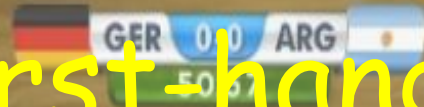


FIFA World Cup Finals

how to stream a **BIG** sports event live



First-hand experiences of
the 2014 FIFA World Cup
Finals in Brazil
internet broadcast
preparation and execution
(and some Euro 2016 stuff...)
(works for 2018 Finals too...)



Who Am I?



1992-1997



1997-2003



2004-2016



2004-2010 – iTVP project
funded by the Polish government (KBJ)



It all started in the
pre-smartphone era...
(2005+)

What TVP did earlier...




What TVP did earlier...



2006

2005

2 Mbit/s PAL 720x576 5.1 surround sound



HOW TO BRING A MATCH
STRAIGHT FROM THE FIELD
ONTO YOUR LAPTOP
CELL PHONE
TABLET

IN 3 EASY STEPS

A person is seen from the side, sitting at a desk and playing a video game. They are using a large monitor that displays a game with a green background and a circular target. The person is wearing a plaid shirt and has a blue wristband. In the background, there is a large window or glass door with a view of an outdoor area where other people are visible. The scene is lit with warm indoor lights and bright outdoor light.

1. CAPTURE IT
2. PREPARE IT
3. BROADCAST IT

1. CAPTURE IT...

Kolokacja, Hosting dedykowany, Dostęp do Internetu



MOSCOW

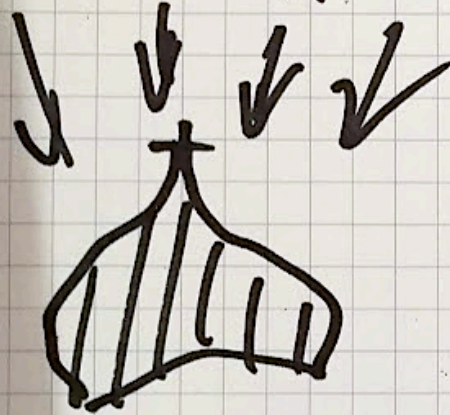
real fibre link!

satellite backup

WARSAW

1. CAPTURE IT...

12 VENUES



MOSCOW

OBS*

- 2X MOSCOW
- ULIYINGRAD
- ST. PETERSBURG,
- NIZHNY NOVGOROD
- KAZAN
- YEKATERINBURG
- SARANSK
- SAMARA
- VOLGOGRAD
- ROSTOV ON-DON
- SOCHI

~ 2800 km
~ 1740 miles

*Olympic Broadcasting Services



GENEVE

ARISTA

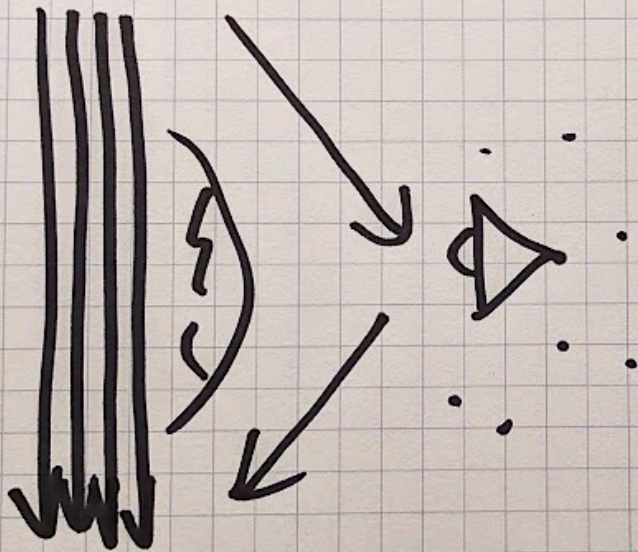
www.arista.com

1. GET IT...

GENEVĚ
EBU HQ

4K SDI x 16
HD SDI x 8
(UPSAMPLED TO 4K)

ARISTA
www.arista.com



TVP

HQ

WARSAW

... and every other licensee

1. GET IT...

WHAT IS SDI?

SDI is NOT Strategic Defense Initiative

https://en.wikipedia.org/wiki/Serial_digital_interface:

*Serial digital interface (SDI) is a family of digital video interfaces first standardized by SMPTE (The Society of Motion Picture and Television Engineers) in 1989 (...) used for transmission of **uncompressed, unencrypted digital video*** signals (optionally including embedded audio and time code) within television facilities.*

** – includes color burst, V-sync, H-sync, etc...*

It's Ethernet for Broadcasting. Key differences:

- don't care for content, care about the signal itself (vs I care a lot about what's inside this packet),
- mostly static, protein-based routing (vs dynamic rule-based routing, like BGP, ISIS or RIP),
- copper PHY is still BNC-based (vs "what's a BNC?"),
- SDI-based PRO broadcasting gear costs a kidney and a liver (vs my Raspberry has a 1 GbE NIC),
- original SDI standard (SD-SDI, 576i in PAL) is almost exclusively **270 Mbit/s**,
- HD-SDI (introduced in 1998) is **1.485 Gbit/s** (or 1.485/1.001 for brain-dead fps rates), **720p** or **1080i**,
- Dual-link HD-SDI and later 3G-SDI (2002, 2006) is **3 Gbit/s** (actually 2.970) at **1080p60**,
- 6G-SDI/12G-SDI (2015) is used for **4K broadcasting**, **2160p30** and **2160p60** respectively and usually uses LACP-like multiple BNC or fibre PHY (4x3 Gbit/s BNC or 2x10 SFP+).

