IRONHAWK TECHNOLOGIES

Delivering Decision Critical Data™

Ironhawk Technologies, Inc.

Preliminary Report: Navy Trident Warrior (TW11) Shore-To-Ship Data Transfer Tests

2011

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DRAFT

Purpose: Benchmark performance of Ironhawk's SmartSync® data transfer application for the Navy SPAWAR Trident Warrior 11 (TW11) Risk Reduction Limited Objective Experiment (RR-LOE).

Government Sponsor: W. Randy Maule, Naval Postgraduate School and U.S. Navy PMW 160

Background: Two key issues being investigated with TW11 are:

1. "DATA THROUGHPUT
MILITARY PROBLEM: There exists a need for naval forces to exchange data in communication stressed environments; specifically IP/SATCOM denied conditions.

2. SATELLITE COMMUNICATIONS (SATCOM).
MILITARY PROBLEM: Robust, reliable and secure communications via SHF and EHF SATCOM are an operational requirement, regardless of geographic location or orientation. Current afloat SATCOM systems are subject to service interruptions in some geographic locations as well as during some ships maneuvers. Initiatives to increase operational reliability are essential for both to meet SHF and EHF Fleet SATCOM requirements."

Premise:
Ironhawk provides a proven data compression and transport solution that combines adaptive compression algorithms with reliable transport to reduce the amount of data transmitted over the air by up to 95%, without sacrificing military capability.

Methods:
- 9 Storyboards were prepared in advance, based on inputs from the US Navy Tactical Networks Program Office (PMW-160). The storyboards cover basic configuration, state/mode observation, and each shore-to-ship data transfer scenario and data type of interest specified by PMW-160.
- Each storyboard involved one or more of 8 unique test cases, covering the specific data transfers, connect/disconnect scenarios, and general usage of the software. These test cases were also used to verify and validate software before delivery.
- Data available to be transferred from Shore to Ship included: VMware drive images, virus definitions, Windows update files, ESXi patches (patches to VMware), database backups, and CBM data.
- Tests were conducted at the SPAWAR test facility, Point Loma Naval base, San Diego, CA.
- VMware baselines were loaded by DVD on the ship and shore systems. Virus definition baselines were delivered "over the air". All baselines will likely be transferred by DVD initially during deployment.
- Virus definition files are compressed archives. Since the form of compression is inferior, the files were "normalized" prior to sending over the air. This involves decompressing the vendor-supplied archive, then re-assembling the archive in its uncompressed state before sending with SmartSync®. See the use cases for details. This process is usually automated. The use cases are designed to expose how SmartSync® works so the Navy can see how to best make use of the technology.
- SATCOM characteristics: 25 kbps – 100 kbps range, 99 kbps average, latency average = 900 ms (round trip)

Dates of Tests: February 2 & 8, 2011

Constraints and Assumptions:
- Results are based on limited sample datasets, which included VMware images and virus definitions. Other data sets were tested at Ironhawk due to time and availability of resources, but will be tested in July, 2011.
- Compression rates are not affected by satellite bandwidth or latency.

Results:

SATCOM characteristics were verified using a protocol analyzer.

SmartSync® was initially installed with no knowledge of sender, receiver, or the data to be transferred.

SmartSync® uses delta differencing – an approach to compression that uses a "baseline" to determine the absolute minimum amount of data needed to create an update for the recipient. A baseline can be transferred over the air, or inserted at both originator and recipient using a command-line utility. The use cases below include both approaches, though it is anticipated that any sizeable baseline would be loaded in the Ship's content store via DVD prior to departure.

Table 1: Compression and Transfer Times (Measured at SPAWAR)

Storyboard & Test Case	Transferred Data	Orig. Size (MB)	Compressed Size (MB)	% Savings	LAN Transfer Time	SATCOM Transfer Time
Storyboard 1.0 (Configuration, Observe states and modes):						
Test Case 2.1.1, 2.1.3	Savelog.log	4.84	0.19	**96.1%**	:01	:15
Storyboard 1.1 (VMware Images):						
Test Case 2.2.2 (load baseline on both sender & receiver)	W2003ServerSP2_updates_20110107_ovf.vmdk	2898.6	N/A (command-line insert)	N/A	N/A	N/A
Test Case 2.3.2 (send first update to the VM: shore to ship, over the air)	W2003ServerSP2_updates_20110107_SmartSyncLite_qa5_VNC_ovf.vmdk	2899.2	35.13	**98.8%**	:17	47:30
Storyboard 1.2 (Virus Definition files):						
Test Case 2.3.1 Send Virus Definition file (load baseline over the air)	vd345203_n.zip	106.7	94.21	**11.7%**	:35	2:13:39
Test Case 2.3.2 Update Virus Definition file over the air	vd345406_n.zip	106.8	0.75	**99.3%**	:01	1:01

* N/A = Not applicable

Notes on the Results Tables:

1. Transfer times do not include time to compress/decompress.
2. See the Test Cases for details on test and data collection methods.
3. Tests involving the other file types were not performed due to a time constraint.

