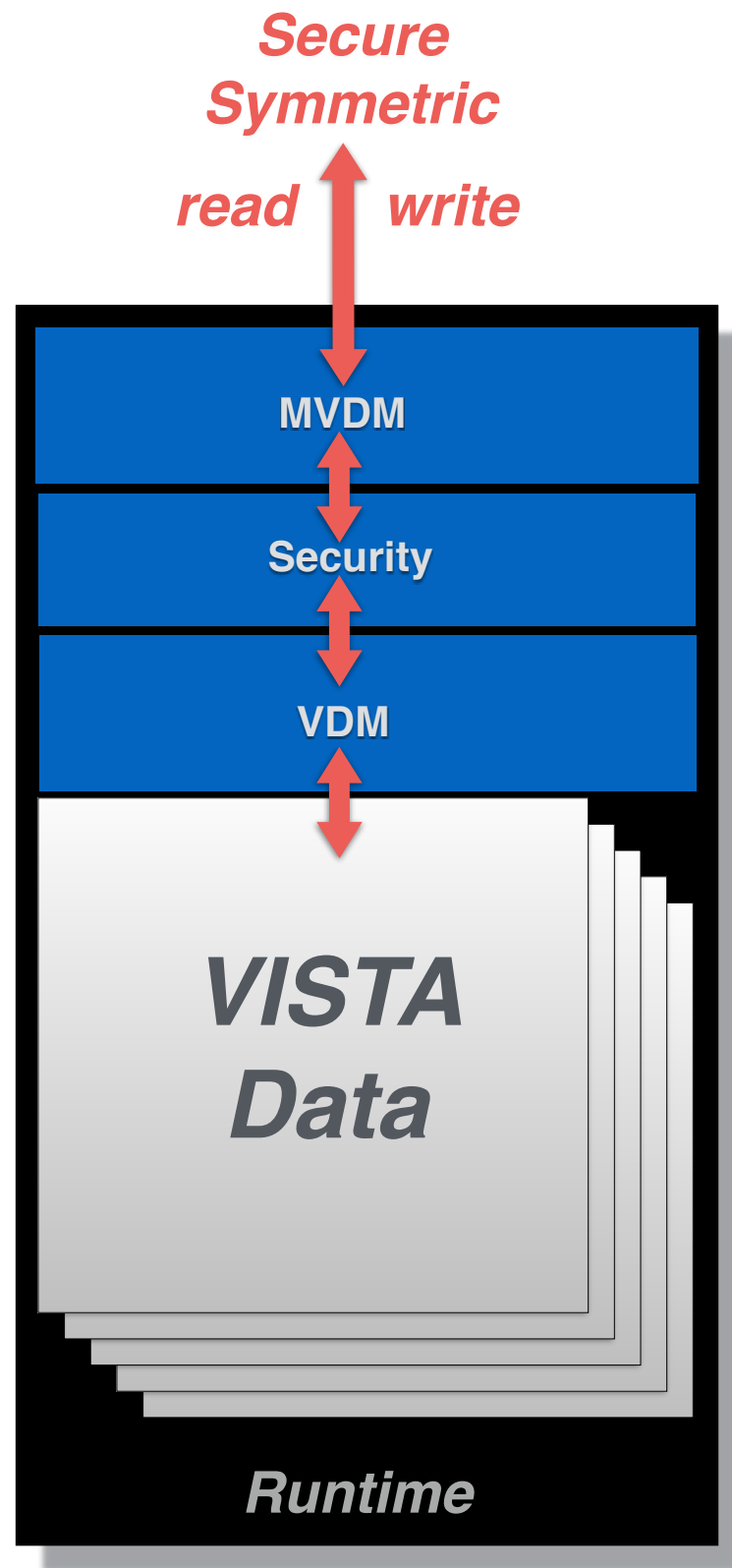


VISTA Data Model (VDM) can access all data spanning 180+ applications with full granularity and definition because the fully exposed VISTA Data model logically bridges all applications through their native data dictionaries. No legacy APIs, HL7, RPCs, or MUMPS code. Just data. All of it. Defined. Structured.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

