



AFLCMC/HNB



CoT-101

6 Feb 2013

Approved for Public Release. Distribution Unlimited
Case Number: 13-0884

.....
Taking Command and Control Data to the Tactical Edge



CoT Origin: General Jumper Speech 2002 C4ISR Summit



“The buzzword for this decade is gonna be integration”



- “...we want the target dead or saved...we gotta get away from platform centric thinking...and we gotta focus on this thing where the sum of the wisdom is a **cursor over the target**...and we’re indifferent [to the source]”
- “F-15 pilot takes that index finger... runs that radar **cursor over that target**, presses it and the system locks on...and pretty soon you’ve got within seconds...”
- “**target altitude, target heading, target airspeed...you** don’t have to run the cursor over it and say give me the altitude...hourglass, hourglass, hourglass”



Effective warfare requires...



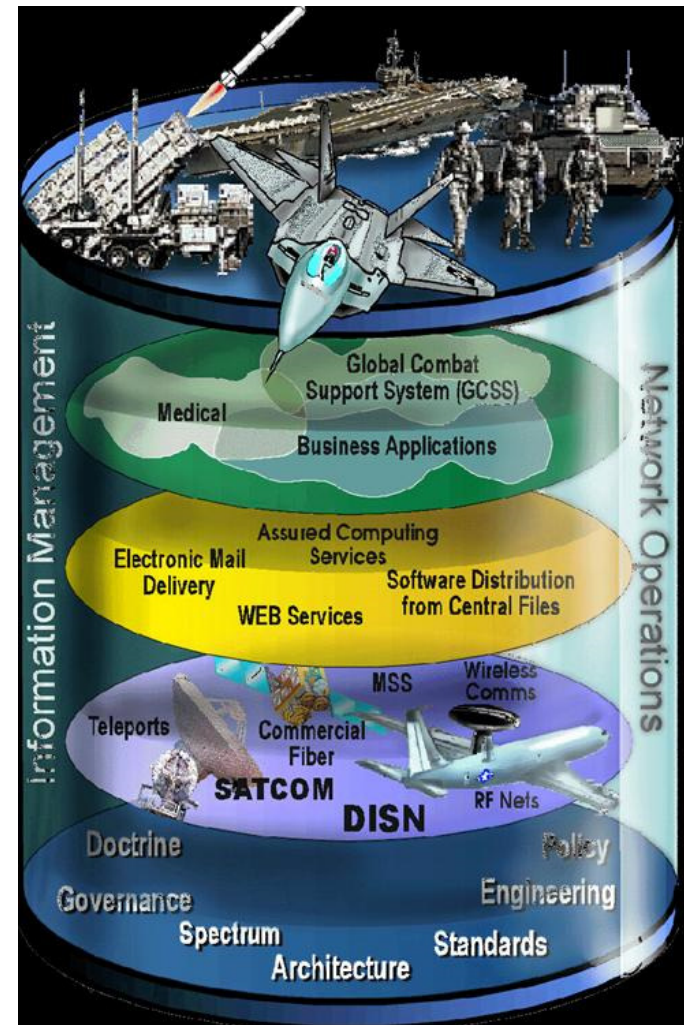
- **Seamless communications between combat elements**
- **Addressing the challenge of low-bandwidth restrictions at the tactical edge**
- **Timely Situation Awareness**
- **Ability to pass data across disparate systems without significant information loss**



DOD's Complex Enterprise Communications



- **Multiple message formats**
 - *Link-16*
 - *VMF*
 - *GCCS*
 - *Etc.*
- **Radio transmissions can be on the order of 2400 bps**
 - *Communications at the tactical edge cannot handle the data being passed on the GIG*
- **Multiple versions of equipment do not communicate with each other**
 - *F-16 Block X and F-16 Block Y*
 - *VMF support for Digital CAS complicated by multiple versions*



.....
Taking Command and Control Data to the Tactical Edge



Complexity Example: VMF K05.19 in Context



MESSAGE DESCRIPTION

MESSAGE NUMBER: K05.19
 MESSAGE TITLE: ENTITY DATA MESSAGE
 MESSAGE PURPOSE: TO PROVIDE SUPPLEMENTAL SITUATION AWARENESS INFORMATION.

