PERFORMANCE IMPROVEMENT OF KSTAR NETWORKS FOR LONG DISTANCE COLLABORATIONS

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- **KSTAR (Korea Superconducting Tokamak Advanced Research) has completed its 6th campaign.**
- **Every year, it produces enormous amount of data that need to be forwarded to international collaborators shot by shot for run-time analysis.**
- **Analysis of one shot helps in deciding parameters for next shot. Many shots are conducted in a day, therefore, this communication need to be very efficient. Moreover, amount of KSTAR data and number of international collaborators are increasing every year.**
- **In presence of big data and various collaborators exists in all over the world, communicating at run-time will be a challenge. To meet this challenge, we need efficient ways of communications to transfer data.**
- **Therefore, in this paper, we will optimize paths among internal and external networks of KSTAR for efficient communication.**
- **We will also discuss transmission solutions for environment construction and evaluate performance for long distance collaborations.**

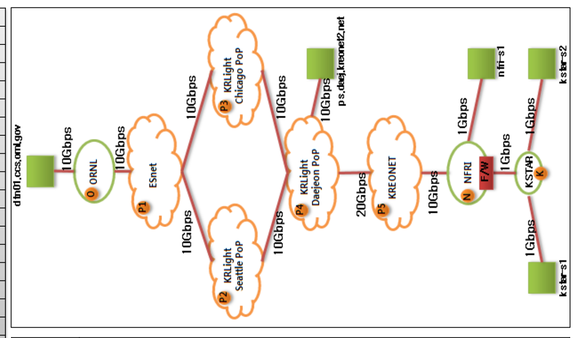
TEST AND TRANSMISSTION SOLUTION

- The traceroute which was a program to check path of networks was used to find the optimal path.
- The iperf program was used to check bandwidth of TCP and UDP.
- The bbcp program was used to check bandwidth when we transfer file data from local to remote.
- We used the dd program to measure each server between local and remote areas because reading and writing performance is important between disk and memory.
- We used the tracepath in order to measure configuration of MTU and Jumbo Frame of networks routers.

PERFORMANCE ANALYSIS AND EVALUATION

- Servers and networks information

Server	Type	Information
dtn01	CPU	Quad-Core 2 2.3 GHz
	MEM	24 GB
	DISK	Luster
	LAN	10 Gbps
ps	CPU	Xeon 2 GHz
	MEM	4 GB
	DISK	Read 2.5 GB/s, Write 115 MB/s
	LAN	10 Gbps
nfri-s1	CPU	Xeon 2.93 GHz
	MEM	8 GB
	DISK	Read 3.5 GB/s, Write 76.9 MB/s
	LAN	1 Gbps
kstar-s1	CPU	Quad-Core 2 2.6 GHz
	MEM	4 GB
	DISK	Read 2.6 GB/s , Write 68.3 MB/s
	LAN	1 Gbps
kstar-s2	CPU	Xeon 2.67GHz
	MEM	16GB
	DISK	Read 3.2 GB/s, Write 121 MB/s
	LAN	1 Gbps



Time	Path of networks
Before	ORNL < P1 < P3 < P4 < P5 < NFRI < KSTAR
After	ORNL < P1 < P2 < P4 < P5 < NFRI < KSTAR

✓We tested in this configuration but we couldn't be able to get assigned resources of networks in order to transfer data in KREONET and GLORIAD-KR. We just use normal networks of research.

✓After we changed the path of the networks to transfer data, we got a result that sending path and receiving path were same.

