The Integrated Data Environment

HL7 And Beyond

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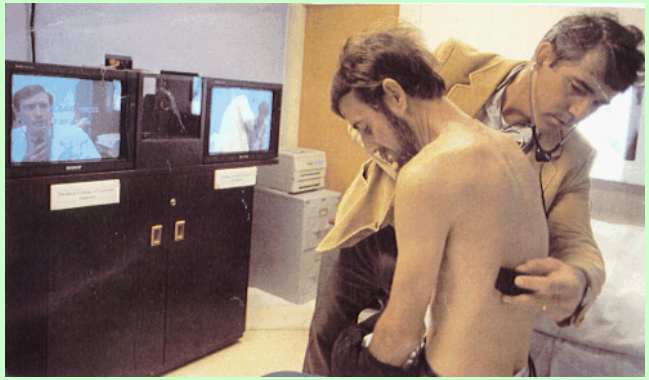
Integrated Data Environment

- Why Integrate
  - The IDE for Telehealth
  - Drivers for a larger IDE
  - Emerging HL7 standards development
  - The Benefits
- How to Integrate

“Types” of Telemedicine

Live (VtC) Consult



Home Health

Store & Forward (Asynchronous)

Store & Forward Telehealth

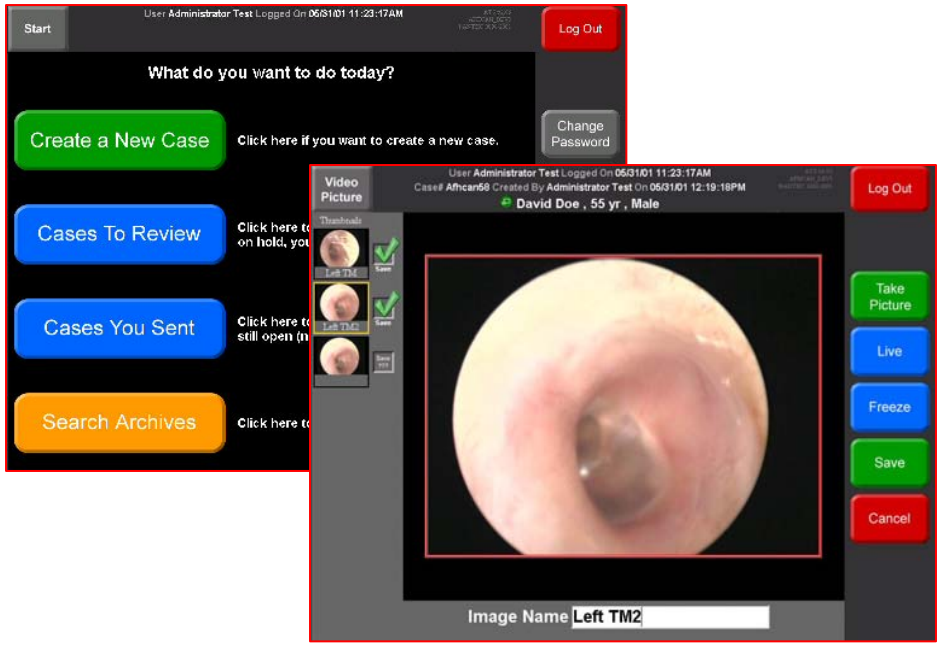
- Low bandwidth requirements
- Static data – e.g. Vital signs
- Static Images
  - Digital camera (megapixel)
  - Scans
  - Captured video images (ENT, Dental, Opthal., Naso.)
- Video Clips – esp. from video devices
- Temporal Data: ECG, stethoscope, tympanometer
- Textual:
  - Health summaries

- Asynchronous.
- Can create a case "on the run."
- Doctor can respond when available.
- Many consults are not critical.
- It is needed as a communication tool.
- Fits with present model.
- Minimal onsite technical support is needed.

AFHCAN Software & Cart

AFHCAN has deployed almost 300 carts to over 200 locations.

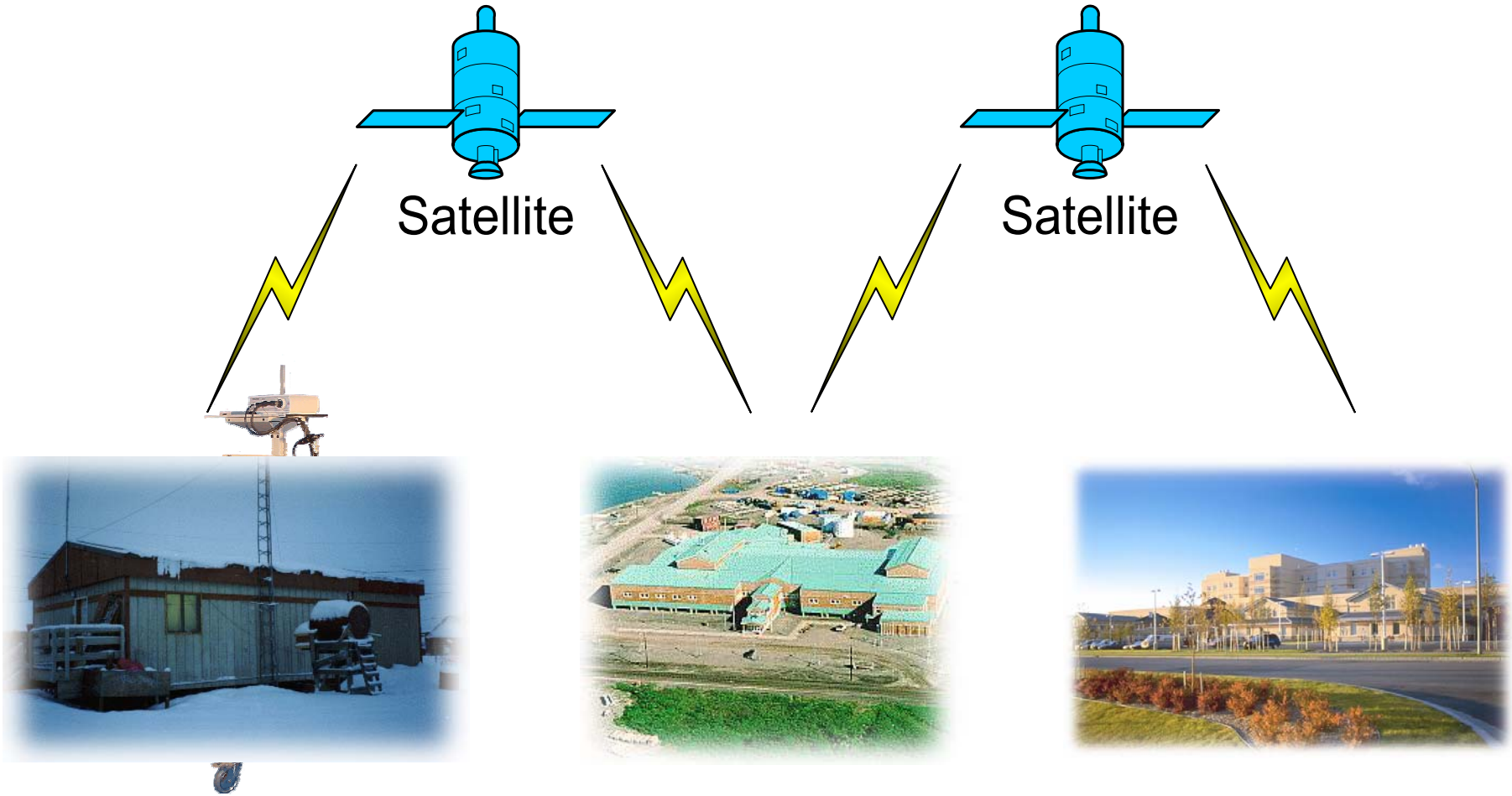
The “Cart” has proven to be exceptionally robust, with minimal downtime and exceptional durability.



User Interface

- Little need for kbd skills
  - Touchscreen
  - Simple, Color coded
- Efficient usage
  - Create case in 5 to 10 minutes (typical)