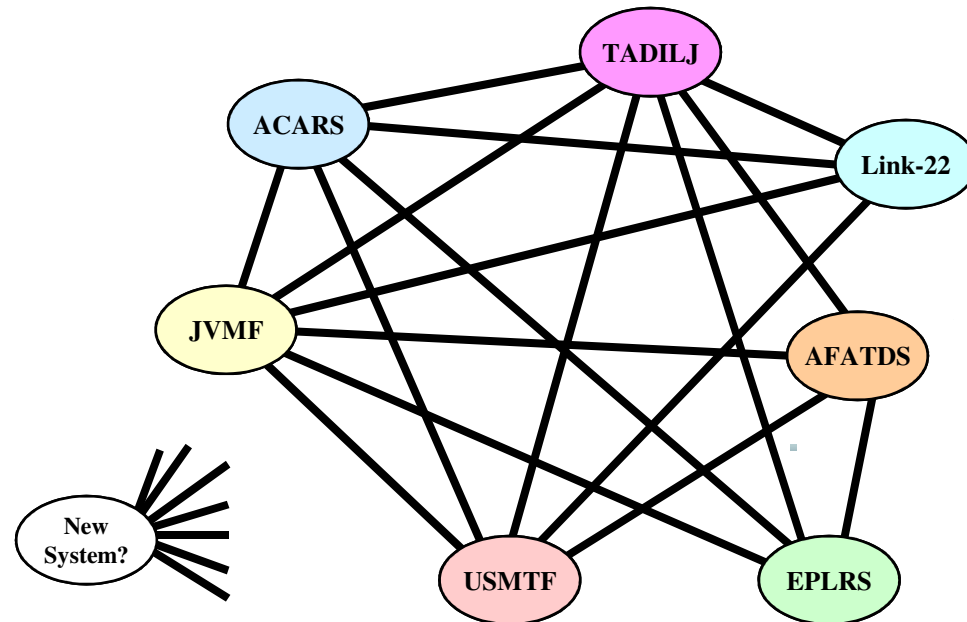
INDEX NO.	REF	DE	NA	VMF	USMTF	EPLRS	ACARS	...
1.1	4045	001
1.2	4004	012	URN		24			...
1.3	4019	001	DAY OF MONTH					...
1.4	792	001	HOUR		5			...
1.5	797	004	MINUTE		6			...
1.6	380	001	SECOND		5			...
1.7	4205	002	GRAPHICAL REFERENCE ENTITY		3			...
1.8			TYPE					...
1.9			IDENTIFICATION NUMBER					...
1.10	4014	001	GPI		1			...
1.10.1	4014	002	FPI		1	G1	R1	...
1.10.1.1	4057	002	FIRE MISSION TYPE		4	G1	R1	...
1.10.2	4014	002	FPI		1	G1	R1	...
1.10.2.1	4003	001	TARGET		1	G1	R1	...
1.10.3	4014	001	GPI		1	G1	R1	...
1.10.3.1	4059	005	MISSION ID/DESIGNATOR		1	G1/G2	R1	...
1.10.3.2	4014	002	FPI		1	G1/G2	R1	...
1.10.3.2.1	4004	012	URN		24	G1/G2	R1	...
1.10.3.3	4014	002	FPI		1	G1/G2	R1	...
1.10.3.3.1	4002	001	METHOD OF ENGAGEMENT		4	G1/G2	R1	...
1.10.3.4.1	281	407	TARGET LATITUDE		25	G1/G2	R1	...
1.10.3.4.2	282	407	TARGET LONGITUDE		26	G1/G2	R1	...

The "total" complexity is simply overwhelming!

Taking Command and Control Data to the Tactical Edge



...Worse Yet, We're Building Numerous Complex Translators



This is a long-term interoperability and maintenance nightmare...

(E.g., How many systems must change to implement MIL-STD-6016E?)

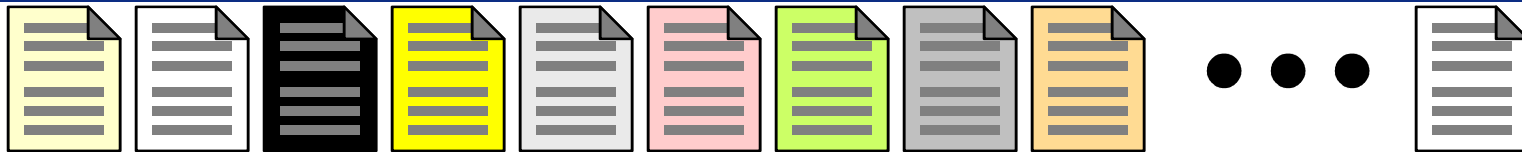
(E.g., How many systems implement “the full” standard?)