- Jumbo Frame and MTU information

Time	O	P1	P2	P4	P5	N (IN)	N (OUT)	K
Before	O	O	X	X	X	X	X	O
After	O	O	O	O	O	O	O	O

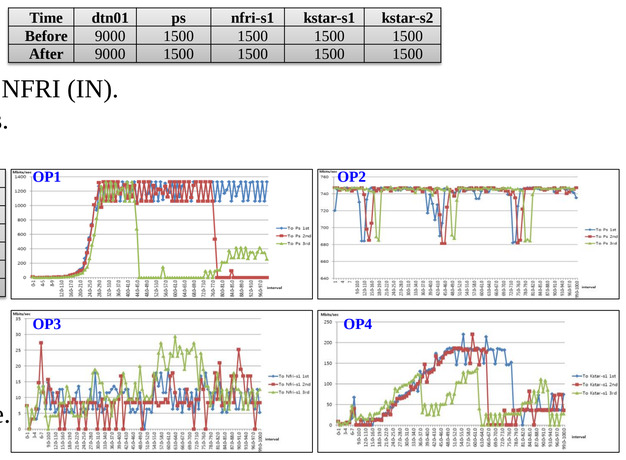
Time	dtn01	ps	nfri-s1	kstar-s1	kstar-s2
Before	9000	1500	1500	1500	1500
After	9000	1500	1500	1500	1500

✓We could not change value of jumbo frame for NFRI (IN).

✓We didn't change the value of MTU for servers.

- Experimental A from ORNL by iperf(mbps)

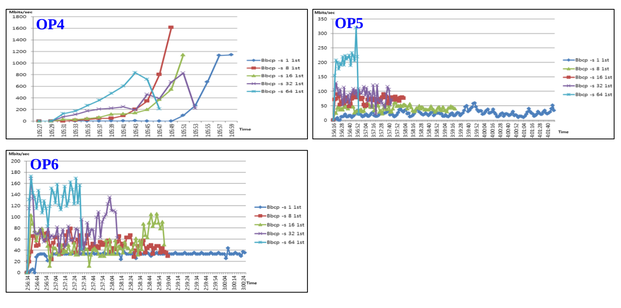
Src.	Dst.	Type	Before	1st After	2nd After	3rd After
dtn01	ps	TCP	X	920	560	293
		UDP	746	738	739	740
	nfri-s1	TCP	2.56	9.37	8.97	12.6
		UDP	X	X	X	X
	kstar-s1	TCP	2.84	88.8	70.3	50.6
		UDP	X	X	X	X



OP1:TCP test from dtn01 to ps after change.
OP2:UDP test from dtn01 to ps after change.
OP3:TCP test from dtn01 to nfri-s1 after change.
OP4:TCP test from dtn01 to kstar-s1 after change.

- Experimental A from ORNL by bbcp(mbps)

Src.	Dst.	Session	Before	1st After	2nd After
dtn01	ps	1	X	196.5	179.7
		8	X	266.8	286.9
		16	X	217.1	220.1
		32	X	272.1	199.8
		64	X	343.7	315.6
	nfri-s1	1	14.4	22.5	22.6
		8	28.8	40.9	40
		16	46.4	70.4	74.7
		32	91.2	84	102.2
		64	155.2	190.6	181.4
	kstar-s1	1	24.8	32.3	26.2
		8	23.2	50	48.3
		16	37.6	51	43.8
		32	71.2	77.6	62.4
		64	119.2	126.8	127



OP4 : Bbcp test from dtn01 to ps after change.
OP5 : Bbcp test from dtn01 to nfri-s1after change.
OP6 : Bbcp test from dtn01 to kstar-s1 after change.

✓We were able to clearly know that bandwidth were difference depending on sessions of bbcp.

✓TCP test was impossible from dtn01 to ps but TCP test was possible from dtn01 to nfri-s1 and kstar-s1 from the default configuration.

✓UDP test was impossible from dtn01 to kstar-s1.

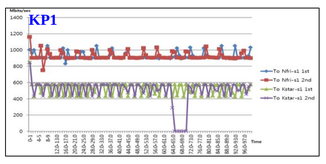
✓When we transferred data from dtn01 to ps and nfri-s1 and kstar-s1, we used the KRLight Seattle PoP instead of KRLight Chicago PoP.

✓After we changed path of networks, we was able to get results of TCP bandwidth from dtn01 to ps.