VISTA Interfacing Evolution

Interface	MUMPS RPCs (x3500)	Master VISTA Data Model (x1)
Method	<ul style="list-style-type: none"> ❌ 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 	<ul style="list-style-type: none"> ✅ <small>NEW</small> Data Model-Driven ✅ <small>NEW</small> Client-agnostic ✅ <small>NEW</small> 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	<ul style="list-style-type: none"> ✅ <small>NEW</small> Applicable to <i>any</i> new interface. ✅ <small>NEW</small> Data-Centric; ✅ <small>NEW</small> Patient-Centric, ✅ <small>NEW</small> Attribute-Based Access Control (ABAC)
Fileman API Compliant	<ul style="list-style-type: none"> ❌ Unreliable, Incomplete ❌ Variable compliance 	<ul style="list-style-type: none"> ✅ Reliable, Complete ✅ 100% Compliant
Audit	<ul style="list-style-type: none"> ❌ Incomplete ❌ Bypassess Fileman auditing 	<ul style="list-style-type: none"> ✅ Comprehensive AND ✅ <small>NEW</small> Patient-Centric
Unit Tested	<ul style="list-style-type: none"> ❌ NO ❌ 0% logic tested 	<ul style="list-style-type: none"> ✅ YES ✅ 100% logic validated
Documentation	<ul style="list-style-type: none"> ❌ Incomplete, inconsistent, unclear. ❌ Requires understanding MUMPS code 	<ul style="list-style-type: none"> ✅ Complete, consistent, clear. ✅ <small>NEW</small> Core is machine generated

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	<p>A single, universal, industry-standard mechanism for reading and writing <i>all VISTA data</i>.</p> <p>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. <i>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.*</i></p>
 Integrity	<p>Comprehensive, automated, standardized, strict data integrity enforcement for <i>all VISTA data</i>.</p> <p><i>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</i></p>
 Security	<p>Comprehensive, industry-standard, fine-grained, data-centric security for <i>all VISTA data</i>.</p> <p>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 <i>what categories of data it is managing</i> 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)</p>

VISTA Data Model Attributes

Representative	<p>VDM operationalizes all relevant VA VISTA data to the maximum extent available.</p> <p>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.</p>
Real-Time	<p>VDM is operationalized using Best-of-Breed real-time server-side runtime technology.</p> <p>The same runtime technology that runs the largest commercial real-time high-traffic websites such as Walmart, eBay, PayPal, Netflix, Uber, LinkedIn, and the New York Times also runs MVDM. <i>This maximizes transactional processing performance directly on the transactional database.</i></p>
Noninvasive	<p>VDM provides VISTA with essential new functionality within the current VISTA architecture 'as is', without modification.</p> <p>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.</p>
Self-Contained	<p>VDM runs entirely server-side, embedded directly on the existing VISTA database.</p> <p>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. <i>This makes it easy to deploy, maintain, and keep highly performant. No moving parts. No external dependencies. No middleware.</i></p>

VISTA Data Model Attributes (continued)

Self-Contained	<p>VDM runs entirely server-side, embedded directly on the existing VISTA database.</p> <p>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. <i>This makes it easy to deploy, maintain, and keep highly performant. No moving parts. No external dependencies. No middleware.</i></p>
Data-Centric	<p>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 <i>comprehensively exposes all the data, which exposes the fact that VISTA has a data model</i> - which up to this point has not been realized nor taken advantage of. <i>This is the opposite of a code-centric approach, which obfuscates the data and its data model.</i></p>
Web-Standard	<p>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.</p>
Empiric Evolution	<p>VDM employs a new approach to empirically 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 <i>the opposite waterfall development</i>. See spiral model</p>