TVP



"solo"

"WORD"

z 210"

EMISJA

4K (12G-SDI)

STUDIO-7
STUDIO-1

KOMEN|TATORZY

DVB-* & CABLE
BROADCASTING

PVR recording
For VOD

CISCO

2x CASPAR

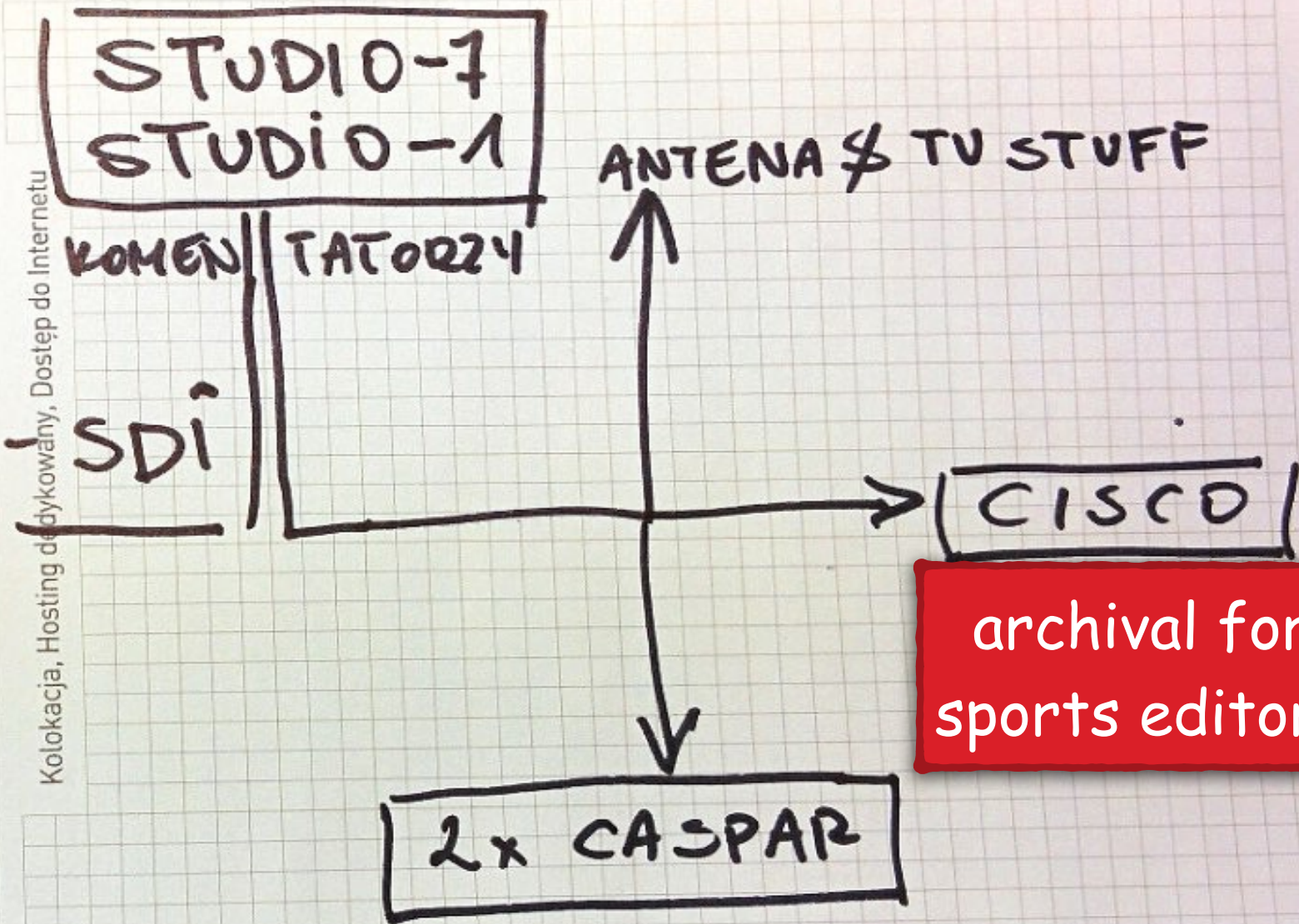
2. PREPARE IT

TVP
SPORT HD
SPORT.TVP.PL



Video player controls including a pause button, a "live" indicator, a progress bar showing 00:14:21 / 00:14:59, and icons for volume, settings, and full screen.

12G



archival for sports editors

Cisco D9036 Modular Encoding Platform

The Cisco® D9036 Modular Encoding Platform provides multi-resolution, multi-format encoding for applications requiring high levels of video quality. The modular platform is scalable to support as many as eight Standard Definition (SD), four High Definition (HD), or other combinations of video encoders within a single rack unit, while providing excellent broadcast quality video and consuming as little as 40 Watts per service.

Figure 1. Cisco D9036 Modular Encoder



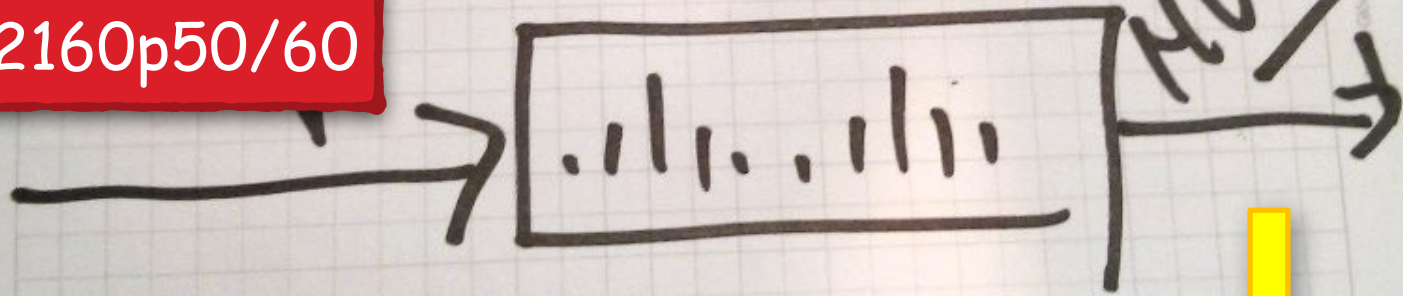
... or harmonic ViBE:



CISCO Forum 2014
19-21 marca 2014, Hotel Kasprowy, Zakopane

12G-SDI
2160p50/60

Encoding gear

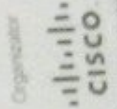
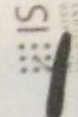


