ATE Trends Circa 2016

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN

David J. Salisbury Director, BD Northrop Grumman

9-12-16

Northrop Grumman Today



- Leading global security company
- \$23.5 billion sales in 2015
- \$35.9 billion total backlog (as of Dec. 31, 2015)
- Leading capabilities in:
 - Cyber
 - Logistics
 - Autonomous Systems
 - C4ISR
 - Strike





Three Operating Sectors at a Glance



Aerospace Systems



Autonomous Systems

Strike Operations

Military and Civil Space Systems

Aircraft and Spacecraft Design, Integration and Manufacturing

Intelligence, Surveillance, and Reconnaissance

Protected Communications

Battle Management

Missile Defense

Space Exploration

Advanced Technologies

Mission Systems



Airborne C4ISR Systems

Cyber and Intelligence Mission Solutions

Land & Avionics C4ISR Mission Solutions

Missile Defense and Protective Systems

Navigation and Maritime Systems

Space ISR Systems

Advanced Concepts and Technologies

Technology Services



Technology-Differentiated, Mission Services & Training Systems

Logistics and Modernization of Military Equipment

Global Sustainment Engineering and Support

> New Innovative Logistics Products

> > **Health IT**

Civil Security and Public Safety Systems

2012: Next Generation Weapon Systems



Better and different sensors and effectors

- Kinetic and Non-Kinetic
 - RF, LiDAR, EO, IR, Hyperspectral, acoustic...
 - Serious demands on the communication bandwidth
 - More intelligence at both the sensor and effector ends
- Moving metadata vice raw data
- More, higher speed processing
 - More data → need for automated data exploitation
 - "Swimming in sensors and drowning in data" USAF Lt. Gen (Ret.) David A. Deptula
 - Distributed processing elements
- Higher bandwidth communication systems
- More autonomous weapon systems
 - Self diagnostics and reporting
- Network Centric/SoS/MOSA Implementations





2012: Implications for Next Gen ATE?



- Evolution from 3 to 2 Level Maintenance?
- Commercial instrumentation has its place.
 - Will always be a gap between commercial instrumentation and DoD requirements
 - Commercial instrument suppliers will first follow commercial requirements
 - · Gap between commercial solutions and DoD requirements will likely widen
 - ATE developers task:
 - · Develop architecture that allows for augmentation and integration with COTS
- · Specific augmentation solutions are in place via the factory
 - Need general purpose implementations to minimize DoD ATE footprint
- · High Performance Interfaces will Need to be Addressed
 - High Performance Digital Interfaces
- Sensor Complexity Drives Increasingly Complex TPS'
 - Compatibility/Commonality with Factory TPS' is essential
 - More intelligent BIT, BITE and diagnostics
 - Tamper Proof, Cyber Hardened
- Network Centric Implementations
- Semantic level of interoperability?

5











AUTOTESTCON 2013 Plenary Session

Sequestration and ATE Standardization... The Perfect Storm

18 Sep 2013

David Salisbury Director, BD, Communications, Intelligence and Networking Solutions

Northrop Grumman Private Proprietary Level I / Competition Sensitive

THE VALUE OF PERFORMANCE.

NORTHROP GRUMMAN



GCSS-Army – Mission

Replace the US Army's tactical logistics systems with a modern ERP-based, integrated near real-time capability that can be accessed by Army units worldwide and supports the Army's Federated Approach to enterprise integration of data.



The Next Big Challenge: Improving Customer Mission Performance



Impact to Ops Tempo Predicted based on Inventory / Work Request Cadence / Quantity on Hand