Multi-Organizational S&F

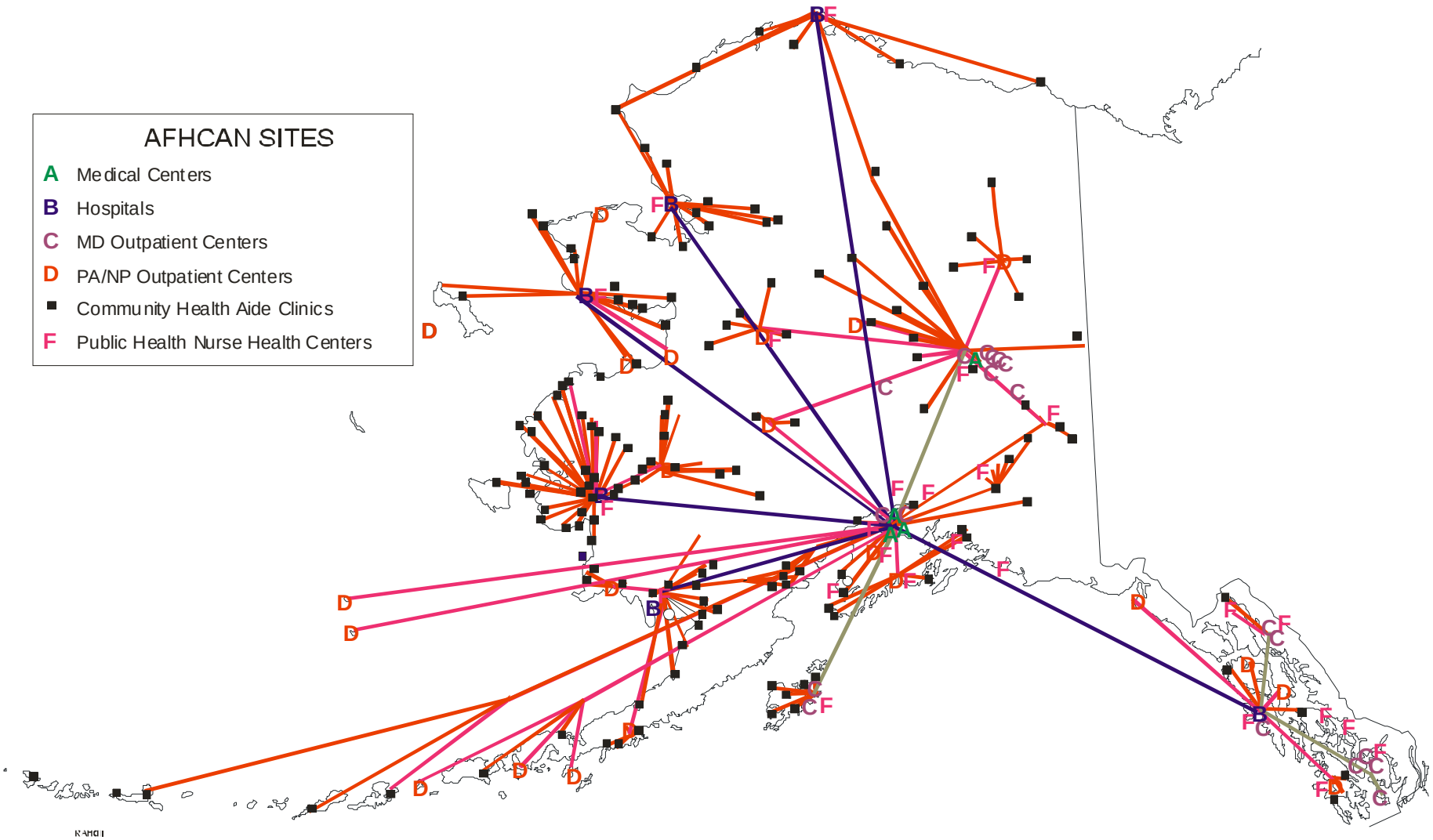


Noatak Health Clinic

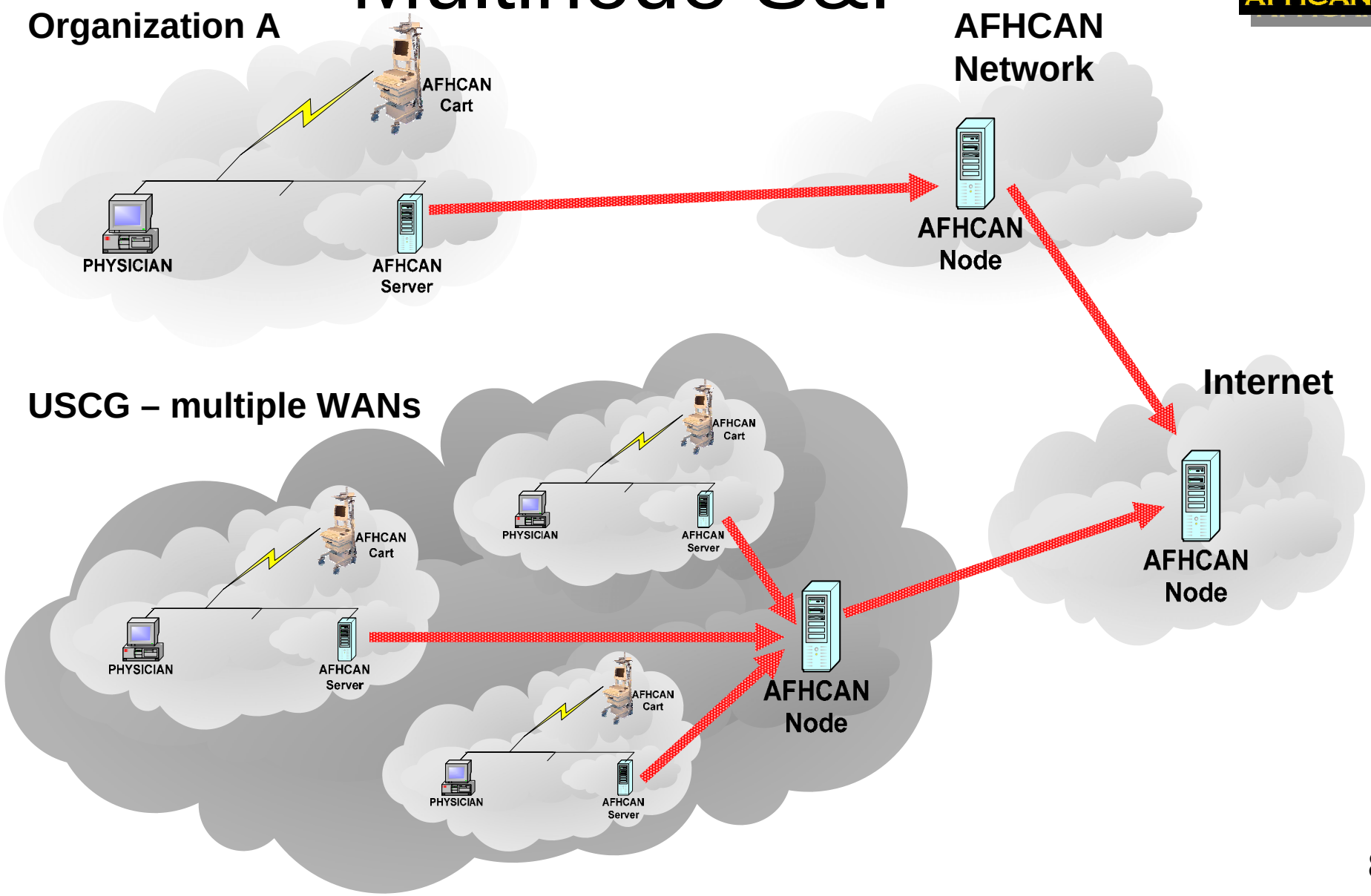
Maniilaq Health Center

Alaska Native Medical Center (ANMC)

AFHCAN Sites: Referral Patterns



Multinode S&F



AFHCAN Telehealth

- 7 years operational history
- R&D Telehealth System
- Manufacturing of Medical Devices
- Whole Product Solution
  - Design → Installation → Training → Support → Marketing

- Installed Customer base includes:
  - 248 sites, 44 organizations
    - 37 Tribal organizations
    - US Army sites (6)
    - US Air Force bases (3)
    - State of Alaska Public Health Nursing (26)
    - US Coast Guard clinics (5)
    - US Coast Guard cutters and ice breakers (6)

AFHCAN Case Numbers

(5/7/2006)

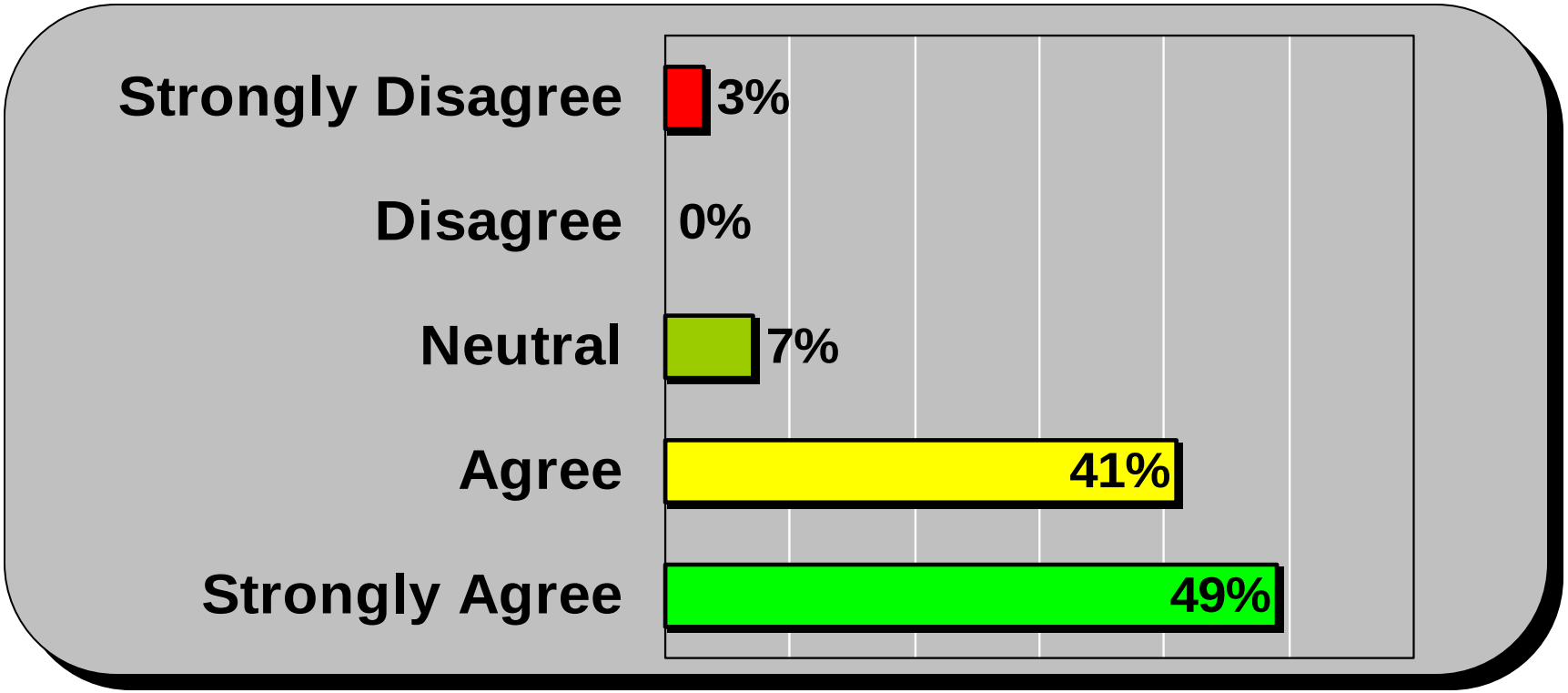
TOTAL Cases:	**41,536**
Archived Real Cases:	**35,057**
Archived Test Cases:	**3,651**
Open Cases:	**2,828**

Enterprise Communication

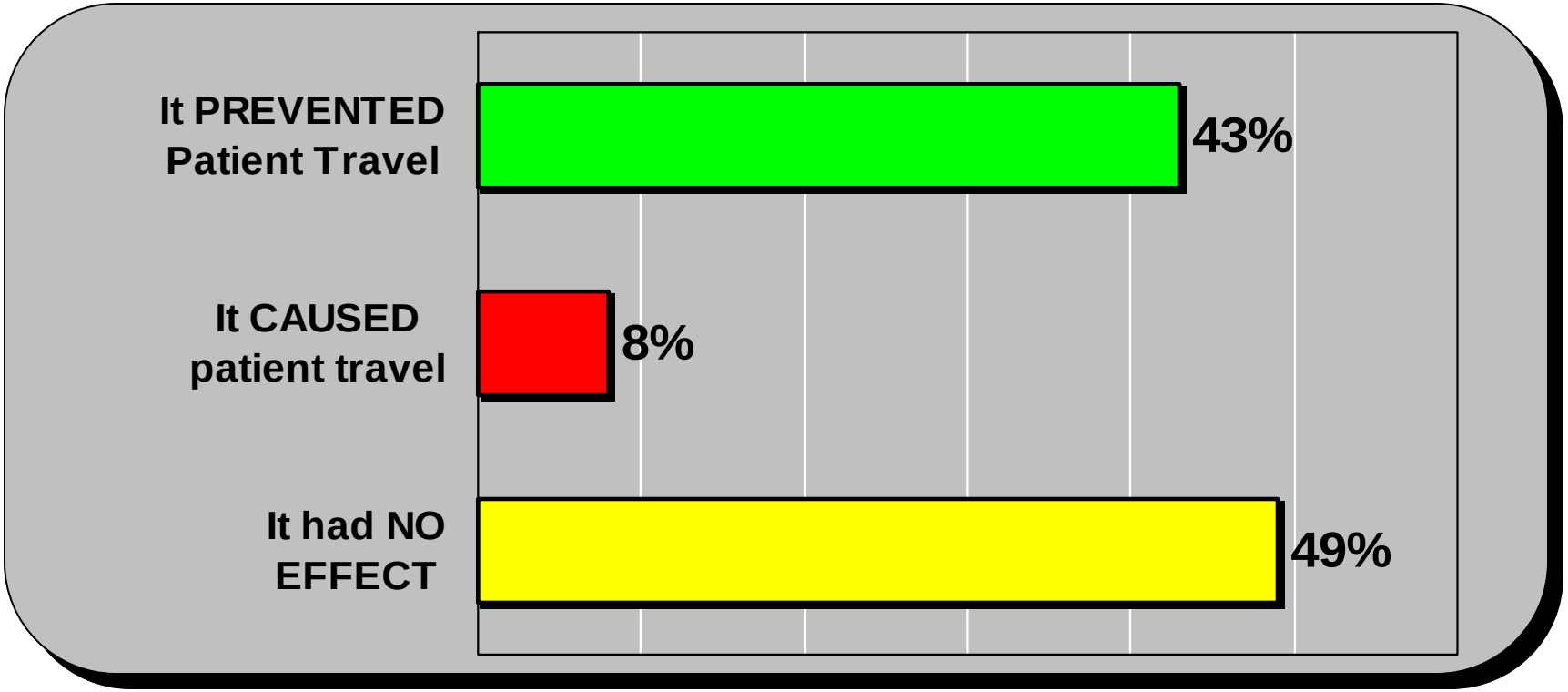
- Business to Business relationships
  - Locally managed
  - Local and Global users / groups
- Secure, transacted delivery
  - Minimal delays in sharing health care data
- Enterprise software management
- Enterprise data collection

For this case, rate the following statement:

Telemedicine helps me COMMUNICATE with a doctor. *(n=761)*



Did viewing this telemedicine case/image affect PATIENT TRAVEL for diagnosis or treatment of this case (compared to a phone consult)? *(n=7,113)*



Extrapolated to 10,000 cases annually, this yields $1.3m - $8m annual savings (depending on airfare estimates and patient age).