✓We were not able to get results of clearly bandwidth from dtn01 to ps and nfri-s1 and kstar-s1 because bandwidth of networks was ever-changing.

- Experimental B from KISTI by iperf(mbps)

Src.	Det.	Type	Before	1st After	2nd After
ps	nfri-s1	TCP	933	922	923
	kstar-s1	TCP	564	525	501



KP1: TCP test from ps to nfri-s1 and kstar-s1 after change.

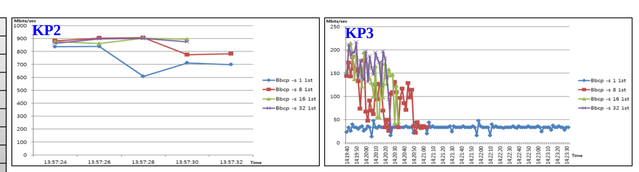
✓We tested to transfer dummy file of 1GB from local to remote server.

✓We got a result of KP1.

✓The more we used TCP sessions which were limited by 64, the data was quickly moved by bbcp from local to remote server.

- Experimental B from KISTI by bbcp(mbps)

Src.	Dst.	Session	Before	1st After	2nd After
ps	dtn01	1	X	X	X
	nfri-s1	1	671.2	739.8	791.5
		8	814.4	850.8	853.4
		16	870.4	885.6	863.6
		32	883.2	885.4	769.7
	kstar-s1	1	32.8	33.1	32.2
		8	91.2	91.8	136.1
		16	135.2	140.3	109.1
		32	138.4	156.7	143.8



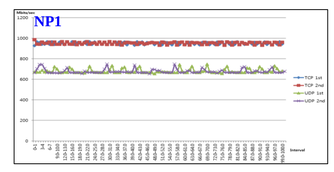
KP2 : Bbcp test from ps to nfri-s1 after change.
KP3 : Bbcp test from ps to kstar-s1 after change.

✓If we want to improve bandwidth of networks, we need to tune security systems between local to remote areas with managers of networks.

✓The peculiar thing was that when we measured bandwidth from ps to nfri-s1 and kstar-s1 by bbcp, if we used sessions of 64, we were not able to transfer file data because bbcp program was killed by security program.

- Experimental C from NFRI by iperf(mbps)

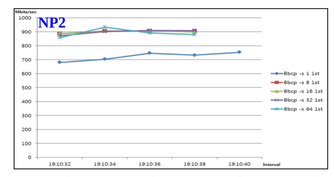
Src.	Dst.	Type	Before	1st After	2nd After
nfri-s1	dtn01	TCP	X	X	X
		UDP	X	X	X
	ps	TCP	956	949	949
		UDP	681	678	676



NP1 : TCP/UDP test from nfri-s1 to ps after change.

- Experimental C from NFRI by bbcp(mbps)

Src.	Dst.	Session	Before	1st After	2nd After
nfri -s1	dtn01	1	X	X	X
	ps	1	741.6	724.8	885.2
		8	686.4	902.2	903.4
		16	896.8	900.2	901.4
		32	851.2	899.6	896.8
		64	891.2	891.8	891.8



NP2 : Bbcp test from nfri-s1 to ps after change.

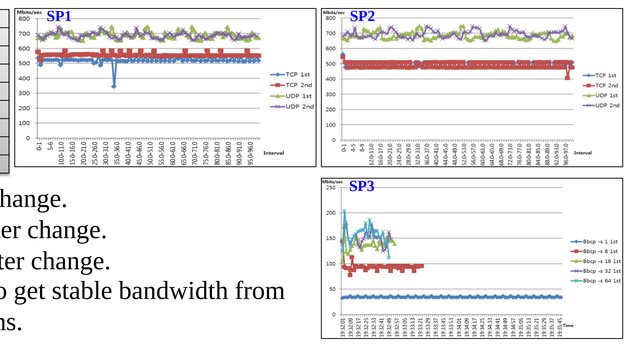
✓We were not able to measure bandwidth of TCP/UDP from nfri-s1 to kstar-s1 by iperf.