Material Se		_						_						
	uation				Or	Igi	I R	1			-			
HIGH ALT		-				-								
NG2CC0	1ST SOLIADRON 11TH	ARM	ORE	CAVAL	RY REGIMENT									
Res * Melend	* Metand Concentra			August Stra	Reduction Reduct	11.4.1. 114	Real Pro	-	Ten Banda Stre	. Strachase Res	Trank Manual	The Read	and here	-
0000 0000220118	TRACK DOOR VEHICLE.AR	14	EA	88	0 A	0.000		· · ·	10	and the second	66/20/201	5 05/05/2015	66/20/2015	Country of the
007128374	WHE ROPE ASSEMBLY SINGLE	1	EA.	1	0.4	0.000		x	1 10		16/15/201	5 10/15/2015	06/13/2015	
007637764	LANP. INCAMOUSCENT	300	TA .	300	0.4	0.000		96 1	2 20		03/24/202	6 03/14/2016	03/14/2016	
007744602	SACE SILVE	1	TA .	1	0.4	0.000		97 1	2 90		64/07/205	6 04/07/2016	01/03/2013	
007773068	INTRING HARNESS	0	EA .	0	1.6	0.000		× 1	90		03/02/201	6 03/02/2016	03/02/2916	
007893706	RASHER THERMAL	1	(A	1	0.4	1.000		96 1	5 294	CDMC .	04/17/201	5 04/17/2015	04/14/2015	
008047646	RINGRETAINING	1	EA .	1	0.4	0.000		97 1	2 70		02/13/200	6 02/13/2016	02/13/2016	
608098533	WASHERIRAT	100	EA .	100	0 A	0.000		97 1	0 10		16/13/201	5 10/13/2015	03/24/2015	
008306660	GENERATOR	1	EA.	1	0 A	0.000	0	90.1	3 90		08/27/201	2 06/20/2012	06/27/2012	64
008438990	01062566	6	1		AUDEEL M	EUTCI		10			1	EA		4
	VIU100.5.300	0		100,1	VINEEL, V	EHICC	LAR				- T	EA		
008635592	11										0			0
008635592 008787301 009209663	1	~			TO LO	1 0110	_				U	60		
008635582 008787301 009109663 009362137	01063567	0	١	VED	GE, TRACK	< SHO	E				0	LA		0
008635582 008787301 009209663 009262137 0093821	01063567	0	١	VED	GE, TRACI	< SHO	E				0	LA		0
000635562 008787301 000109653 000362137 0003827 009853	01063567	0	1	VED	SE, TRACI	< SHO	E	97.0	1 40	_	65/28/201	4 05/28/2014	CALL-POINT	0
000635582 008787305 00030653 000305130 0003853 000853 000853 000853	01063567	0	1	VED	SE, TRACI	C SHO	E	97 1 97 1	1 FD 1 FD		0 65/28/201 62/18/200	< 05/28/2014 + 05/28/2014 + 02/10/2016	6303-09977 62/16/2916	0
000035002 000707302 00030270 00000270 00000270 000007700 000007700		0	1	VED	SE, TRACI	K SHO	E	97 1 97 1 98 1	P 22 22		65/28/201 02/16/201 63/24/201	 65/28/2014 62/10/2016 63/24/2016 	63/13/0911 62/16/2816 12/22/2814	0
000010000 00070700 00000000 00000000 0000000 000000		0	1 2 2 2 2	VEDO	SE, TRACI	< SHO	E	97 1 97 1 97 1	PPPP		65/28/201 62/15/200 63/24/201 62/13/201	 05/28/2014 02/10/2016 03/24/2016 02/13/2016 	63/13/0911 62/16/2816 12/22/2814 62/13/2816	0
000015502 000707302 000100001 0000010000 0000010000 0000010000 0000010000 0000010000 0000010000		0	1 1 1 1 1 1 1 1	VEDO	SE, TRACI	K SHO	E	97 1 97 1 98 1 91	10 10 10 10 10 10 10 10 10 10 10 10 10 1	C004	65/28/201 62/18/200 63/24/201 62/13/201 12/13/201	 05/28/2014 05/28/2014 02/10/2016 02/13/2016 12/14/2015 	63/34/9411 62/16/2816 12/22/2814 62/13/2816 12/02/2815	0
		0	1	VED	SE, TRACI	K SHO	E	91 1 91 1 92 1 90 92 1		C004	0 65/28/201 63/24(20) 63/24(20) 62/13/201 12/54(20) 62/23/201	 05/28/2014 02/10/2016 03/24/2016 02/13/2016 12/14/2015 02/03/2016 	62/16/2014 62/16/2014 12/22/2014 62/13/2014 12/02/2015 62/03/2015	•
000135000 00025730 00010000 00010000 0000000 0000000 000000	от 01063567 от 0	0	1	VEDO	SE, TRACI	C SHO	E	91 91 91 90 90 90 90 90 91 91	1 F0 1 F0 1 F0 2 F0 2 F0 2 F0 2 F0 2 F0 2 F0 2 F0 2	0162	0 05/28/281 02/16/285 03/24/285 02/03/295 02/03/295 03/05/295	 05/28/2014 02/10/2016 03/24/2016 02/13/2016 12/14/2015 02/03/2016 10/12/2012 	02/14/2014 02/16/2016 12/22/2014 02/13/2016 12/02/2015 02/03/2016 03/05/2014	•