Extending Care to the Village

- Pilot project providing audiological services at the village clinic
  - 897 Patients
  - 38 Clinics
  - Proven cost effective

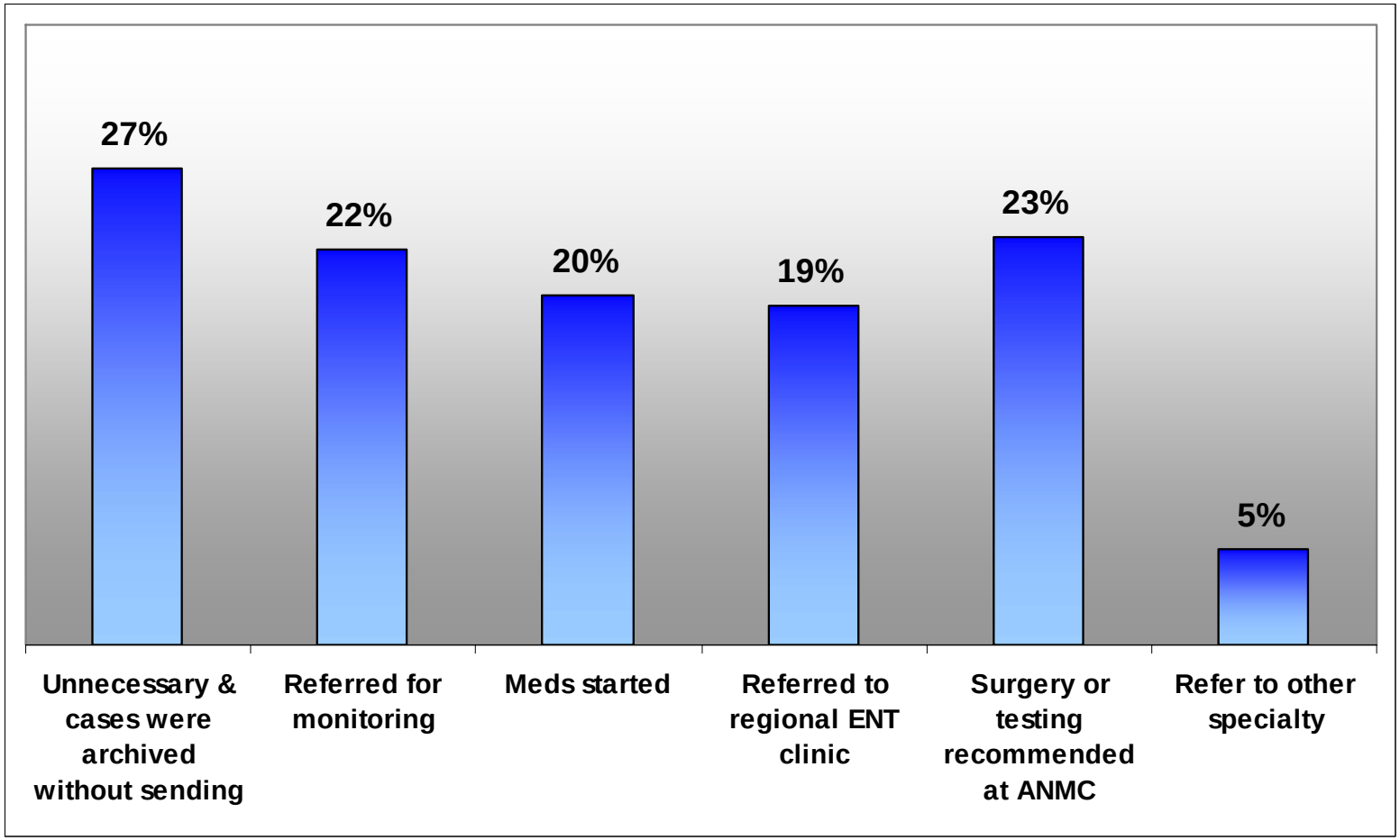
"Having [the audiologist] go out to the villages is a huge financial benefit.

[She] saw 20 patients a day in Selawik which saved us $2400.00 in airfare alone, since those patients would have to be flown to Kotzebue for the same service. Since most of the patients she saw were minors, you can add on another $2400.00 for a parent to accompany the child.

On top of that, the child misses a day of school, the parent misses a day of work, and there are usually other children in the family whose care must be arranged."

Leslie Neely RN
Case Manager, ENT Clinic,
Kotzebue, AK

Outcomes (n=897)



About 73% of the patients seen needed something done (meds, surgery, ongoing monitoring) and 27% needed to be screened out.

Note: Percentages may not add to 100% due to multiple outcomes per case.

Telehealth Surgical Referrals

- A review of 56 telehealth cases that led to direct surgical referrals found:
  - 92.9% accuracy in predicting procedure
  - 31 minute average difference in predicted versus actual operative time.

- By comparison, a matched selection of 56 non-telehealth referrals for surgery:
  - 87.5% accuracy in predicting procedure
  - 36 minute average difference in predicted versus actual operative time.

Less Waiting Time for Patients

- Nome
  - ENT waiting time
    - 6-9 months 2002
    - 2-3 months 2003

"The specialty clinic manager came to see me this morning to indicate that there were four open slots in ENT clinic for September.

This is the first time they were having a tough time to fill those spots!! Speaks well of the telemedicine."

Philip Hofstetter
Audiologist, NSHC

Meeting "Standards of Care"

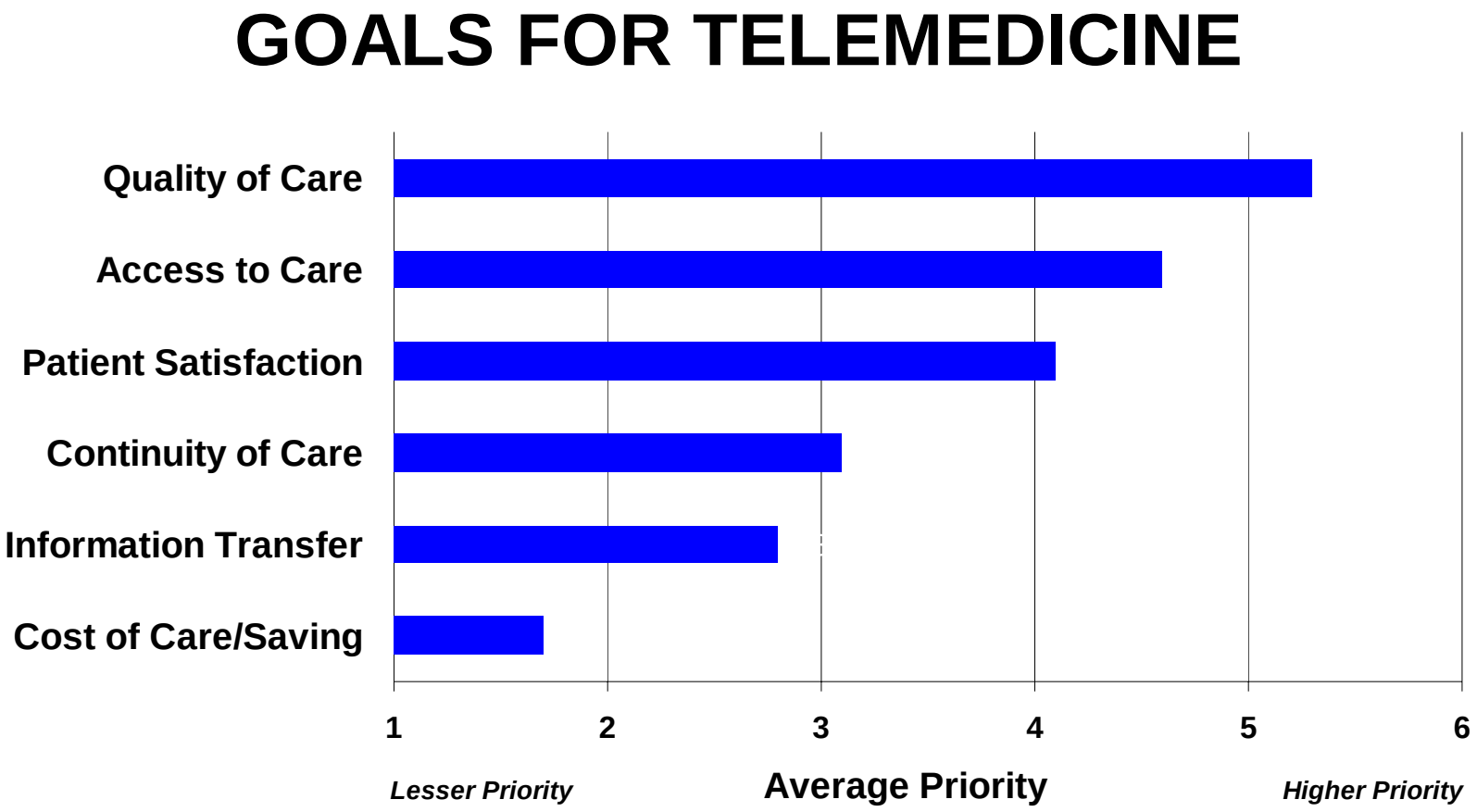
- Post-surgical follow-up is difficult for patients from remote settings.

- Telehealth provides ability to monitor and followup.
  - Validated model
  - "Reverse Consult" empowers CHA/Ps and midlevels to respond to requests from specialists.

"Many simple problems, such as tympanostomy tube follow-up can be done with telemedicine without asking the patient to leave their village."

ENT Specialist

What are your key organizational goals for telehealth applications?



Is Your System Integrated?

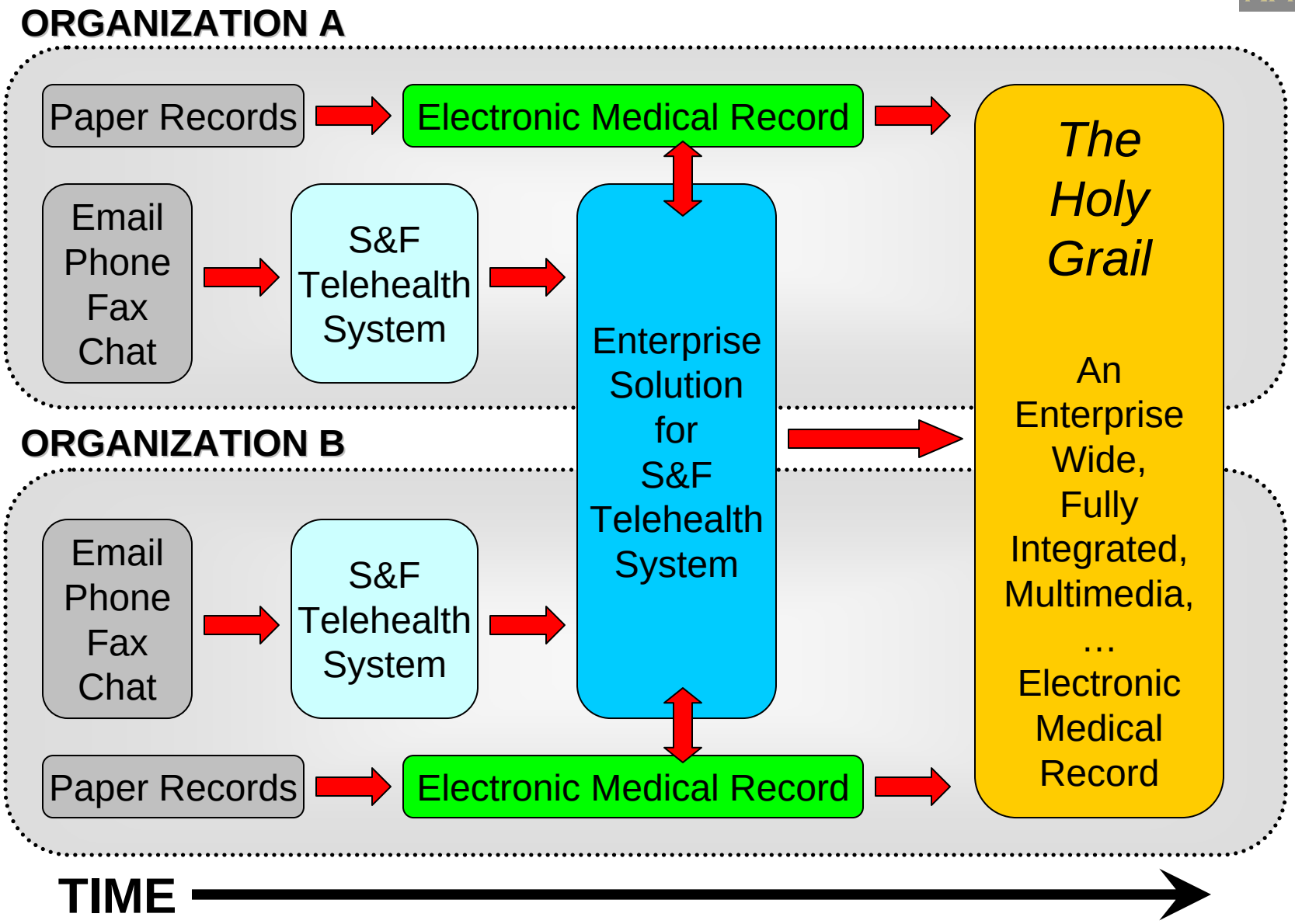
- *"Respondents were asked if their telehealth information system (excluding teleradiology) is integrated with their Hospital Information System."*
  - *"A vast majority (81%, n=70) stated that the telehealth system is not integrated with the Hospital Information System, 13% said the two systems were integrated and 4% were unsure if there was integration.*

Source: National Initiative for Telehealth Guidelines (NIFTE) , April 2003, Canada

Silo telehealth systems can provide significant value to providers.