(E.g., How do you “synchronize” rollout of standards versions?)

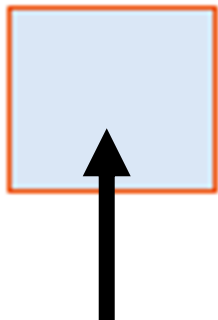
(E.g., Will I need to carry *another* radio to talk to a new link?)



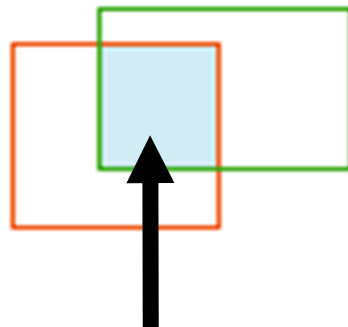
CoT Takes a Different Approach: Start with the most common info



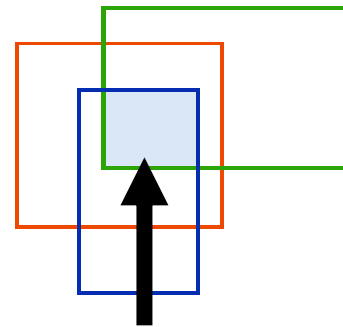
**Traditional approach: Add a new message for each new exchange...
and the “catalog” gets large.**



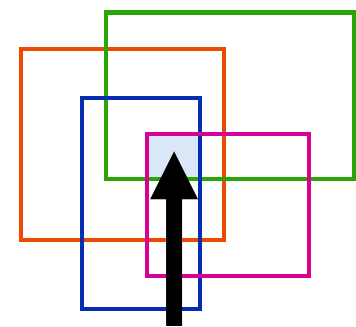
**One system,
info intersection
is everything**



**Two systems,
much info less
is common**



**Three systems,
Intersection
gets smaller**



**CoT starts here
with a core set
of common info!**



What is the core “What, Where, When, Who, Why, How”

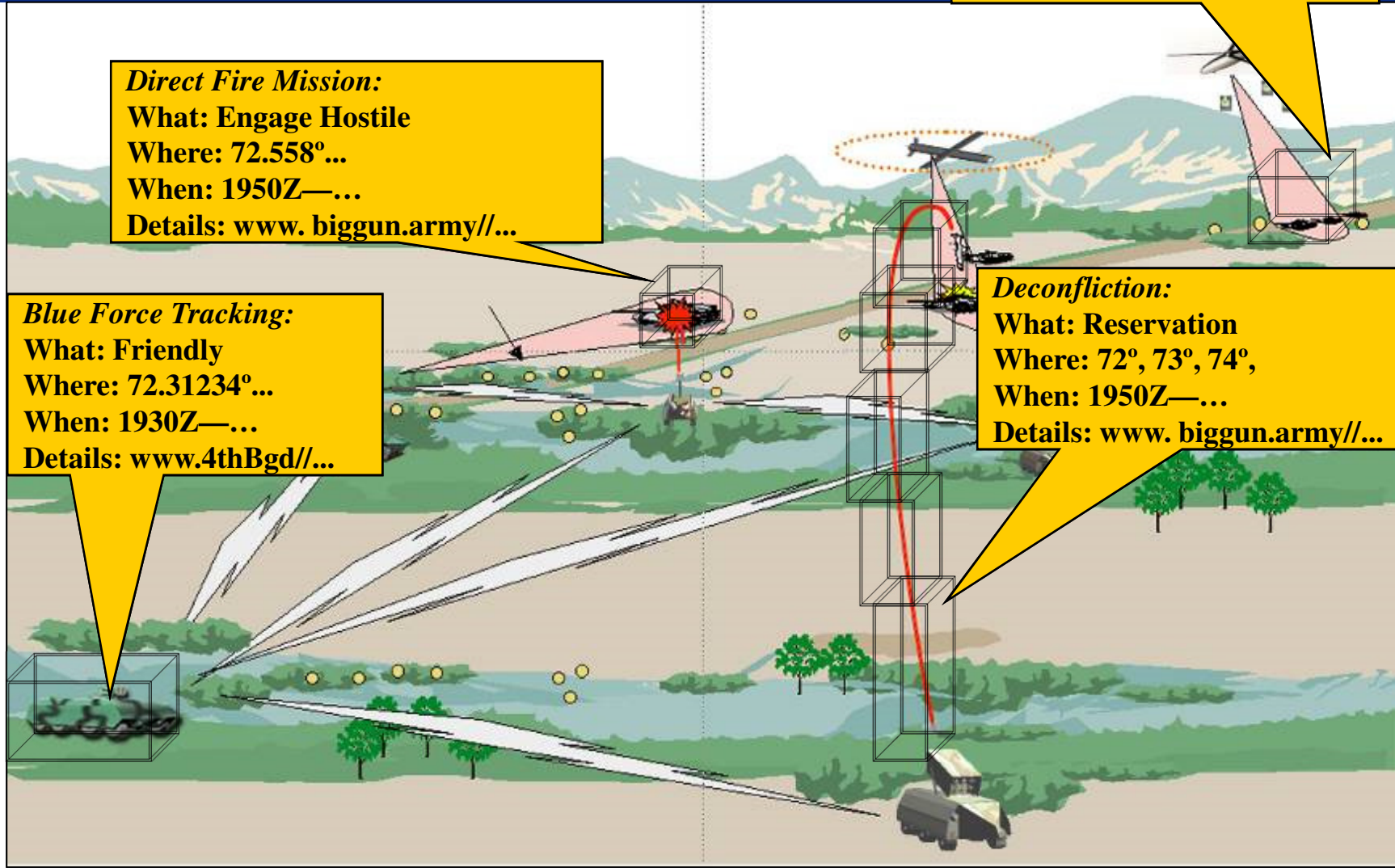
Surveillance results:
What: ISR data
Where: 73°—74°...
When: 1930Z—...
Details: www.intel.af//...