1. Higher Quantity of Maintenance Work Requests – Indicates Increased Ops

		01													
Material Site	uation				De	eple	ete	9	C	1					
EN IGN CAN		100							_			_			
WG2CC0	1ST SQUADRON, 11TH	ARM	ORE	D CAVAL	RY REGIMENT										
SLoc * Michael	* Muterial Description	5240	100	Avel Stk	Rest: SOL Butch	Safety Stk	Serial No.	sc .	0	Top Bench St	oc Starioge Ber	Last Meret	Lat Most	Lat here	UNDOOK PH
0000 006829316	TRACK SHOE, VEHICLEAR	81	EA.	#3	6 A	6.000		90	57	PO		03/14/2014	66/05/2015	03/14/2016	
007128374	WHE KOPE ASSEMILY, SINGLE	1	EA.	1	0 A	0.000		5K	0	80		10/15/2013	10/15/2015	06/13/2015	
007637744	LANP, INCANDESCENT	300	EA.	300	0 A	6.000		96	0	90		03/14/2014	63/14/2016	03/14/2016	
007744682	SPACER, SLEVE	1	KA.	1	0 A	6.000		91	0	90		04/07/2014	6 04/07/2005	01/03/2011	
007773068	WIRDIG HARNESS		EA	0	1.8	0.000		98	8	90		03/02/2014	03/02/2026	03/02/2016	
607993206	FLASHER THERMAL	1	EA.	1	0.4	1.000		96	ŵ.	24	coosc	04/17/2015	64/17/2015	04/14/2015	
000047646	ERIC BETAINING		64	1		6.000		97	ŵ.	20		02/13/2014	02/13/2016	02/13/2016	
608098533	WAGHERRAT	100	EA.	100	0.4	6.000		97	10	80		10/13/2011	10/13/2015	03/24/2015	
008306660	GENERATOR	1	EA	1	0 A	6.000	0	90	U.	10		08/27/2013	66/20/2012	06/27/2012	64
0004309990	01062566	6			A/HEEL	VENICI		1	-			1	EΔ		1
008797301	101003500	0		100,	wincec,	VEHICC	LAN					-	L.		-
000100663	01063567	0		WED	GE, TRA	CK SHO	E					2	EA		2
00008150	NUT STOFIC COMPACING AND ADDRESS OF	14	11	14	2.4	1.000		97	v	10		05/26/2014	05/28/2014	CN12-PPTT	-
60000 2724	SCREW CAP SOCKET HEAD		EA.	1	0.4	0.000		91	0	P0		02/10/2014	+0707012014	02/10/2016	
02043247	HUB ASSEMBLY, SUSPENSION		EA	1	0 A	0.000		SK	2	10		63/24/2014	63/24/2016	12/22/2014	
£ 2000022	SPRING HELICIAL COMPRESSION	- 2	2.4	2	0 A	0.000		92_	÷	10	A.L.	02/13/2014	02/13/2006	02/13/2016	
	HUR, WHEEL, VEHICULAR		EA		0 A	1.000	-	90	2	24	C004	12/14/2015	12/14/2015	12/02/2015	
000633666	WEDGE, TRACK SHOE	2	64		2.4	8.000		×.	6	20		02/03/2014	62/03/2016	02/03/2016	
009635666			-			10.000		97	ŵ	24	0702	03/05/2014	10/12/2012	03/05/2014	
000635620	KING BLAKING, INVER	0.28	10.	1 1 1 1 1 1 1	A										
010030600 010030670 107030600	KING, BLARDIG, INNER	28	*	10	10	14 855				-	1000		a hits a radie of	-	