… it just makes the leap to the next level a “little” harder

Time Varying Solution



Integration Drivers

The Power of Health Data

= Content × Volume × Access

= Information / Encounter × Encounters / Time × Access

CaseViewer

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Case

Patient: Demo, Patient (47 yrs, M)

Case #: Office-D-1

User: Ferguson, Stewart, PhD

AFHCAN Client 4.6

AFHCAN iServer Working Off-Line

0 Cases in Transit

Log Out

Comments

Form

ENT Referral

H&P Page 1

H&P Page 2

H&P Page 3

Ear

Tympanogram

Add To Case

Add Comment

Print

Done

Ear (by Stewart Ferguson PhD, at Office, on 5/5/2006)

“Cart” Roadmap

The “Classic” Cart

Four Devices

“Next Generation” Cart

More Devices - Repackaged

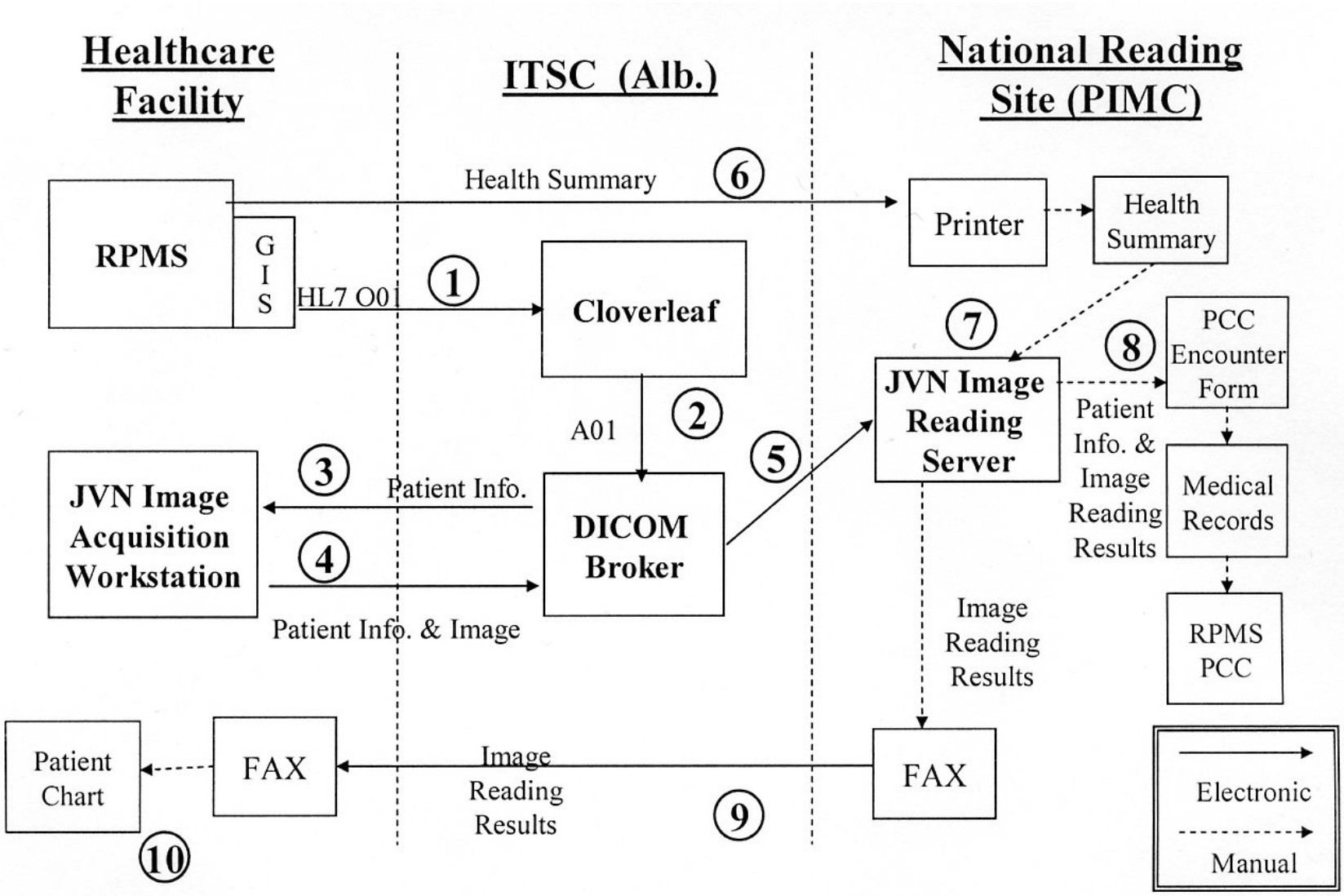
Future Directions – Pushing More Capability to the Village

Ultra-Portable Telehealth Technology

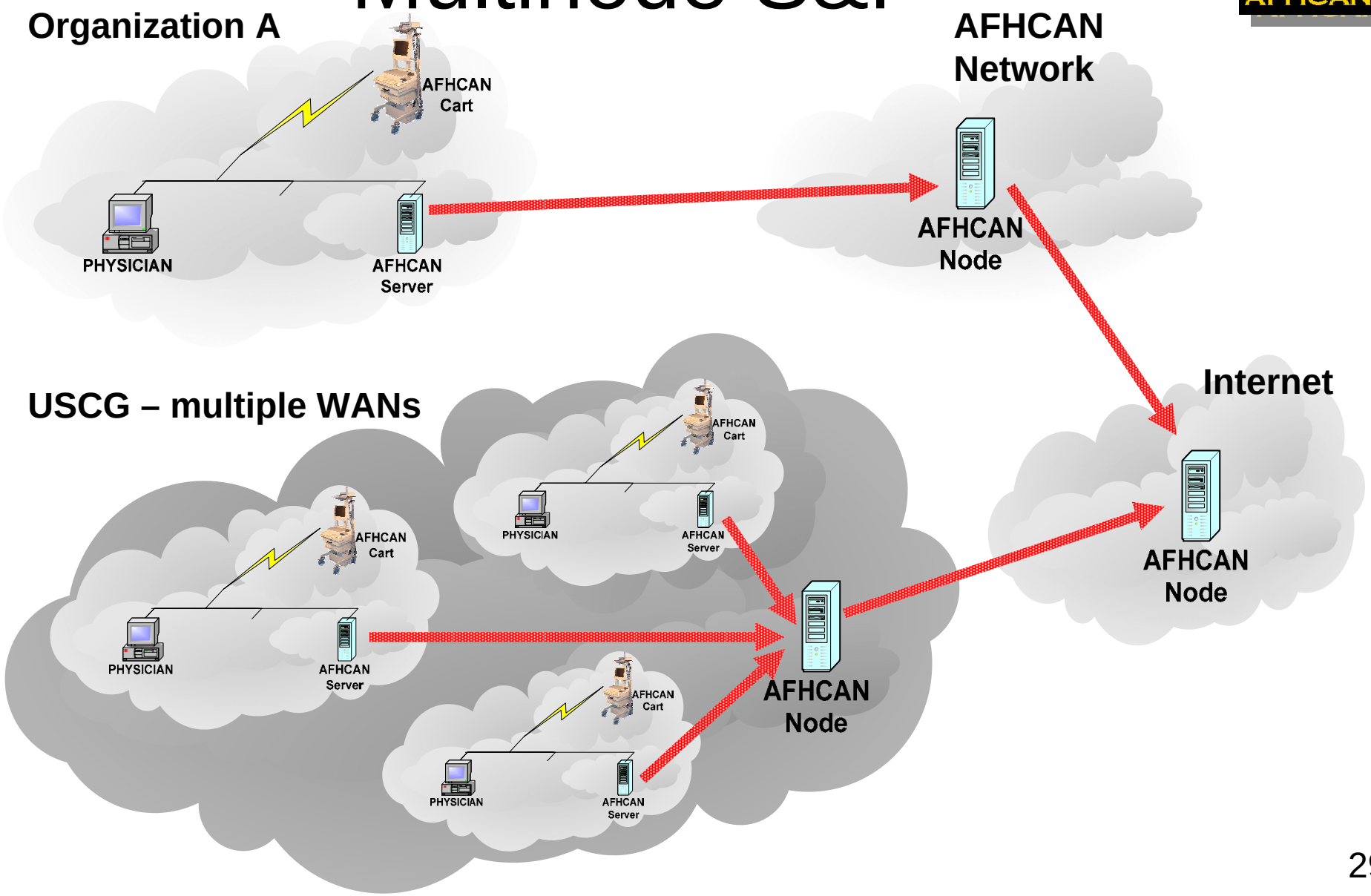
Home Health

Extending more sophisticated technologies with midlevel providers

JVN – RPMS Integration



Multinode S&F



Future Directions - Product Development

- Blended Telehealth
  - Video / S&F / Home
- Fully integrated system approach
  - Migrate from 30 to 300 encounters / week
  - Scheduling interface
  - Billing Interface
  - Evaluation interface
  - Patient-oriented instructions / content

Drivers for Integration

- Continuity of Care
  - Knowledge of telehealth cases within RPMS
  - Providing RPMS data to telehealth system
- Workload credit
- Billing
- Scheduling (e.g. Surgery)
- Integrating with other telehealth technologies
  - JVN
  - PACS
- Multiple modes/sources of information
- Multi-specialty consults
- Take advantage of communications capability
- Single repository
  - BLOBS / Images
  - Master patient list
  - MPI, NPI

HL7 Standards

The “Onion”

HL7 - QUICK history

- Founded by healthcare providers early in 1987
- Produced Version 1.0 late in 1987
- Produced Version 2.0 late in 1988
- Versions 2.1, 2.2, 2.3 and 2.3.1 published in 1990, 1994, 1997 and 1999 -- the “production” standards
- Accredited as a Standards Developing Organization by the American National Standards Institute (ANSI) in 1994
- Version 2.2 through 2.3.1 are “American national standards”
- Work on Version 3 (and 2.6 / 2.7) is underway