Direct Fire Mission:
What: Engage Hostile
Where: 72.558°...
When: 1950Z—...
Details: www.biggun.army//...

Blue Force Tracking:
What: Friendly
Where: 72.31234°...
When: 1930Z—...
Details: www.4thBgd//...

Deconfliction:
What: Reservation
Where: 72°, 73°, 74°,
When: 1950Z—...
Details: www.biggun.army//...





CoT Components



- An XML message schema
 - Basic (mandatory): “what, when, where”
 - Extensible (optional): add subschema to add details
- A standard
 - Established as USAF standard by SECAF memo April 2007
 - Incorporated in USAF (SAF/XC) Enterprise Architecture
 - Registered by SAF/XC in DISROnline as a USAF Organizationally Unique Standard (OUS)
 - Foundation for UCore data model
 - On the way to becoming a MIL-STD
- A set of software plug-ins to enable systems, including VMF and Link 16, to input and output CoT messages
- A CoT message router (software) to facilitate publish/subscribe message routing
- A simple developer’s tool kit



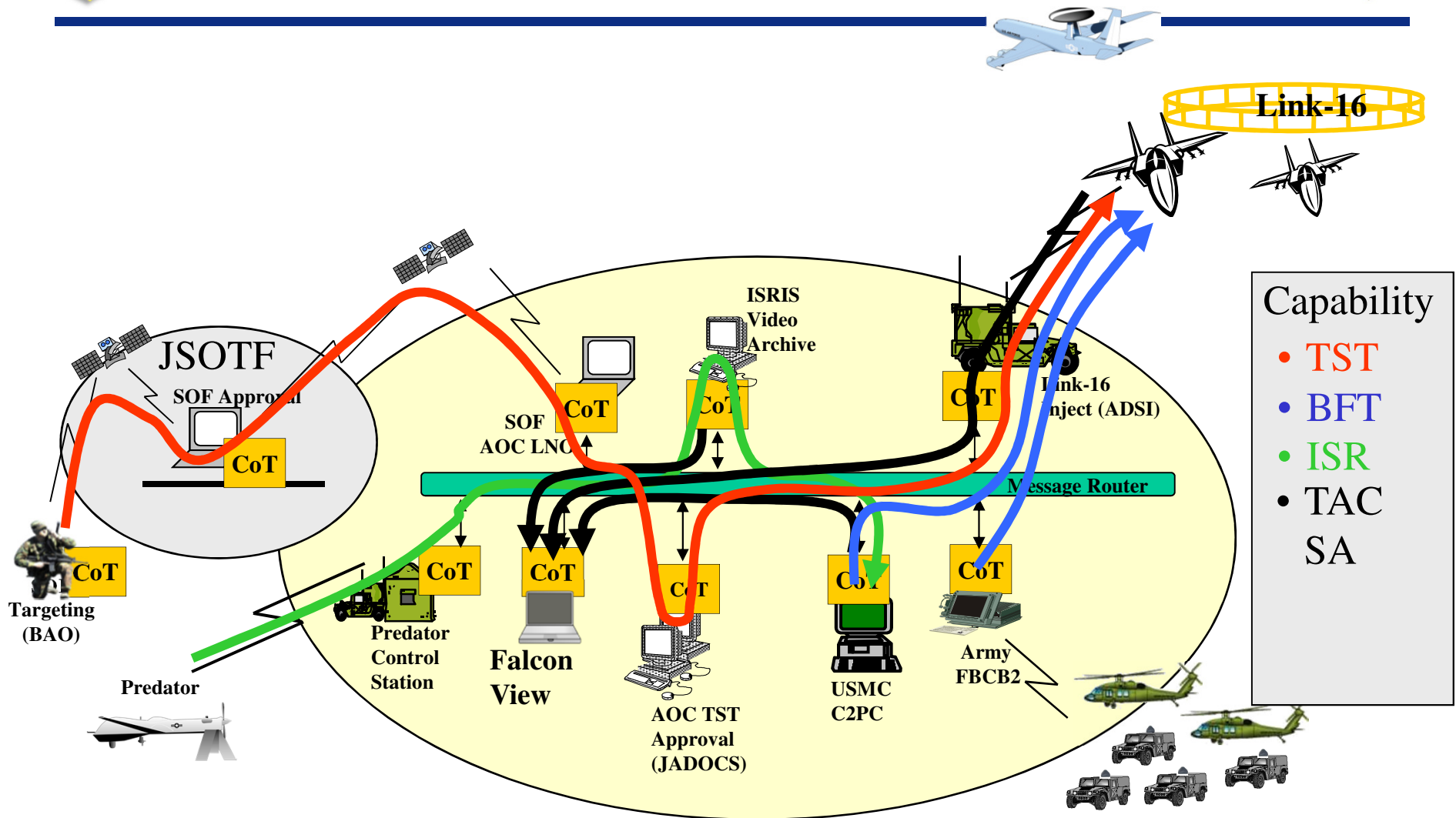
Use Case Examples

- Pre-planned & Dynamic Airspace Management
- Time Sensitive Targeting (TST) / Spot Reporting
- Blue Force Tracking (BFT)
- ISR Tasking / Sensor Point of Interest (SPI) display
- Unmanned Aerial Vehicle (UAV) route planning
- Force Protection (FP) system integration
- Handheld / Mobile Device Applications
- Payload data transmission
- Sensor detection data transmission
- Tactical Data Link (TDL) integration

Bottom Line: CoT is a *flexible* data standard for machine-to-machine (M2M) information exchange. It's not tied to a specific use case or mission thread.