✓We were able to confirm that by configuration of NAT (Network Address Translation) system in NFRI.

✓As we can see the NP2, we were able to get results that this test had stable bandwidth from nfri-s1 to ps between the outside firewall by iperf and bbcp.

- Experimental D from KSTAR by iperf(mbps)

Src.	Dst.	Type	Before	1st After	2nd
kstar-s1	dtn01	TCP	X	X	X
		UDP	X	X	X
	ps	TCP	528	524	557
		UDP	690	689	687
	nfri-s1	TCP	500	491	491
		UDP	678	689	687
	kstar-s2	TCP	943	990	990
		UDP	684	680	682

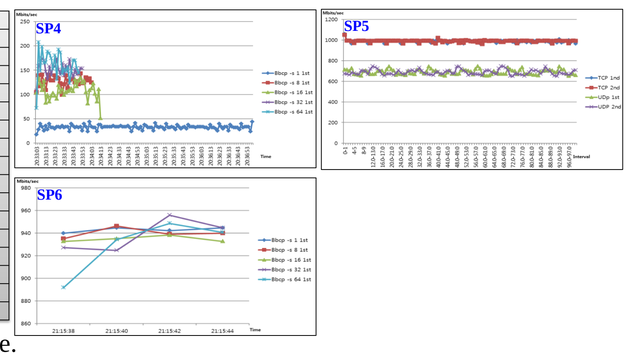


SP1 : TCP/UDP test from kstar-s1 to ps after change.
SP2 : TCP/UDP test from kstar-s1 to nfri-s1after change.
SP3 : CP/UDP test from kstar-s1 to kstar-s2 after change.

✓As we can see the Figure 16, we were able to get stable bandwidth from kstar-s1 to kstar-s2 without security systems.

- Experimental D from KSTAR by bbcp(mbps)

Src.	Dst.	Session	Before	1st After	2nd
kstar-s1	dtn01	1	X	X	X
	ps	1	33.6	32.8	32.8
		8	86.4	127.2	75.8
		16	104.8	107.7	134.8
		32	130.4	151.9	137.6
		64	154.4	161	153.8
	nfri-s1	1	34.4	34.1	34.1
		8	135.2	94.1	93
		16	135.2	137.8	136
		32	150.4	150.8	156.4
		64	156.8	157.4	169.4
	kstar-s2	1	852	943.2	941.8
		8	882.4	940.2	939
		16	887.2	934.8	936.4
		32	892	938.2	935.2
		64	892	929	934.2



SP4 : Bbcp test from kstar-s1 to ps after change.
SP5 : Bbcp test from kstar-s1 to nfri-s1 after change.
SP6 : Bbcp test from kstar-s1 to kstar-s2 after change.

✓As we can see the SP4 and SP5, the results that bandwidth values were similar from kstar-s1 to nfri-s1 and kstar-s1 to ps.

✓So, we were able to confirm that security systems were able to affect reducing bandwidth.

CONCLUSIONS

- When we used more TCP session of bbcp, we were able to know an increase in Bandwidth.
- We were not reserved dedicated bandwidth on research networks because we wanted to know general bandwidth in this experiment. So, bandwidth was able to be both good and bad according to state of KREONET and GLORIAD-KR.
- The utilization of the servers will be affected to measure bandwidth.
- The measurement values of networks bandwidth are different depending on how to change configuration of security systems which are in each site.

FUTURE PLANS

- We paln to conduct experiment to measure bandwidth from local to remote areas after we reserved the dedicated bandwidth from end to end.
- We plan to cooperate with the person in charge who is a manager of KREONET and GLORIAD-KR in more details to measure the performance of each section of KREONET and GLORIAD-KR.
- We plan to measure transfer data after we found more diverse solution of data transfer.
- We plan to improve performance of KSTAR networks after we found and verified more diverse solutions for long distance collaborations.

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