MULTICASTS



local Ethernet

Partner



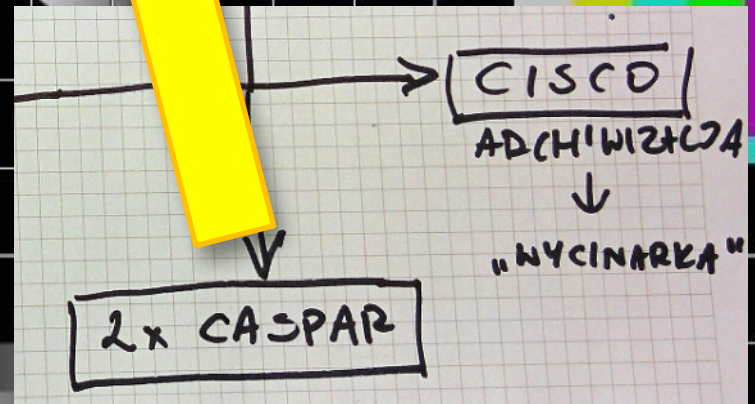
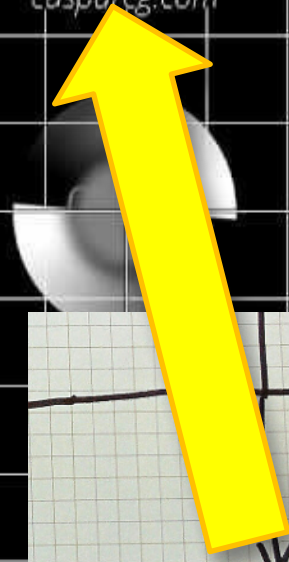
USTRZEGANIE: Cisco nie gwarantuje, że informacje zawarte w tym dokumencie są aktualne, kompletnymi lub bezbłędne. Informacje zawarte w tym dokumencie mogą być zmieniane bez powiadomienia. Informacje zawarte w tym dokumencie nie stanowią oferty. Informacje zawarte w tym dokumencie mogą być zmieniane bez powiadomienia. Informacje zawarte w tym dokumencie mogą być zmieniane bez powiadomienia. Informacje zawarte w tym dokumencie mogą być zmieniane bez powiadomienia.



CasparCG vel „Caspar“

Alpha/key correct:
PREMULTIPLIED /
LINEAR / ADDITIVE

CASPARCG 
casparcg.com



CasparCG vel „Caspar“



Alpha/key correct:
**PREMULTIPLIED /
LINEAR / ADDITIVE**

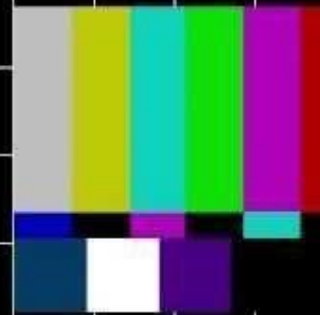
CASPARCG

casparcg.com



FREE broadcasting software
developed by **svt** 

Works flawlessly with a cheap
Black Magic Decklink HD video
card and **SQUADAQ**-like gear



SECURITY

AFTER HOURS

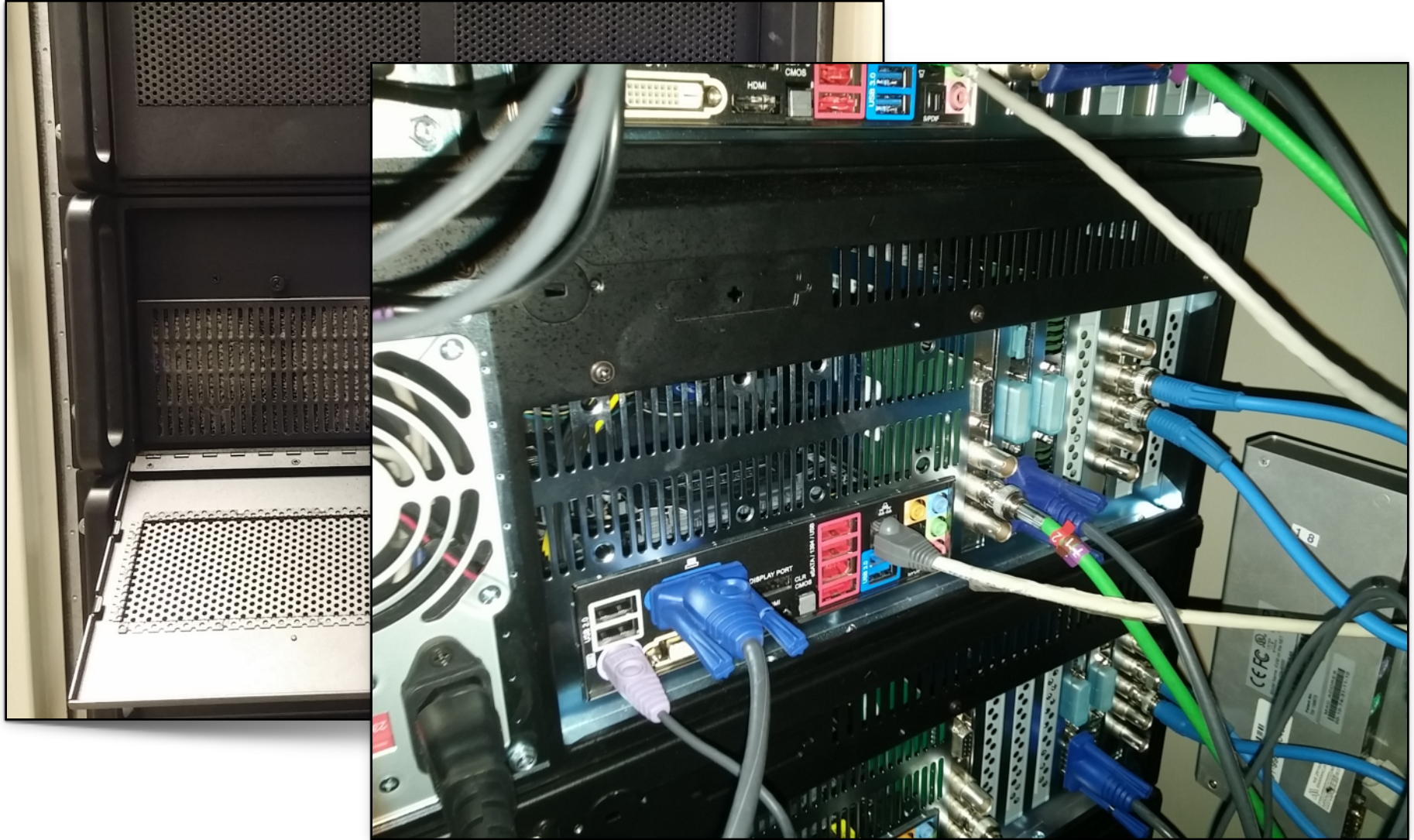
SQUADAQ gear...