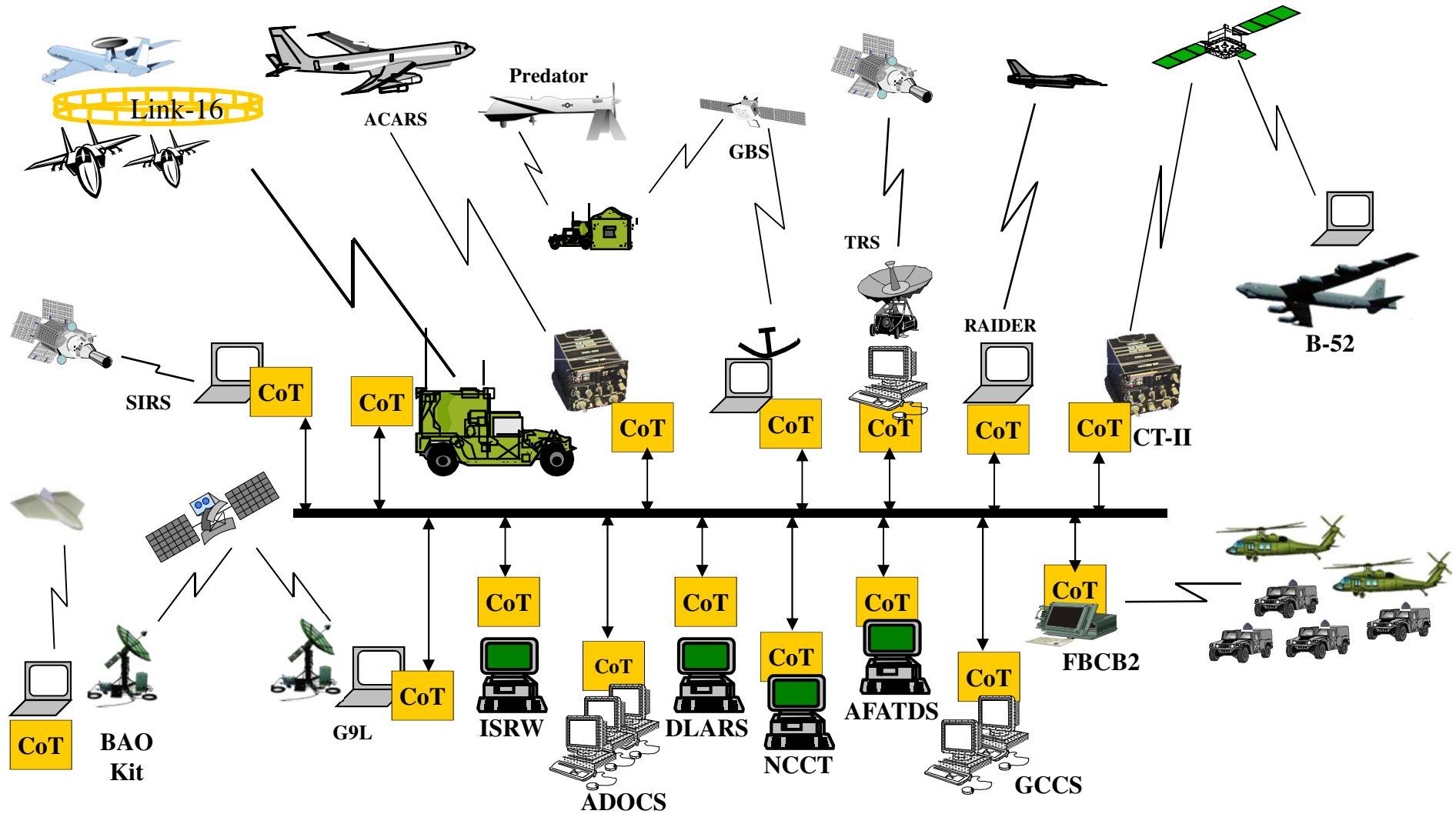
CoT Reduces Communication Complexity



Connects disparate systems to enable mission capability



200+ DoD Systems “speak” CoT...



Taking Command and Control Data to the Tactical Edge



CoT Usage

- Employed heavily in AFSOC systems and UAS communities; used operationally 24x7 in Iraq and Afghanistan
- All Services, not just USAF
- Widely used in experimentation/demonstration venues
 - *JEFX, CWID, Empire Challenge, Bold Quest*
 - *Many others*

Examples

<u>ISR</u>	<u>UAV</u>	<u>Manpack</u>	<u>C2</u>
High Mobility FLIR	Video Scout	BAO Kit	AFATDS
Litening Pod	Raven and Wasp	Soldier-worn gunfire detection	Combat Track II
RAVE video exploitation	Air RECCE Low, MARSS	THLDS	FCS Test Bed
Constant Hawk			JADSI



Sample CoT Organizations



402 XMSG (AFMC)
642 AESS (AFMC)
645 AESS (AFMC)
653 ELSG (ESC)
653 ELSW/EID (ESC)
670th AESS (ASC)
720 STG/OSS
8 AF
812 AESG/SYCA (ITC)
HAF/A2U
HAF/A2UI
AAI Corporation
AFRL
AFSOC
AGIS, Inc.
Applied Research
ARINC
AVWatch
BBN
Boeing
BOSH Global Services
Critical Response
Deloitte
DHS
DRS-IAS
DSCI
ForceX

Foster-Miller
General Dynamics
Georgia Tech Electronic Systems
Laboratory
Harris
Insight Technology
Insitu
ITT Advanced Engineering and Sciences
Jackpine Technologies
JFCOM
Lockheed Martin
Johns Hopkins Advanced Physics Lab
Joint Interoperability Test Center
JFIIT
Kihomac
KC Regional Terrorism Early Warning
Group
L-3 Com
Lakota Technical Solutions
Missouri Civil Air Patrol
MIT Lincoln Labs
MITRE
Naval Postgraduate School
Naval Surface Warfare Center
NGA
Northrop Grumman
Oregon National Guard