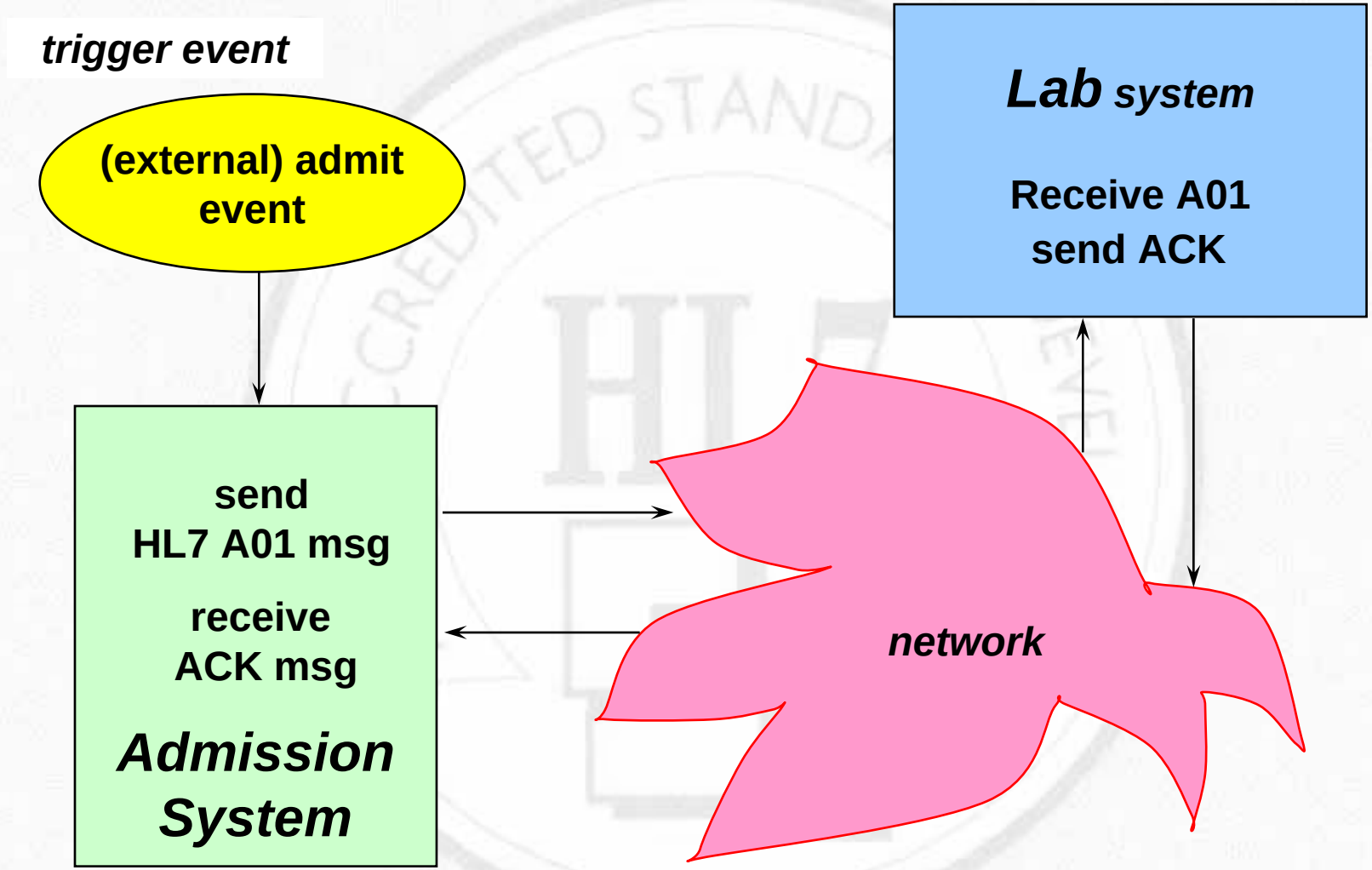
HL7 Mission

- To provide standards for the exchange, management and integration of data that supports clinical patient care and the management, delivery and evaluation of healthcare services. (7/97)

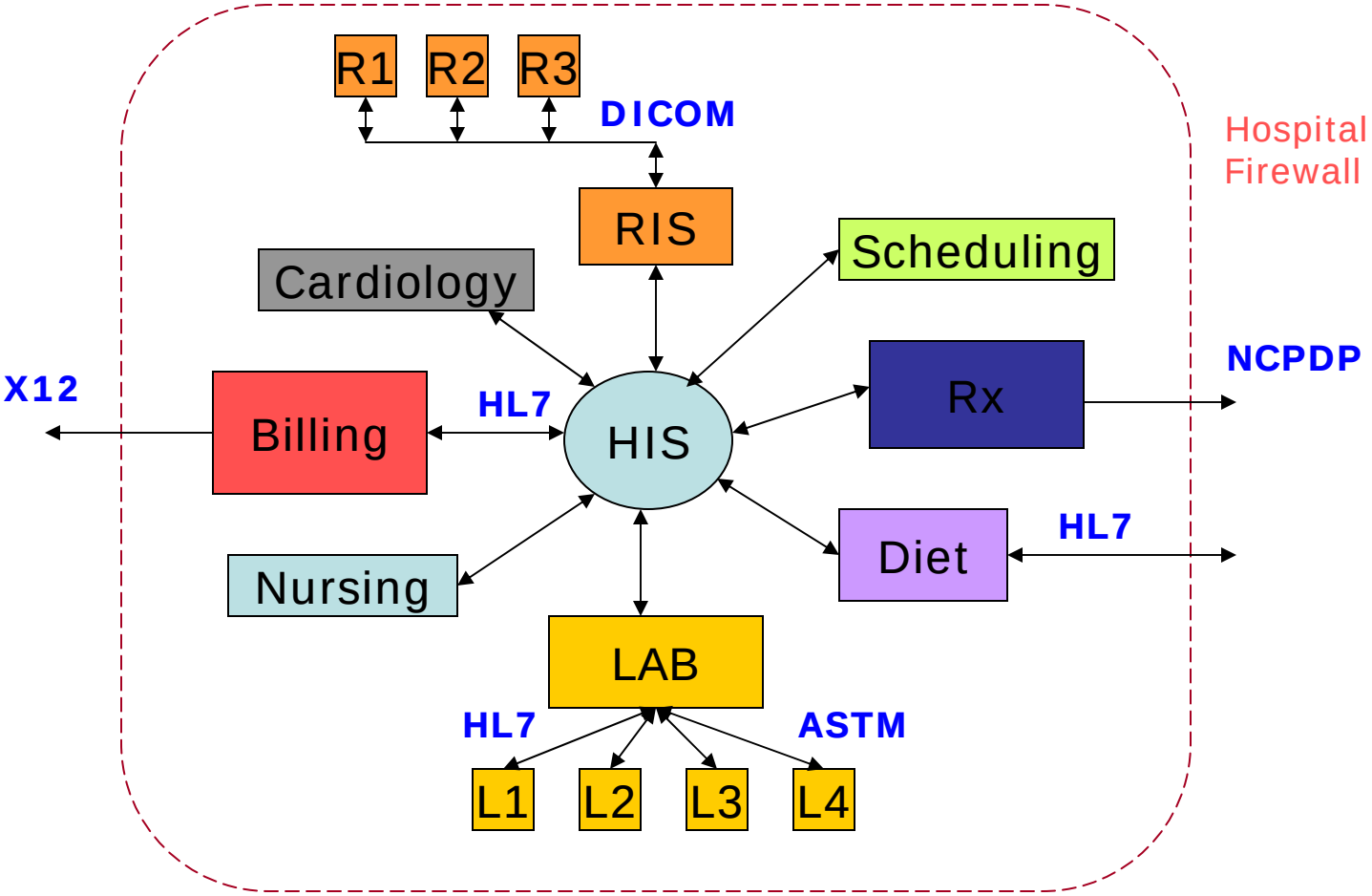
- To provide a comprehensive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services. Specifically, to create flexible, cost effective standards, guidelines, and methodologies *to enable healthcare information system interoperability and sharing of electronic health records*."
  (Source: HL7 Mission statement, revised 2001)

The HL7 basic transaction model

Mr. Jones is admitted to the hospital



HL7 and Healthcare Integration



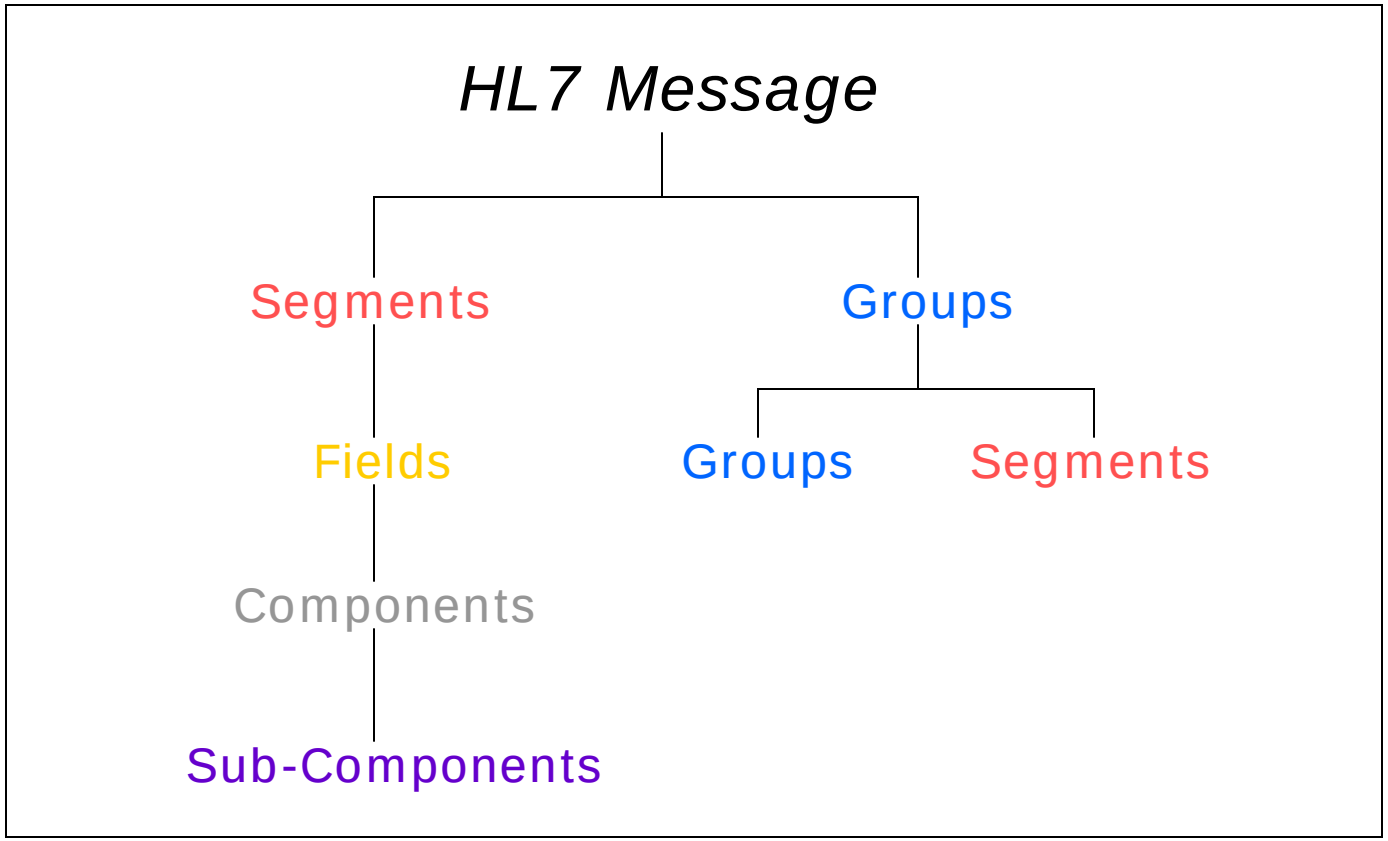
Robert Snelick, National Institute of Standards & Technology (NIST)

The anatomy of an HL7 V2.x message

```
MSH|^~\&|ADT1|MCM|LABADT|MCM|199807201126||ADT^A01|
   MSG00001|P|2.3|<cr>

EVN|A01|199807201123|<cr>

PID|1||PATID1234^5^M11||Jones^Sam^Houston||19670329|M|
   |C|1200 N ELM STREET^^GREENVILLE^NC^27401-1020|GL|
   (919)379-1212|(919)271-3434||S||X454337 ^2^M10|
   123456789|987654^NC|<cr>

NK1|1|JONES^BARBARA^K|WIFE||||CP^Contact person|<cr>

PV1|1|I|2000^2012^01|E||||004777^LEBAUER^SARA^J.||
   TRMA||||ADM|A0|<cr>
```

A **message** is the unit of data transferred between information systems. It is composed of a group of **segments** in a defined sequence. Each message has a message type that defines its purpose. A three-character code contained within each message identifies its type. The first segment (MSH) in each message identifies the message type and the trigger event type that caused the message to be sent.