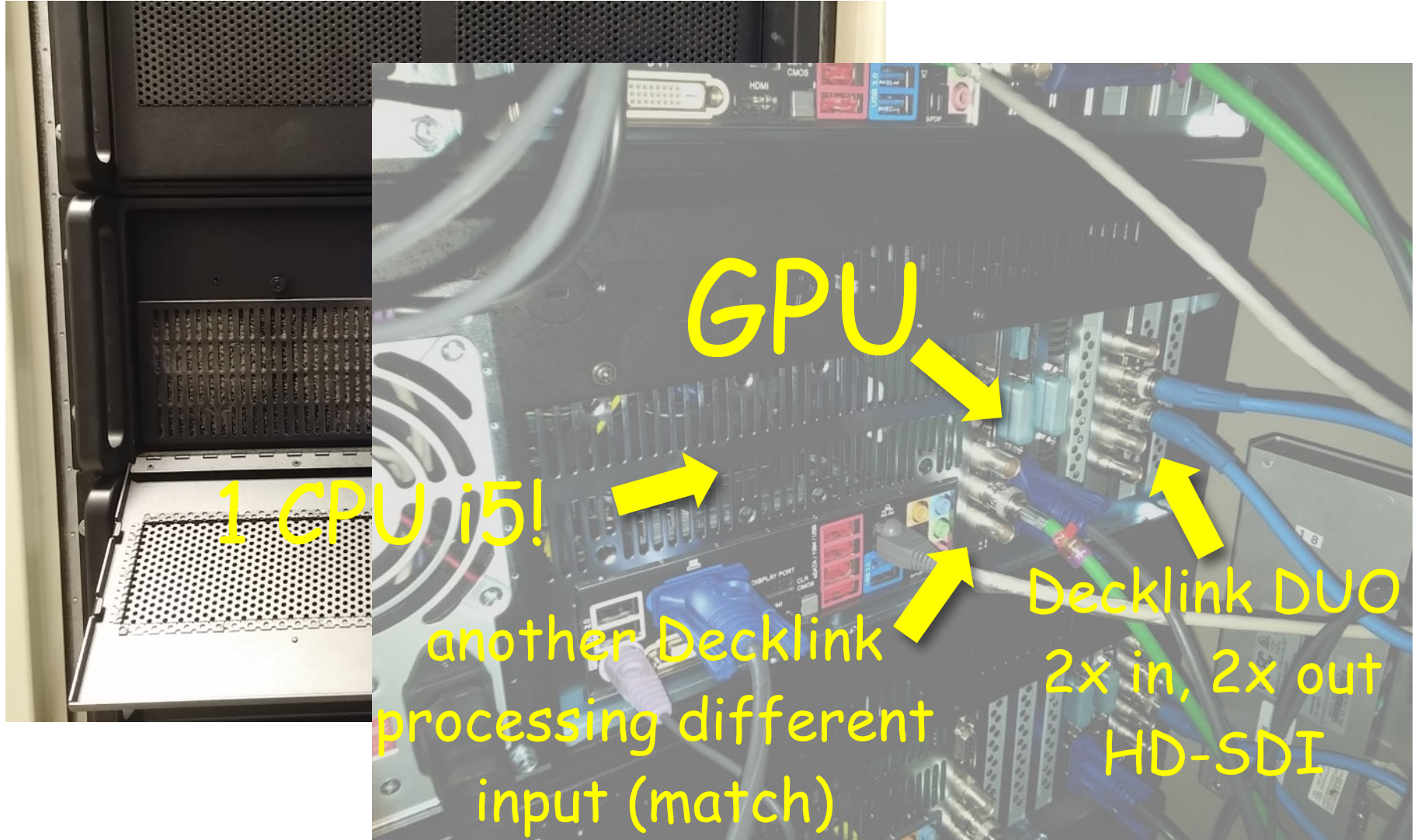
CasparGC is there to:

- convert multicast HD into HLS (400-2300 kbit/s streams),
- add the broadcaster logo (mandatory license requirement),
- mix signals (pre- and post-match + jingles during the pause)

SQUADAQ style...



SQUADAQ style...



3. BROADCAST IT



• live

00:14:25 | 00:14:59



sport.tvp.pl/2014fifaworldcup

GRUPA A GRUPA B GRUPA C GRUPA D GRUPA E GRUPA F GRUPA G GRUPA H

ŚRODA, 09.07, 22:00, 1/2 FINAŁU

HOLANDIA 0:0 ARGENTYNA
(0-0, 0-0) KARNE - 2:4

SOBOTA, 12.07, 22:00, MECZ O 3. MIEJSCE

BRAZYLIA 0:3 HOLANDIA
(0-2)

NIEDZIELA, 13.07, 21:00, FINAŁ

NIEMCY 1:0 ARGENTYNA
(0-0, 0-0)

WIDEO INFORMACJE PLAN TRANSMISJI WYNIKI OPINIE STATYSTYKI

Najpiękniejszego gola mundialu strzelił...

HOULLIER: MESSI ZASŁUŻYŁ NA ZŁOTĄ PILKĘ

TRENER REWELACJI MUNDIALU ZREZYGNOWAŁ

WYDARZENIA WIDEO ZDJĘCIA STATYSTYKI

rio.tvp.pl

faworldcup

GRUPA F GRUPA G GRUPA H

NIEDZIELA, 13.07, 21.00, FINAŁ

NIEMCY 1:0 ARGENTYNA (0:0, 0:0)

STATYSTYKI



MUSLERA 7

Najpiękniejszego gola mundialu strzelił...