Orion Networks
Proxy Aviation Systems
RAIDER TPG (US Navy)
Raytheon
Rockwell Collins
SET Corporation
Sierra Nevada Corporation
Smartronix
Symetrics
System Dynamics Int.
TAIS
Thales
Ticom Geomatics
Traverse Technologies
US Army
US Navy
USASOC-SOAR
USSOCOM
VIPMobile
Wintec Aeromaker, Inc.
WVHTC Foundation



Summary



- **Simple light weight core – Starts with most common data elements**
- **Sub-schema extension “Future-Proofs” standard**
- **Network-centric – Adaptable by nearly all systems with only modest effort**
- **Readily Reconfigurable - Approach handles unforeseen needs**
- **Government developed, all material openly available to all with US DoD sponsorship**



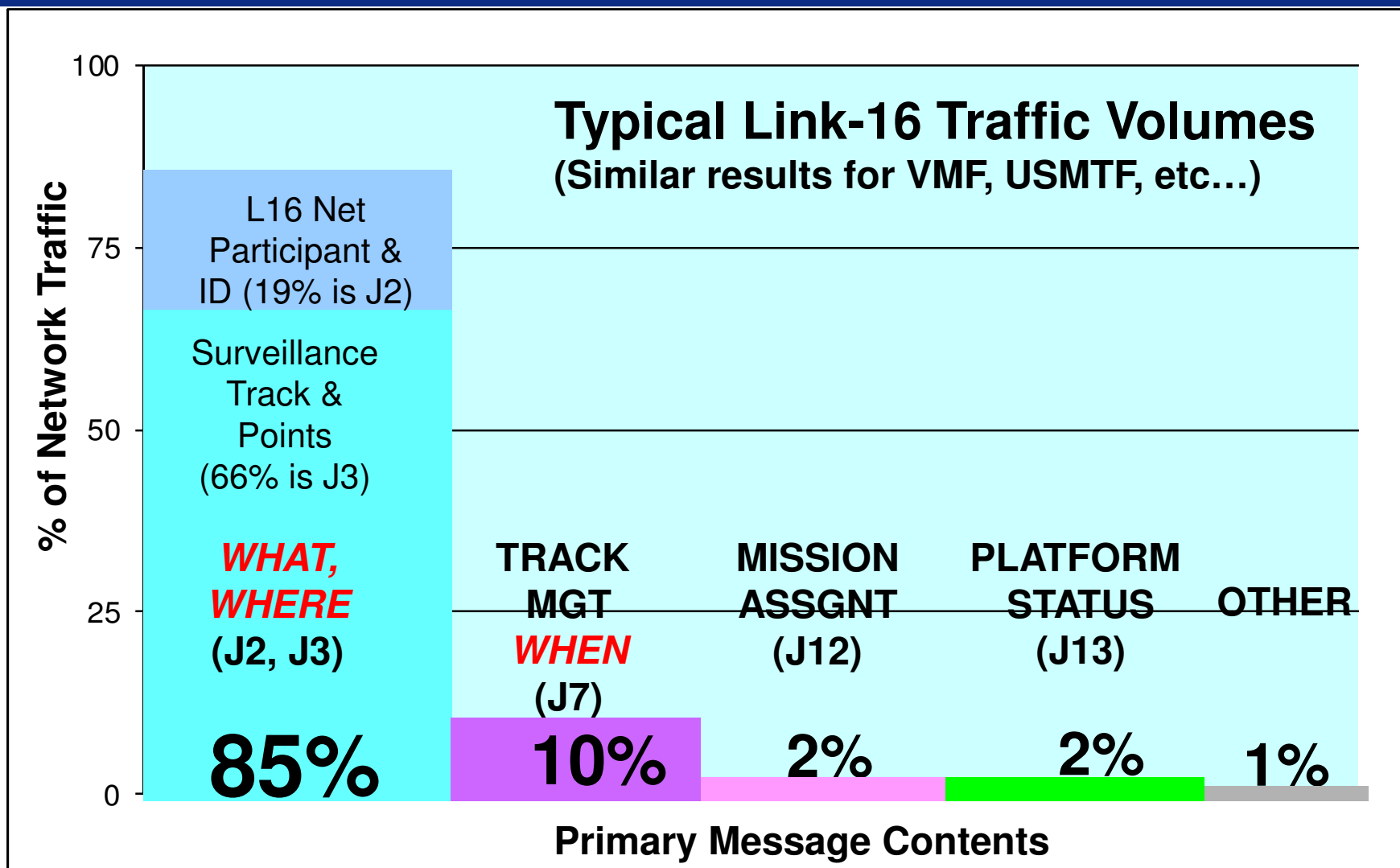
Backups



.....