HL7 Message Structure



- Hierarchical data storage

V2.x Abstract Message - ADT

```
MSH                 Message Header
EVN                 Event Type
PID                 Patient Identification
 [PD1]              Additional Demographics
 [{NK1}]            Next of Kin /Associated Parties
PV1                 Patient Visit
[PV2]               Patient Visit - Add'l Info.
[{DB1}]             Disability Information
[{OBX}]             Observation/Result
  . . . . . . .
[{GT1}]             Guarantor
[{IN1               Insurance
  [IN2]             Insurance Additional Info.
  [IN3]             Insurance Add'l Info - Cert.
  }]
[ACC]               Accident Information
[UB1]               Universal Bill Information
[UB2]               Universal Bill Information
```

[ ] optional

{ } may repeat

PID: Patient Identification Segment

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O			00104	Set ID - PID
2	20	CX	B			00105	Patient ID
3	250	CX	R	Y		00106	Patient Identifier List
4	20	CX	B	Y		00107	Alternate Patient ID - PID
5	**250**	**XPN**	**R**	**Y**		**00108**	**Patient Name**
6	250	XPN	O	Y		00109	Mother's Maiden Name
7	26	TS	O			00110	Date/Time of Birth
8	1	IS	O		0001	00111	Administrative Sex
9	250	XPN	B	Y		00112	Patient Alias
10	250	CE	O	Y	0005	00113	Race
11	250	XAD	O	Y		00114	Patient Address
12	4	IS	B		0289	00115	County Code
13	250	XTN	O	Y		00116	Phone Number - Home
14	250	XTN	O	Y		00117	Phone Number - Business
...							
37	80	ST	O			01541	Strain
38	250	CE	O	2	0429	01542	Production Class Code

- Segments contain fields

Extended Person Name (XPN)

Components: <family name (FN)> ^ <given name (ST)> ^
<second and further given names or initials thereof (ST)> ^ <suffix (e.g., JR or III) (ST)> ^
<prefix (e.g., DR) (ST)> ^ <degree (e.g., MD) (IS)> ^ <name type code (ID) > ^
<name representation code (ID)> ^ <name context (CE)> ^
<name validity range (DR)> ^ <name assembly order (ID)>

Subcomponents of family name: <surname (ST)> ^ <own surname prefix (ST)> ^
<own surname (ST)> ^ <surname prefix from partner/spouse (ST)> ^
<surname from partner/spouse (ST)>

Subcomponents of name context: <identifier (ST)> & <text (ST)> &
<name of coding system (IS)> &
<alternate identifier (ST)> & <alternate text (ST)> &
<name of alternate coding system (IS)>

Subcomponents of name validity range: <date range start date/time (TS)> &
<date range end date/time (TS)>

Elements have Attributes

- Usage
  - Indicates how the element can be used
  - Required, Optional, Not Supported, Conditional, Required or Empty, etc.
- Cardinality
  - Indicates how many time the element can appear
  - [0..0], [0..1], [1..1], [0..3], [3..5], [0..*]
- Code Sets (Tables)
  - Indicates a set of valid values for a given primitive element
  - HL7 Table 001 Administrative Sex
- Length
  - Indicates the maximum of an element or a compound element

The Problem …

- It is impossible to measure the compliance of HL7 V2.x interfaces relying only on the HL7 2.x base standard.
  - Often vendors claim compliance to HL7 without providing supporting documentation.

- HL7 V2.x provides little more than a starting point for vendor negotiation, and terms like *HL7-like* or *HL7-ish* are frequently used to describe HL7 interfaces.

- As a result, interfacing continues to be slow, painful, and costly.

Version 3 is a change to the HL7 Architecture

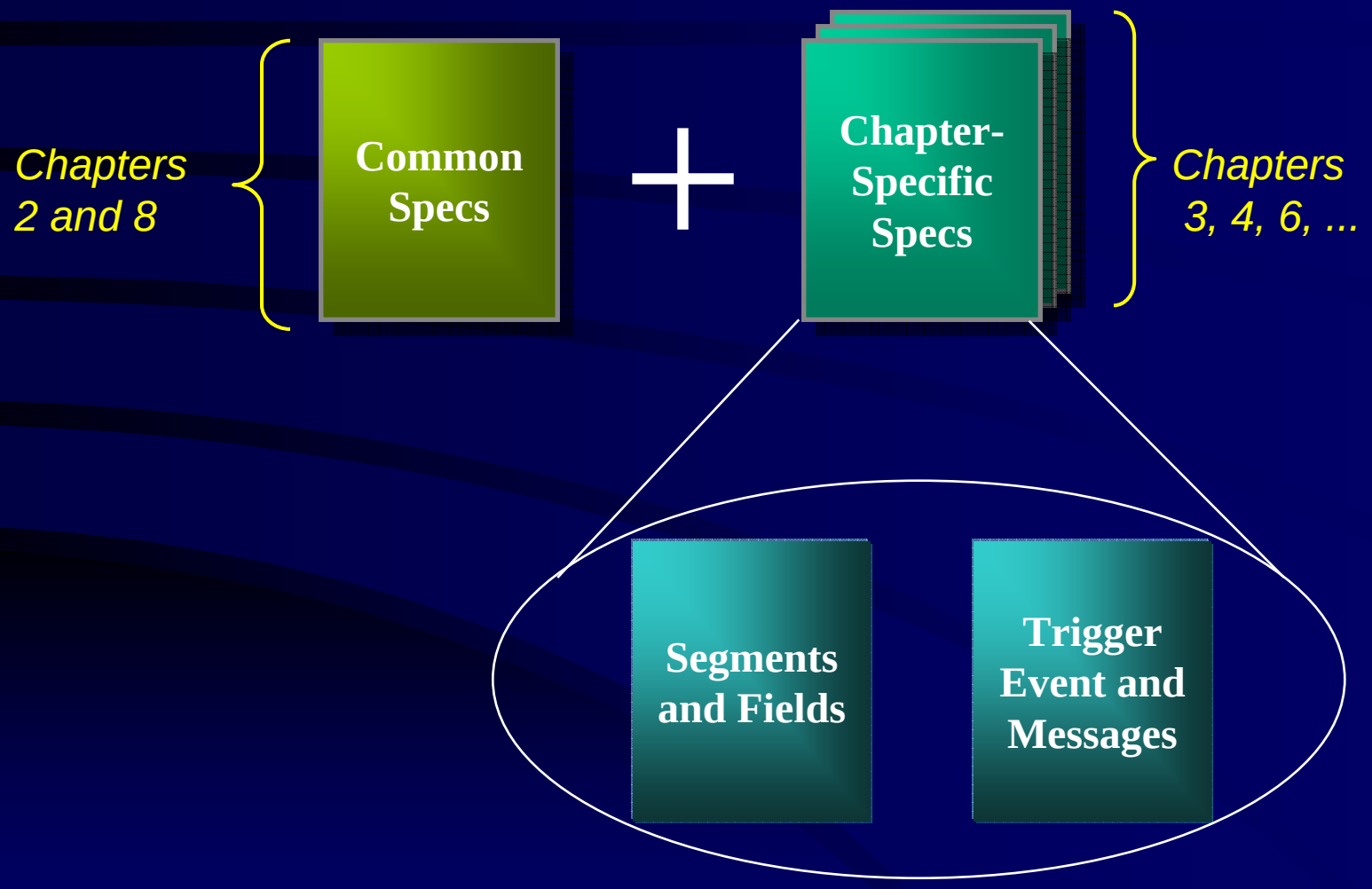
- The HL7 2.x specifications have:
  - Segments that suggest information entities
  - Events that indicate implied behaviors
  - And descriptive content that suggests use cases

    but never formally documents these

- Version 3 seeks to formalize this by applying object analytic methods
  - to improve the internal consistency of HL7
  - to provide sound semantic definitions
  - to enable future architectures
  - to produce an evolution not a revolution