Table 2: Compression and Transfer Times (Measured at Ironhawk)

Storyboard & Test Case	Transferred Data	Orig. Size (MB)	Compressed Size (MB)	% Savings	LAN Transfer Time	SATCOM Transfer Time
Storyboard 1.3 (Windows Update Files (WSUS):						
Test Case 2.2.2 (load baseline on both sender & receiver)	wsusoffline-2003_20110105.zip	1682.3	N/A (command-line insert)	N/A	N/A	N/A
Test Case 2.3.2 (send first update to the VM: shore to ship, over the air)	wsusoffline-2003_20110121.zip	1683.4	20.2	**98.8%**	:09	26:02
Storyboard 1.4 (VMware ESXi Patch files):						
Test Case 2.3.1 (Send ESXi Patch file (load baseline over the air)	ESXi400-201009001_preprocess.zip	176.0	165.6	**5.9%**	1:12	3:33:14
Test Case 2.3.2 (Send next ESXi Patch file)	ESXi400-201101001_preprocess.zip	176.6	81.8	**53.7%**	:36	1:45:20
Storyboard 1.6 (CBM data):						
Test Case 2.3.1 (Send CBM Data baseline)	ULLSAE_20090226_64M.BAK	64.0	9.8	**84.7%**	4.2	12:37
Test Case 2.3.2 (Send next CBM data file)	ULLSAE_20090227_64M.BAK	64.0	0.035	**99.9%**	:01	:03

Summary of Results:
When sending the initial (baseline) file, SmartSync® achieved a 50% compression ratio, but subsequent transfers yielded compression rates as high as 99%, which clearly demonstrated the benefits of the delta differencing algorithm.

Interpretation of Results:
These findings suggest that Ironhawk SmartSync® is very effective at compressing the serial data files provided, with an estimated 95% or better compression rate being observed for critical VMware images and virus definition update files. The data attributes that contribute to such high compression rates include:

1) The data files are very large, and Ironhawk's technology is highly effective with large files where other technologies fail.
2) The data must be managed and maintained as a whole, such as a virus definition file or VM images, and the data is updated incrementally over time.

These characteristics favor SmartSync®, particularly when sending the same updates to multiple recipients over disadvantaged, intermittent networks such as wireless networks.

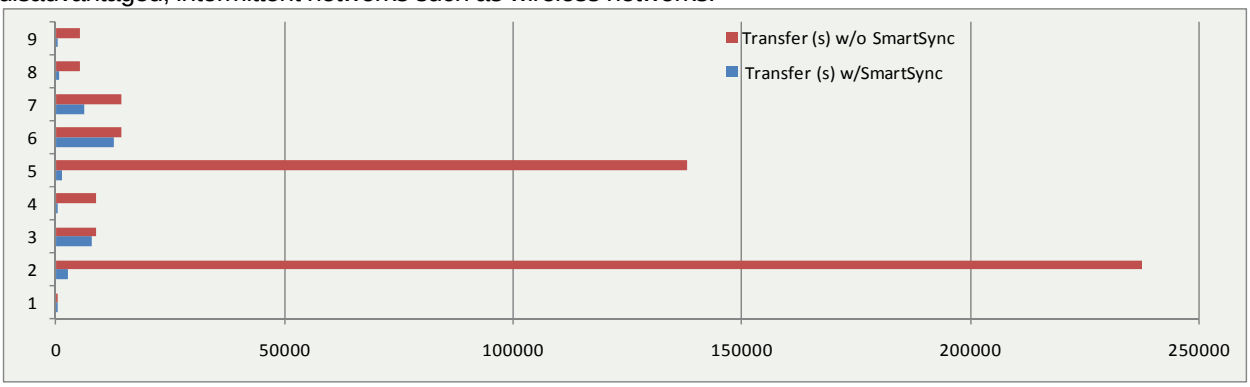

Figure 1: Comparison of Transfer Times (s) Without and With SmartSync(r)