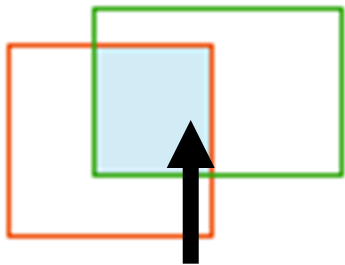


CoT What, When, Where Analysis

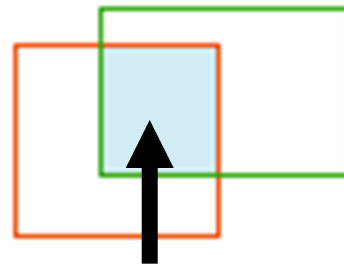




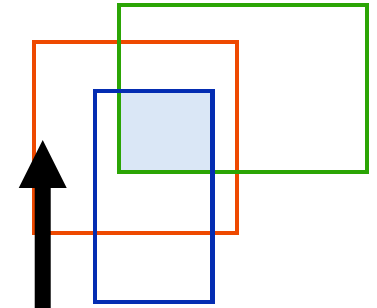
CoT Takes a Different Approach: Start with the most common info



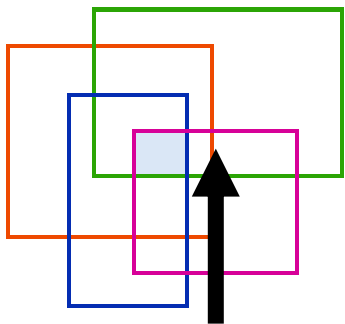
One system,
Intersection is
everything



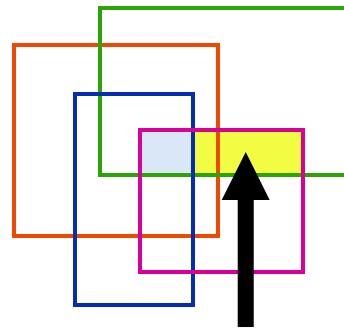
Two systems,
much less is
common



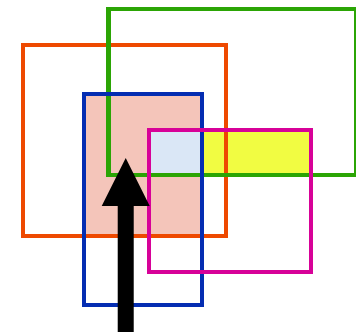
Three systems,
Intersection
gets smaller



More systems,
intersection
keeps shrinking



Green & Purple
can form a
sub-schema

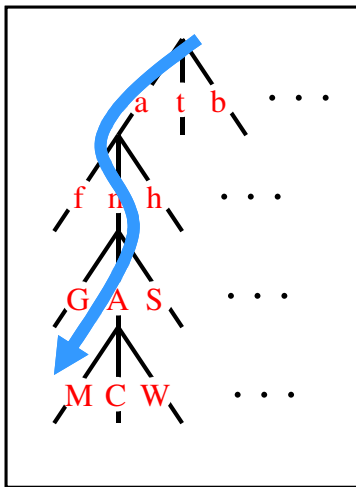


Other COIs
can have
sub-schemas



Why all That “a-b-X-Y-Z” Stuff? Just use an *enumeration* like everyone else!

No! Enumerations require too much maintenance...



```
<?xml version='1.0' standalone='yes'?>
<event version='2.0' uid='f.1423412' type='a-h-G-E-W-A-L' how='m-i'
  time='2003-08-04T18:41:09.00Z' start='2003-08-04T18:41:09.00Z'
  stale='2003-08-05T18:41:09.00Z' >
  <point lat='30.6320' lon='-86.7368' le='3.300' hae='11.439' ce='3.000' />
  <detail></detail>
</event>
```

- “a-h-G-E-V-A-T” is short-hand notation for a *path* through an *object hierarchy*:
atoms::hostile::Ground::Equipment::Vehicle::Armored::Tank
- A hierarchy facilitates *abstraction* and *extension* (an enumeration does not!)
E.g., What are these? “a-h-G-E-V-A-T-t72”, “a-h-G-E-V-A-A”, “a-h-G-E-S”