2. Quantity of Tank Parts begins to run low

0	• * [] 🕲 🕄 🜑	0.0			12210	0.17								
Material Situ	wtion				- h	<i>Rest</i>	00		K					
		10						_	_					
WG2CC0	1ST SQUADRON, 11TH	ARM	ORE	D CAVAL	RY REGIME	ENT								
SLoc" Material	Muterial Description	5200	UNH	Aval 50k	Reit/ SOL But	tch Safety Stk	Seld No.	50.	CTV	Bench Stor Stark	H En Lut Me	wit Last Regit	Let beve	LEVOCOX PH
0000 006929316	TRACK SHOE, VEHICULAR	81	EA.	#5	A 0	0.000		90	7 90		03/24/2	016 06/05/2015	03/14/2016	
007128374	WHE ROPE ASSEMBLY, SINGLE	-1	EA	1	A 0	0.000		9K	U P0		10/15/2	015 10/15/2015	06/13/2015	
007637744	LANP, INCANDESCENT	300	£A	300	A 0	0.000		96	U 90		03/14/2	006 03/14/2016	03/14/2016	
007744602	SPACERSLEVE	. 1	EA.	1	A 0	0.000		91	U 90		04/07/2	036 04/07/2016	01/03/2011	
007773068	WIRDIG HARNESS	0	EA.	0	1.8	0.000		94	U. PO		03/02/2	006 03/02/2016	03/02/2016	
007093706	RASHER DIERHAL	1	EA.	1	A 0	1.000		96	U 24	C0064	04/17/2	015 04/27/2015	04/14/2015	
008047646	RING,RETAINING	1	EA.		0 A	0.000		97	U 90		02/13/2	006 02/13/2016	02/13/2016	
000000533	WASHERJILAT	100	EA.	100	0. A	0.000		97	U. PO		10/13/2	015 10/13/2015	03/24/2015	
008306660	GENERATOR	-1	A.	1	0.A	0.000	10	90	U. PO		08/27/2	012 06/20/2012	08/27/2012	64
009430990 009635592	01063566	6	1	HUB,	NHEE	L, VEHICL	JLAR				8	EA		8
000109663	01000507	•		MED		ACK CUO	-				•	-		0
00936213	10100320/	U		VVEDU	JE, IR	ACK SHU	E				8	EA		8
00902000	NUT, SULLON MANAGENEOUS	16	LAS	16	0 A	0.000	-	97	U 10	_	05/38/3	014 05/28/2014	COULD STATE	
029917794	SOREVALCAP, SOCKET HEAD		EA.	1	A 0	0.000		91	U PO		02/10/2	014 00/10/2016	\$2/10/2016	
01/041147	HUE ASSEMBLY, SUSPENSION		EA	1.	A 0	0.000		94	Z P0		03/24/2	006 03/24/2016	32/22/2014	
R.2000020	SPRENCHELSCAL CORRESSION	- 2	14	2	A 0	0.000	-	-12	4 10	1.000	02/13/2	026 02/13/2016	02/13/2016	
010635666	HUR WMEEL VEHICULAR		EA.		0 A	4.009	-	90	2 24	C604	05/28/3	016 05/26/2016	12/02/2015	
010635670	WEDGE, TRACK SHOE		EA.		-	0.000		×	U 90	1 1/2	05(25)2	006 05/25/2010	02/03/2016	
Report of the local division of the local di	KING, BEAKING, INNER	. 18	EA.	28	A 0	18.000		91	0 24	0/02	03/05/2	004 10/12/2012	03/05/2014	
010635781									10.000	7783	101104	or course	TRANSFORMER.	
010635781	PERSONAL PROPERTY.													

NORTHROP GRUMMAN

3. Restock Order Placed by G-Army

The Cyber Perspective



- 1. Reconnaissance What opportunities exist?
 - Scanning and enumeration of attack surfaces (interfaces)
 - Vulnerability identification
- 2. Penetration / Exploitation What can we do?
 - Acquire and maintain access
 - Escalate privileges
 - Enable command and control
 - Enable denial of service
 - Enable cyber "effects"
 - Enable propagation to other systems
- 3. Cover Tracks How do we get away with this?
 - Hide artifacts and remove logs
 - Avoid anti-virus and intrusion detection

- Example: Stuxnet
 - Targeted and destroyed centrifuges at the nuclear facility in Natanz, Iran
 - Used seven distinct mechanisms to spread (6 zero-days)
 - USB Drives
 - Internet
 - Infects specific software:
 - Microsoft Windows
 - Siemens Step7
 - Infects specific hardware configuration of
 - S7-315 Programmable Logic Controller
 - CP-345-5 Net modules,
 - Farao Paya or VaconNX frequency converters



- UUT infections can manifest themselves in dozens of ways:
 - Corrupted targeting/geolocation data
 - Remote "kill switch" activated by adversary signal
 - Clandestine beaconing allowing an adversary to more easily detect blue forces
 - Corrupted/interrupted/intercepted blue force comms
 - Catastrophic equipment malfunction
 - Clandestine transmission of mission data to adversaries
 - Retrieval of collected data by adversaries
- In general, disrupt, deny, degrade, destroy, or deceive an adversary

2016: ATE Trends



- Network Centric Systems are here
- Cyber threats are real
- ATE offers a perfect attack vector
- Cyber resilience is really important

THE VALUE OF PERFORMANCE.



Approved For Public Release, #15-0608; Unlimited Distribution