HOULLIER: MESSI ZASŁUŻYŁ NA ZŁOTĄ PILKĘ



TRENER REWELACJI MUNDIALU ZREZYGNOWAŁ

WYDARZENIA WIDEO ZDJĘCIA STATYSTYKI



MATCH SCHEDULE

64 matches

Venue	Thursday, 12 June	Friday, 13 June	Saturday, 14 June	Sunday, 15 June	Monday, 16 June	Tuesday, 17 June	Wednesday, 18 June	Thursday, 19 June	Friday, 20 June	Saturday, 21 June	Sunday, 22 June	Monday, 23 June	Tuesday, 24 June	Wednesday, 25 June	Thursday, 26 June	Friday, 27 June	Saturday, 28 June	Sunday, 29 June	Monday, 30 June	Tuesday, 1 July	Wednesday, 2 July	Thursday, 3 July	Friday, 4 July	Saturday, 5 July	Sunday, 6 July	Monday, 7 July	Tuesday, 8 July	Wednesday, 9 July	Thursday, 10 July	Friday, 11 July	Saturday, 12 July	Sunday, 13 July		
Belo Horizonte Estadio Mineirao			5 13:00 COL v GRE		15 13:00 BEL v ALG					27 13:00 ARG v IRN			40 13:00 CRC v ENG				49 13:00 1A v 2B																	
Brasilia Estadio Nacional				9 13:00 SUI v ECU					21 13:00 COL v CIV			33 17:00 CMR v BRA			46 13:00 POR v GHA					53 13:00 1E v 2F														
Cuiaba* Arena Pantanal		4 19:00 CHI v AUS			16 18:00 RUS v KOR				26 18:00 NGA v BIH				37 18:00 JPN v COL																					
Curitiba Arena da Baixada					12 18:00 IRN v NGA				26 18:00 HON v ECU			35 13:00 AUS v ESP			48 17:00 ALG v RUS																			
Fortaleza Estadio Castelao			7 16:00 URU v CRC			17 16:00 BRA v MEX			29 16:00 GER v GHA				38 17:00 GRE v CIV																					
Manaus* Arena Amazonia			8 18:00 ENG v ITA				18 18:00 CMR v CRO			30 18:00 USA v POR			41 16:00 HON v SUI																					
Natal Estadio das Dunas		2 13:00 MEX v CMR			14 18:00 GHA v USA			22 19:00 JPN v GRE					39 13:00 ITA v URU																					
Porto Alegre Estadio Beira-Rio					10 18:00 FRA v HON			20 13:00 AUS v NED				32 18:00 KOR v ALG			43 13:00 NGA v ARG																			
Recife Arena Pernambuco				6 22:00 CIV v JPN					24 13:00 ITA v CRC			34 17:00 CRO v MEX			45 13:00 USA v GER																			
Rio de Janeiro Estadio do Maracana					11 19:00 ARG v BIH			19 16:00 ESP v CHI				31 13:00 BEL v RUS			42 17:00 ECU v FRA																			
Salvador Arena Fonte Nova		3 16:00 ESP v NED			13 13:00 GER v POR				25 16:00 SUI v FRA				44 13:00 BIH v IRN																					
Sao Paulo Arena de Sao Paulo	1 17:00 BRA v CRO							23 18:00 URU v ENG				36 13:00 NED v CHI			47 17:00 KOR v BEL																			

*Note: Local kick-off times for Culaba and Manaus UTC -4, all other venues UTC -3

Subject to change

- B** Brazil (BRA), Croatia (CRO), Mexico (MEX), Cameroon (CMR)
- 8** Spain (ESP), Netherlands (NED), Chile (CHI), Australia (AUS)
- C** Colombia (COL), Greece (GRE), Côte d'Ivoire (CIV), Japan (JPN)
- D** Uruguay (URU), Costa Rica (CRC), England (ENG), Italy (ITA)
- E** Switzerland (SUI), Ecuador (ECU), France (FRA), Honduras (HON)
- F** Argentina (ARG), Bosnia-Herzegovina (BH), Iran (IRN), Nigeria (NGA)
- G** Germany (GER), Portugal (POR), Ghana (GHA), USA (USA)
- H** Belgium (BEL), Algeria (ALG), Russia (RUS), Korea Republic (KOR)

FUDO SECURITY
AFTER HOURS

FIFA WORLD CUP SPONSORS



What you've got...

And this is what you really need..

source: Google



When you need SPEED
you use REAL hardware

... and some nice network switches

24x40 GbE


```
RP/0/RSP0/CPU0/1#sh int hu0/3/0/0
```

```
Wed Apr  9 12:40:27.816 CET
```

```
HundredGigE0/3/0/0 is up, line protocol is up
```

```
Interface state transitions: 277
```

```
Hardware is HundredGigE, address is c067.af (bia c067.af)
```

```
Layer 1 Transport Mode is LAN
```

```
Description: PLIX
```

```
Internet address is 195.182.218.20/23
```

```
MTU 1514 bytes, BW 1000000000 Kbit (Max: 1000000000 Kbit)
```

```
reliability 255/255, txload 3/255, rxload 0/255
```

```
Encapsulation ARPA,
```

```
Full-duplex, 100000Mb/s, link type is force-up
```

```
output flow control is off, input flow control is off
```

```
loopback not set,
```

```
ARP type ARPA, ARP timeout 04:00:00
```

```
Last input 00:00:00, output 00:00:00
```

```
..and a few of these, please...
```

```
Last clearing of "show interface" counters 01:10:29
```

```
5 minute input rate 6042000 bits/sec, 7360 packets/sec
```

```
5 minute output rate 1291884000 bits/sec, 109622 packets/sec
```

```
CFP EEPROM port: 0
```

```
Xcvr Type: CFP
```

```
Ext Type: 24W, Host Lane n:m, LANWDM, CLEI,
```

```
Connector Type: SC
```

```
Ethernet Application Codes: 100GE-LR4,
```

```
Number of Lanes: Network 4, Host 10
```

```
0 broadcast packets, 27 multicast packets
```

```
errors, 0 underruns, 0 applique, 0 resets
```

```
buffer failures, 0 output buffers swapped out
```

```
r transitions
```

TVP tested 100 GbE in April 2014



WHAT DO YOU NEED?