  Done by applying MODELING to the HL7 process

An HL7 Version 2.X Spec



An HL7 Version 3.X Spec

HL7 Reference Model

Common Specs

+

Chapter-Specific Specs

*Future Consideration

Use Case Model

Information Model

Interaction Model

Message Model

2-nd Order
1 choice of
0-n Drug
0-1 Nursing

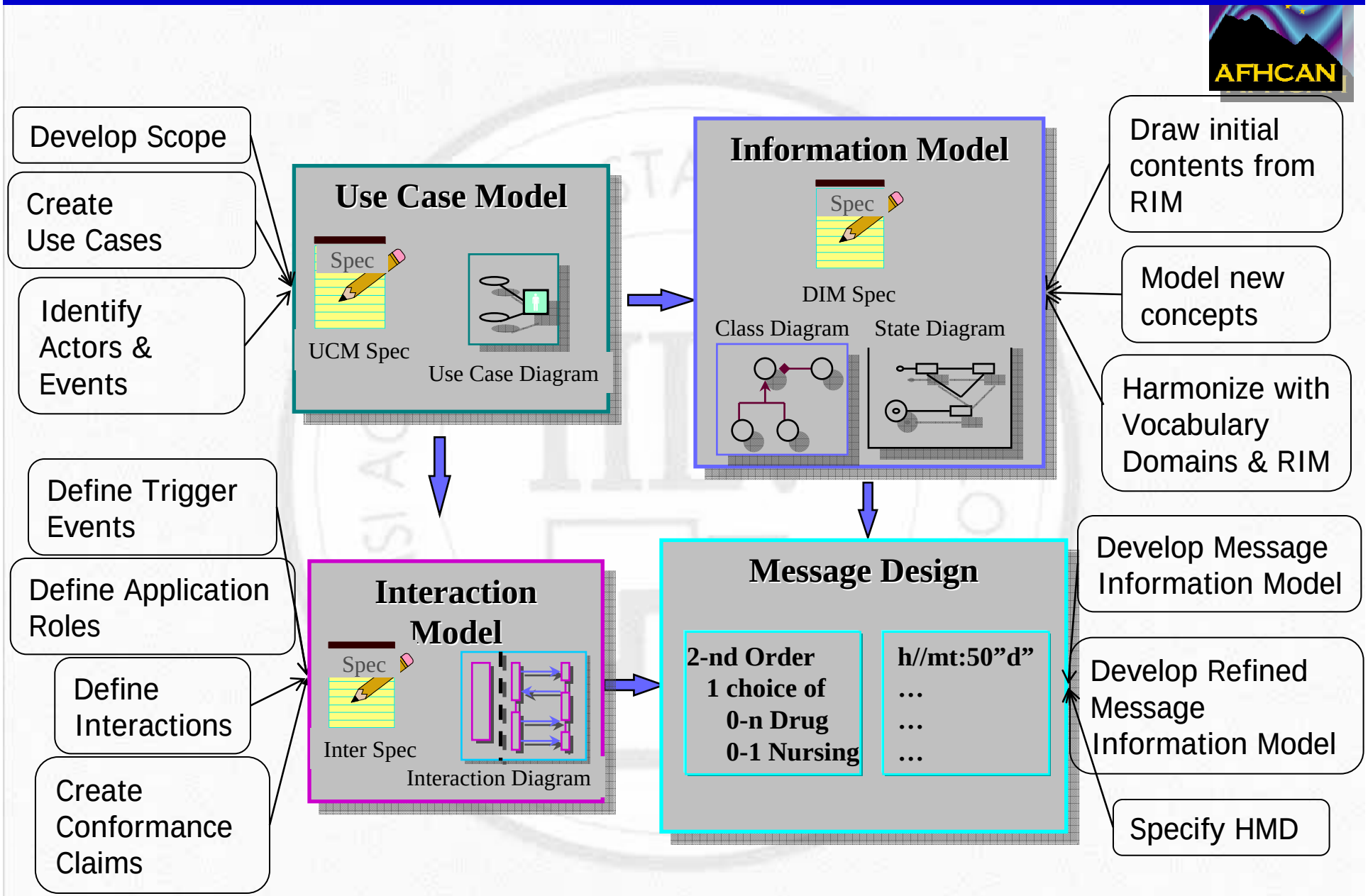
Implementable Message Specification

XML/ER7/…

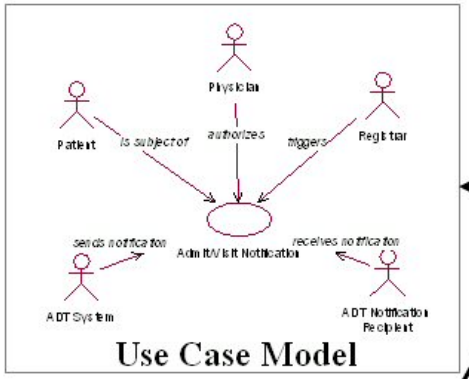
OLE/CORBA

EDIFACT*

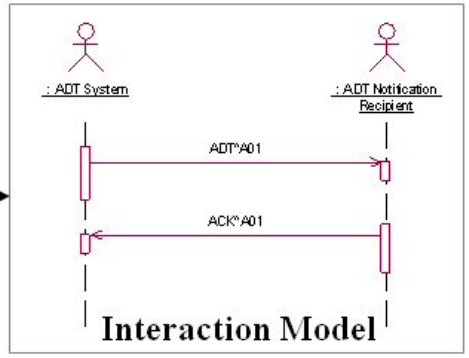
V3.x Models developed in Phases



Message Profile Example



Use Case Model



Interaction Model

1. USE CASE MODEL
1.1 USE CASE: ADMIT/VISIT NOTIFICATION
2. DYNAMIC INTERACTION MODEL
3. STATIC PROFILE: ADT/ACK (EVENT A01)

3.1 ADT^A01
3.2 ACK^A01

4. DYNAMIC PROFILE: ADT/ACK (EVENT A01)

4.1 ADT^A01
4.2 ACK^A01

5. SEGMENT PROFILES

5.1 MSH – MESSAGE HEADER SEGMENT DEFINITION
5.2 EVN - EVENT TYPE SEGMENT DEFINITION
5.3 PID (Y) - PATIENT DEMOGRAPHICS SEGMENT DEFINITION
5.4 PD1 – PATIENT ADDITIONAL DEMOGRAPHIC SEGMENT DEFINITION
5.5 NK1 - NEXT OF KIN SEGMENT DEFINITION
5.6 PV1 (2) - ADMIT VISIT INFO SEGMENT DEFINITION
5.7 AL1 - ALLERGY SEGMENT DEFINITION
5.8 MSA - MESSAGE ACKNOWLEDGMENT SEGMENT DEFINITION
5.9 ERR - ERROR SEGMENT DEFINITION

6. TABLES

6.1 TABLE 0001 – SEX
6.2 TABLE 0002 – MARITAL STATUS
6.3 TABLE 0003 – EVENT TYPE CODE
6.4 TABLE 0004 – PATIENT CLASS
6.5 TABLE 0005 – RACE
6.6 TABLE 006 – RELIGION
6.7 TABLE 0007 – ADMISSION TYPE
6.8 TABLE 0008 – ACKNOWLEDGEMENT CODE
6.9 TABLE 0009 – AMBULATORY STATUS
6.10 TABLE 0010 – ADMITTING/ATTENDING/REFERRING/CONSULTING DOCTOR
6.11 TABLE 0018 – PATIENT TYPE
6.12 TABLE 0023 – ADMIT SOURCE
6.13 TABLE 0062 – EVENT REASON CODE
6.14 TABLE 0063 – RELATIONSHIP
6.15 TABLE 0069 – HOSPITAL SERVICE
6.16 TABLE 0087 – PREADMIT TEST INDICATOR
6.17 TABLE 0092 – READMISSION INDICATOR

ADT	Cardinality	Description
MSH	1..1	Message Header
EVN	1..1	Event Type
PID	1..1	Patient Identification
[PD1]	0..3	Additional Demographics
[{ NK1 }]	1..1	Next of Kin /Associated Parties
PV1	1..1	Patient Visit
[PV2]	0..0	Patient Visit - Additional Info.
[{ DB1 }]	0..0	Disability Information
[{ OBX }]	0..0	Observation/Result
[{ AL1 }]	0..*	Allergy Information
[{ DG1 }]	0..0	Diagnosis Information
[DRG]	0..0	Diagnosis Related Group
[{	0..0	
PR1	0..0	Procedures
[{ROL}]	0..0	Role
}]		
[{ GT1 }]	0..0	Guarantor
[{	0..0	
IN1	0..0	Insurance
[IN2]	0..0	Insurance Additional Info.
[IN3]	0..0	Insurance Add'l Info - Cert.
}]		
[ACC]	0..0	Accident Information
[UB1]	0..0	Universal Bill Information
[UB2]	0..0	Universal Bill 92 Information

Static Profile

1.1 ADT^A01

The dynamic profile of the ADT^A01 event notification requires that an HL7 Accept Acknowledgement be sent but that no HL7 Application Acknowledgement is sent in response to this ADT^A01 message.

Dynamic Profile Identifier:

{ swg(1) hl7(1) v2-3(5) dynamic-profile(2) accAL-appNE(5) }

1.2 ACK^A01

The dynamic profile of the ACK^A01 acknowledgement requires that neither an HL7 Accept Acknowledgement or an HL7 Application Acknowledgement is sent in response to this ACK^A01 message.

Dynamic Profile Identifier:

{ swg(1) hl7(1) v2-3(5) dynamic-profile(2) accNE-appNE(6) }

Dynamic Profile

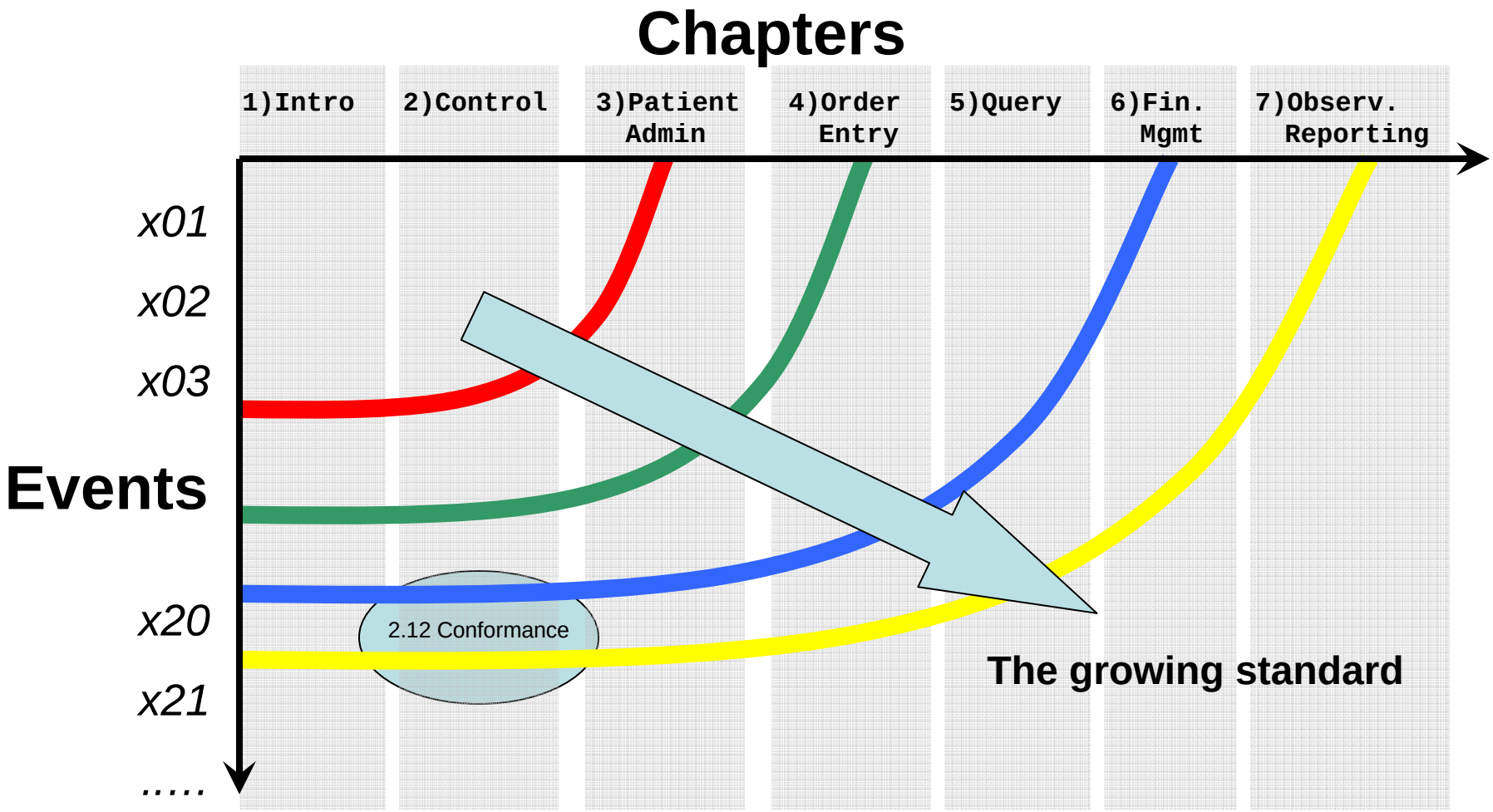
SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM #	ELEMENT NAME
1	1	ST	R			00001	Field Separator
2	4	ST	R			00002	Encoding Characters
3	180	HD	R			00003	Sending Application
4	180	HD	X			00004	Sending Facility
5	180	HD	RE			00005	Receiving Application
6	180	HD	X			00006	Receiving Facility
7	26	TS	RE			00007	Date/Time Of Message
8	40	ST	X			00008	Security
9	7	CM	R			00009	Message Type
10	20	ST	R			00010	Message Control ID
11	3	PT	R			00011	Processing ID
12	8	ID	R		0104	00012	Version ID
13	15	NM	X			00013	Sequence Number
14	180	ST	X			00014	Continuation Pointer
15	2	ID	R		0155	00015	Accept Acknowledgment Type
16	2	ID	R		0155	00016	Application Acknowledgment Type
17	2	ID	RE			00017	Country Code
18	6	ID	X	Y/3	0211	00692	Character Set
19	60	CE	X			00693	Principal Language Of Message

Segment Profiles

Type	Table	Name	Value	Description	Source	Used
AWG suggested	0007	Admission Type			HL7 2.3, AWG, UB92	PV1-4
	0007		A	Accident	HL7	
	0007		E	Emergency	HL7	
	0007		L	Labor and Delivery	HL7	
	0007		R	Routine	HL7	
	0007		ACC	Accident		
	0007		EMR	Emergency		
	0007		LAD	Labor and Delivery		
	0007		NEB	Newborn		
	0007		ROU	Routine		
	0007		OBS	Observation		
	0007		URG	Urgent		
	0007		ELE	Elective		
	0007		REH	Rehabilitation		
	0007		HEL	Helicopter		
	0007		NEP	Newborn Premature		
	0007		NSP	Newborn Sick Premature		
	0007		OCH	Occupational Heath		
	0007		OTI	Outpatient to Inpatient		

Tables

Evolving HL7 v2.x



(Ch 2.12) Message Profiling

- HL7 V2.x Message Profiling provides a guideline for documenting particular uses of HL7 messages.
  - A defined V2.x message profile will be registered with HL7 and may be reused by other HL7 users, moving the HL7 V2.x standard closer to “plug and play” interfaces.