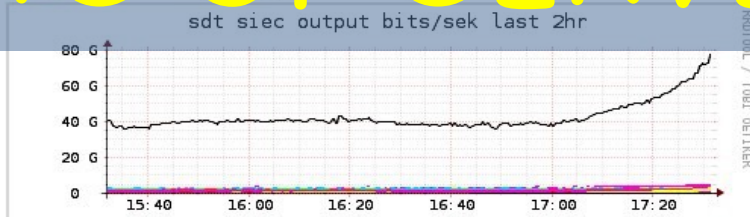
1. GEAR
2. CDN
3. GIGABITS
4. LUCK



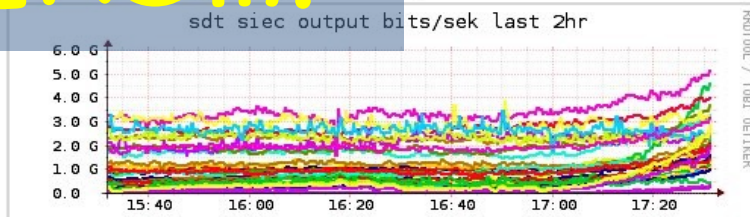
KEEP
CALM
AND
CARRY
ON

LOTS OF SERVERS....

- Last hour 2hr 4hr day 5 days week month year
- default
- rsdt regiony
- rsdt warszawskie
- sdt inne
- sdt suma ruchu
- sdt-dyski-siec sdt-nodeXX
- sdt-dyski-siec-cache
- sdt-dyski-siec-plex
- sdt-node23-dyski-siec
- serwery portalv4-xxx
- serwery statyki



Server	Now	Min	Avg	Max
Total	77.6G	36.0G	42.5G	77.6G
rsdt-gdal	1.5G	488.6M	745.8M	1.5G
rsdt-kat1	1.2G	349.9M	510.4M	1.2G
rsdt-kat2	1.1G	263.1M	468.5M	1.1G
rsdt-lub1	1.4G	420.3M	612.8M	1.4G
rsdt-szn1	1.4G	448.2M	701.9M	1.4G
rsdt-tpix1	382.4M	5.6M	61.2M	382.4M
rsdt-tpix2	329.0M	6.5M	60.0M	329.0M
rsdt-tpix3	380.0M	14.4M	61.7M	380.0M
rsdt-tpix4	399.6M	14.5M	61.5M	399.6M
rsdt-tpix5	311.6M	3.4M	54.2M	311.6M
rsdt-waw101	1.5G	497.1M	979.5M	1.6G
rsdt-waw102	1.3G	568.4M	997.8M	1.4G
rsdt-waw103	1.0G	224.7M	393.7M	1.0G
rsdt-waw104	1.0G	205.1M	363.7M	1.0G
rsdt-wro1	2.0G	466.7M	706.9M	2.0G
sdt-netia1	2.9G	63.7M	505.6M	2.9G
sdt-netia2	4.6G	170.4M	831.7M	4.6G
sdt-node139	3.3G	2.1G	2.4G	3.3G
sdt-node191	3.3G	1.5G	1.9G	3.3G
sdt-node192	3.7G	1.6G	2.0G	3.7G
sdt-node193	4.0G	2.4G	2.9G	4.0G
sdt-node194	5.2G	1.6G	3.5G	5.2G
sdt-node81	2.4G	1.6G	2.2G	3.2G
sdt-node82	2.4G	2.1G	2.4G	3.0G
sdt-node83	3.1G	2.3G	3.0G	3.9G
sdt-node84	2.4G	1.8G	2.7G	3.5G
sdt-node85	1.6G	824.5M	1.1G	1.6G
sdt-node86	1.5G	905.2M	1.1G	1.5G
sdt-node87	1.8G	1.0G	1.2G	1.8G
sdt-nodeg1	470.5M	352.6M	508.2M	774.6M
sdt-plex31	2.5G	926.6M	1.3G	2.5G
sdt-plex33	2.3G	671.2M	1.0G	2.3G
sdt-plex35	2.2G	810.0M	1.0G	2.2G
sdt-plex37	2.1G	776.3M	1.0G	2.1G
sdt-plex39	3.2G	1.7G	2.0G	3.2G
sdt-plex41	2.0G	57.4M	312.7M	2.0G
sdt-plex43	2.7G	99.9M	503.9M	2.7G
sdt-plex45	2.9G	112.5M	481.7M	2.9G
sdt-thinx1	30.8k	30.4k	49.4k	93.0k
sdt-thinx2	89.7k	32.9k	51.2k	89.7k



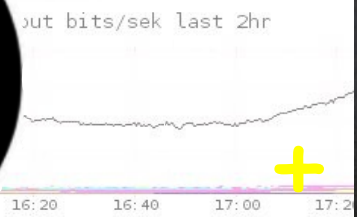
Server	Now	Min	Avg	Max
rsdt-gdal	1.5G	488.6M	745.8M	1.5G
rsdt-kat1	1.2G	349.9M	510.4M	1.2G
rsdt-kat2	1.1G	263.1M	468.5M	1.1G
rsdt-lub1	1.4G	420.3M	612.8M	1.4G
rsdt-szn1	1.4G	448.2M	701.9M	1.4G
rsdt-tpix1	382.4M	5.6M	61.2M	382.4M
rsdt-tpix2	329.0M	6.5M	60.0M	329.0M
rsdt-tpix3	380.0M	14.4M	61.7M	380.0M
rsdt-tpix4	399.6M	14.5M	61.5M	399.6M
rsdt-tpix5	311.6M	3.4M	54.2M	311.6M
rsdt-waw101	1.5G	497.1M	979.5M	1.6G
rsdt-waw102	1.3G	568.4M	997.8M	1.4G
rsdt-waw103	1.0G	224.7M	393.7M	1.0G
rsdt-waw104	1.0G	205.1M	363.7M	1.0G
rsdt-wro1	2.0G	466.7M	706.9M	2.0G
sdt-netia1	2.9G	63.7M	505.6M	2.9G
sdt-netia2	4.6G	170.4M	831.7M	4.6G
sdt-node139	3.3G	2.1G	2.4G	3.3G
sdt-node191	3.3G	1.5G	1.9G	3.3G
sdt-node192	3.7G	1.6G	2.0G	3.7G
sdt-node193	4.0G	2.4G	2.9G	4.0G
sdt-node194	5.2G	1.6G	3.5G	5.2G
sdt-node81	2.4G	1.6G	2.2G	3.2G
sdt-node82	2.4G	2.1G	2.4G	3.0G
sdt-node83	3.1G	2.3G	3.0G	3.9G
sdt-node84	2.4G	1.8G	2.7G	3.5G
sdt-node85	1.6G	824.5M	1.1G	1.6G
sdt-node86	1.5G	905.2M	1.1G	1.5G
sdt-node87	1.8G	1.0G	1.2G	1.8G
sdt-nodeg1	470.5M	352.6M	508.2M	774.6M
sdt-plex31	2.5G	926.6M	1.3G	2.5G
sdt-plex33	2.3G	671.2M	1.0G	2.3G
sdt-plex35	2.2G	810.0M	1.0G	2.2G
sdt-plex37	2.1G	776.3M	1.0G	2.1G
sdt-plex39	3.2G	1.7G	2.0G	3.2G
sdt-plex41	2.0G	57.4M	312.7M	2.0G
sdt-plex43	2.7G	99.9M	503.9M	2.7G
sdt-plex45	2.9G	112.5M	481.7M	2.9G
sdt-thinx1	30.8k	30.4k	49.4k	93.0k
sdt-thinx2	89.7k	32.9k	51.2k	89.7k

Ganglia

Last hour 2hr 4hr day week month year job or from



- default
- rsdt regiony
- rsdt warszawskie
- sdt inne
- sdt suma ruchu
- sdt-dyski-siec sdt-nodeXX
- sdt-dyski-siec-cache
- sdt-dyski-siec-cache
- sdt-dyski-siec-plex
- sdt-node1-sdyski-s
- serwer
- serwery statyki



ANSIBLE

Host	Now	Min	Avg	Max
rsdt-gda1	Now: 1.5G	Min: 488.6M	Avg: 745.8M	Max: 1.1G
rsdt-kat1	Now: 1.2G	Min: 349.9M	Avg: 510.4M	Max: 1.1G
rsdt-kat2	Now: 1.1G	Min: 263.1M	Avg: 468.5M	Max: 1.1G
rsdt-lub	Now: 1.5G	Min: 420.3M	Avg: 2.8M	Max: 1.1G
rsdt-szn	Now: 1.5G	Min: 448.2M	Avg: 701.9M	Max: 1.1G
rsdt-tpi	Now: 1.5G	Min: 5.6M	Avg: 51.2M	Max: 382.1M
rsdt-tpi	Now: 1.5G	Min: 6.5M	Avg: 60.0M	Max: 329.1M
rsdt-tpi	Now: 1.5G	Min: 1.4M	Avg: 1.7M	Max: 380.1M
rsdt-tpix4	Now: 399.6M	Min: 14.5M	Avg: 61.5M	Max: 399.6M
rsdt-tpix5	Now: 311.6M	Min: 3.4M	Avg: 54.2M	Max: 311.6M
rsdt-waw101	Now: 1.5G	Min: 497.1M	Avg: 979.5M	Max: 1.6G
rsdt-waw102	Now: 1.3G	Min: 568.4M	Avg: 393.7M	Max: 1.0G
rsdt-waw103	Now: 1.0G	Min: 224.7M	Avg: 363.7M	Max: 1.0G
rsdt-waw104	Now: 1.0G	Min: 205.1M	Avg: 706.9M	Max: 2.0G
rsdt-wro1	Now: 2.0G	Min: 466.7M	Avg: 505.6M	Max: 2.9G
sdt-netia1	Now: 2.9G	Min: 63.7M	Avg: 831.7M	Max: 4.6G
sdt-netia2	Now: 4.6G	Min: 170.4M	Avg: 2.4G	Max: 3.3G
sdt-node139	Now: 3.3G	Min: 2.1G	Avg: 1.9G	Max: 3.3G
sdt-node191	Now: 3.3G	Min: 1.5G	Avg: 2.0G	Max: 3.7G
sdt-node192	Now: 3.7G	Min: 6G	Avg: 2.0G	Max: 3.7G
sdt-node193	Now: 4.0G	Min: 0.9G	Avg: 3.2G	Max: 4.0G
sdt-node194	Now: 5.2G	Min: 1.6G	Avg: 2.2G	Max: 3.2G
sdt-node81	Now: 2.4G	Min: 2.1G	Avg: 2.4G	Max: 3.0G
sdt-node82	Now: 2.4G	Min: 2.1G	Avg: 3.0G	Max: 3.9G
sdt-node83	Now: 3.1G	Min: 2.1G	Avg: 2.7G	Max: 3.5G
sdt-node84	Now: 2.4G	Min: 1.8G	Avg: 1.1G	Max: 1.6G
sdt-node85	Now: 1.6G	Min: 1.5G	Avg: 1.1G	Max: 1.5G
sdt-node86	Now: 1.5G	Min: 1.5G	Avg: 1.2G	Max: 1.8G
sdt-node87	Now: 1.5G	Min: 1.5G	Avg: 508.2M	Max: 774.6M
sdt-node88	Now: 1.5G	Min: 1.5G	Avg: 1.3G	Max: 2.5G
sdt-node89	Now: 2.3G	Min: 1.7G	Avg: 1.0G	Max: 2.3G
sdt-node90	Now: 2.2G	Min: 810.0M	Avg: 1.0G	Max: 2.2G
sdt-node91	Now: 2.1G	Min: 776.3M	Avg: 1.0G	Max: 2.1G
sdt-node92	Now: 3.2G	Min: 1.7G	Avg: 2.0G	Max: 3.2G
sdt-node93	Now: 2.0G	Min: 57.4M	Avg: 312.7M	Max: 2.0G
sdt-node94	Now: 2.7G	Min: 99.9M	Avg: 503.9M	Max: 2.7G
sdt-node95	Now: 2.9G	Min: 112.5M	Avg: 481.7M	Max: 2.9G
sdt-thinx1	Now: 30.8k	Min: 30.4k	Avg: 49.4k	Max: 93.0k
sdt-thinx2	Now: 89.7k	Min: 32.9k	Avg: 51.2k	Max: 89.7k

ANSIBLE



ALL THE THINGS!

A CDN....