- With consistent and complete V2.x Message Profile documentation, HL7 V2.x interface partners explicitly understand:
  - What data will be passed
  - The format in which the data will be passed
  - The acknowledgement responsibilities of the sender and receiver.

Profile Components

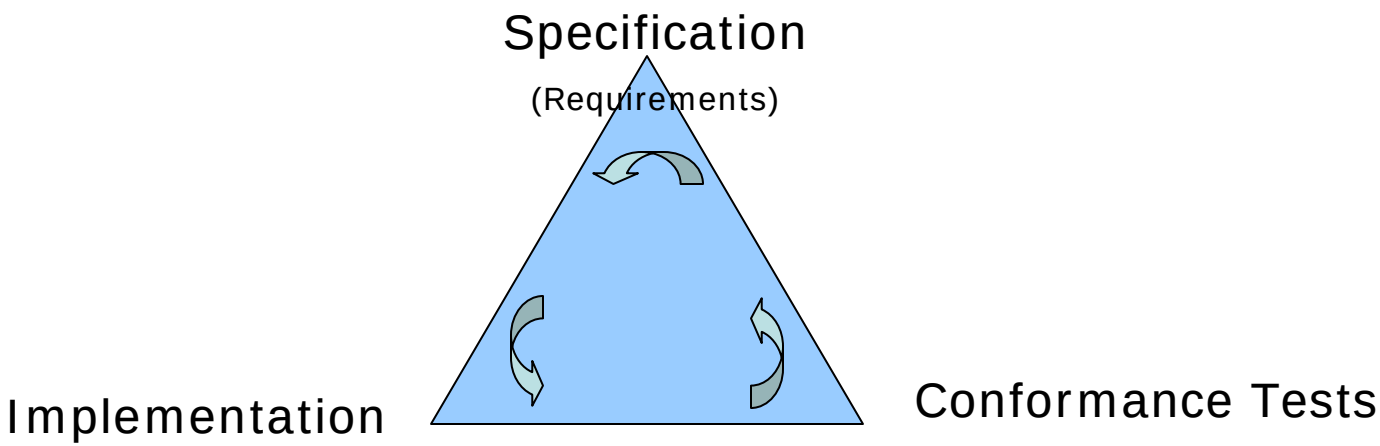
- HL7 V2.x Message Profiles must consist of the following components:
  - **Use Case Model -** this may be a use case diagram supported with text or just a textual description
  - **Static Definition** – consisting of Message Level Profile, Segment Level Profile, and Field Level Profile
  - **Dynamic Definition** – consisting of an Interaction Model and Dynamic Profile

Profile Types

- There are three basic profile types used in documenting standard conformance:
  - HL7 Standard profile (represents a specific HL7 published standard, creation and publication limited to HL7 use)
  - Constrainable profile (with “Optional” elements which must be further constrained in order to create implementation profiles)
  - Implementation profile (no “Optional” parts, fully implementable).

Conformance Testing

- A way to verify implementations of a specification to determine whether or not deviations from the specifications exist (through the use of test suites)
- Standards are not enough to ensure interoperability



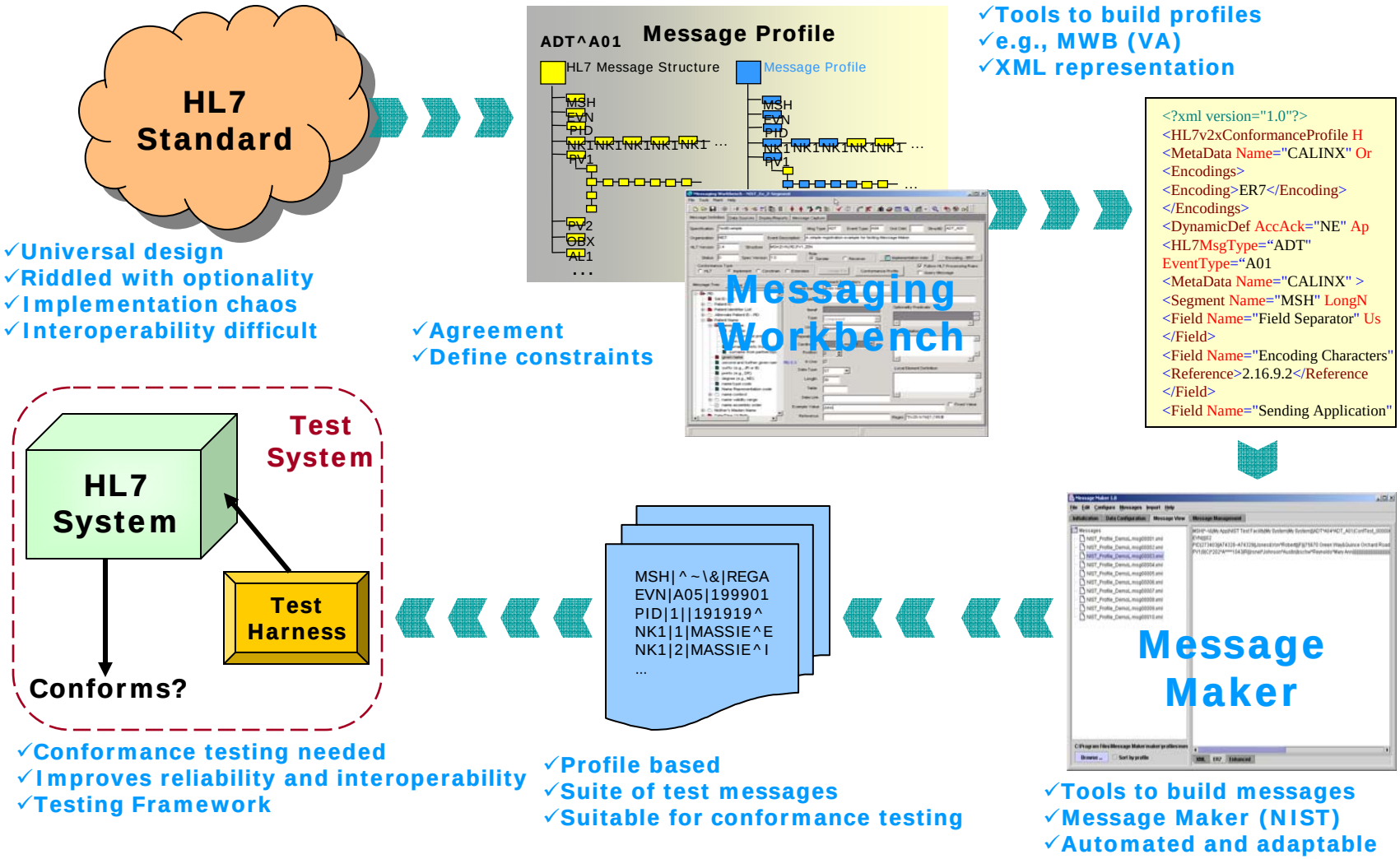
Benefits of Conformance Testing

- Increase probability that products are implemented correctly
  - Contains required functionality
  - Behaves as expected
  - Performs functions in a known manner
- Increased likelihood of portability and interoperability
  - Portability – the ability to move software or applications among different systems
  - Interoperability – the ability of two or more systems to exchange and use information
- Provides a feedback loop for developers
- Increases buyer's confidence in a product and substantiate seller's claim
- Not locked into purchasing from a single vendor

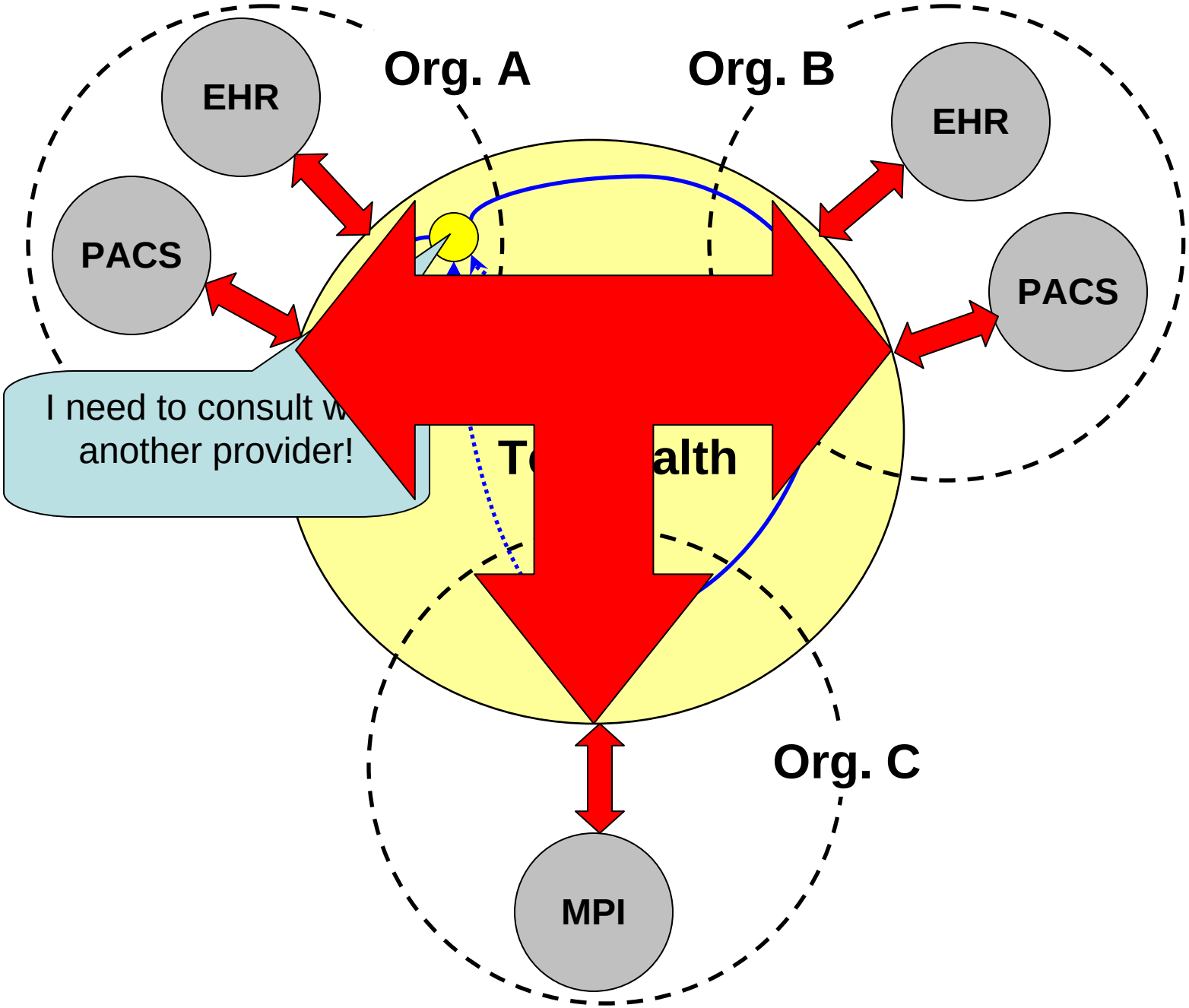
Tools

- Generate Profiles
  - Commercial: Orion's Symphonia, others
  - Free: VA's Messaging Workbench (MWB)
    - Messaging Workbench
- Conformance Testing
  - Free: Message Maker (NIST)

The Big Picture



Robert Snelick, National Institute of Standards & Technology (NIST)


Org. A
Org. B
Org. C
EHR
PACS
EHR
PACS
MPI
I need to consult w
another provider!
T
alth

An Integrated Data Environment

- Empowers individual applications
- Empowers clinicians
- Empowers clinical care

References

- HL7 Reference materials
  - www.hl7.org
- Messaging Workbench
  - www.hl7.org
    - Select “Special Interest Groups” → “Conformance” → “Documents / Presentations” → “MWB Rel 605.zip”
- Message Maker
  - **http://www.nist.gov/messagemaker**
- HL7 profile specifications
  - Many exist. Good example is:
    - VA Home Telehealth Specification (“Home Telehealth HL7 Functions Overview”)
- Contact Information:
  - SFerguson@AFHCAN.org

Thank You

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