CDN - either you buy it or DIY

Usually a CDN (Content Delivery Network) consist of:

- ✓ redirector nodes - the more the better, this is the magic ingredient making the whole CDN smart (decisions are based on live BGP data, server load, viewer ISP and type of content),
- ✓ proxy nodes (kind of L2 cache) - usually grouped geographically,
- ✓ edge nodes (kind of L1 cache) - lots of them, cleverly deployed to take advantage of uplink asymmetries,
- ✓ origin nodes are usually provided by the CDN customer - live feeds need just two sources, VPN is used due to license restrictions,

... think Akamai CDN, L3 CDN, Fastly, Amazon (for VODs), etc.

or...

you can build a CDN yourself and use just collocated services (usually free of charge*) and borrowed servers...

It will take just 12 people, over a million+ Euro/\$ investment and 5+ years to develop

but the running cost is ~1/3 of what the commercial CDNs charge...



... and a nice webpage with live stuff...



Najnowsze Wyniki Drużyny - Wideo Reprezentacja Statystyki Komentarz Izaka

Dołącz do nas:



Wybierz najlepszego mistrza świata ostatnich lat [ankieta]

ZOBACZ TEŻ



MŚ w liczbach: maratończyk Perišić, koszmar Meksyku



"Ale urwał!": miny Czerchesowa i szalona radość Chorwatów



Cała Polska przed telewizorami. "To wielki sukces TVP"

105 245 213 252



"You've got to ask yourself one question:
Do I feel lucky? Well, do ya, punk?"

Internal Server Error

The server encountered an internal error or misconfiguration and was unable to complete your request.

Please contact the server administrator, admin@localhost and report the details of the error that occurred, and anything you might have done that may have caused the error.

More information about this error may be available in the server error log.


Error 503 Service Unavailable

Service Unavailable

Guru Meditation:

XID: 1495675306

Varnish cache server

A large, fiery nuclear explosion with a massive mushroom cloud, rendered in a monochromatic orange and yellow color scheme. The text is overlaid on the central part of the explosion.

IT'S THE
HOSTING,
STUPID!



Requests Through CloudFlare

Total Requests

Last 24 Hours

106,277,748

Cached Requests

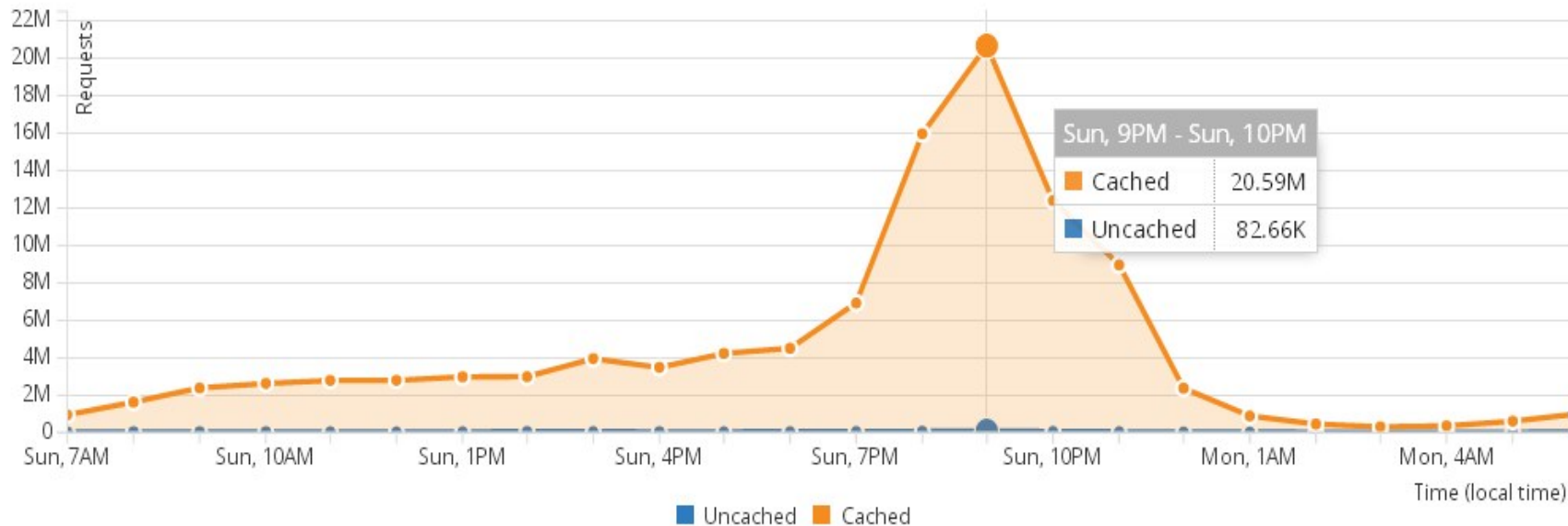
Last 24 Hours

105,548,148

Uncached Requests

Last 24 Hours

729,600



[Help](#)

Let's skip the boring stuff and talk about...

TVP
SPORT
SPORT.TVP.PL

The 2014 RIO FINALS

Skip the boring stuff, let's talk about...

TVP

SPORT

SPORT.TVP.PL

WTOREK, 08.07, 22:00, 1/2 FINAŁU



BRAZYLIA

1:7

(0:5)



NIEMCY

200,97

Gbit/s

Skip the boring stuff, let's talk about...

TVP
SPORT
SPORT.TVP.PL

WTOREK, 08.07, 22:00, 1/2 FINAŁU



BRAZYLIA

1:7

(0:5)



NIEMCY

200,97

Gbit/s

ŚRODA, 09.07, 22:00, 1/2 FINAŁU



HOLANDIA

0:0

(0:0, 0:0)
KARNE - 2:4



ARGENTYNA

208,71

Gbit/s

Skip the boring stuff, let's talk about...

TVP
SPORT
SPORT.TVP.PL

WTOREK, 08.07, 22:00, 1/2 FINAŁU



BRAZYLIA

1:7

(0:5)



NIEMCY

200,97

Gbit/s

ŚRODA, 09.07, 22:00, 1/2 FINAŁU



HOLANDIA

0:0

(0:0, 0:0)
KARNE - 2:4



ARGENTYNA

208,71

Gbit/s

SOBOTA, 12.07, 22:00, MECZ O 3. MIEJSCE



BRAZYLIA

0:3

(0:2)



HOLANDIA

161,23

Gbit/s

TVP

SPORT HD

SPORT.TVP.PL

THE FINAL

July 13th



• live

00:08:13 | 00:14:59



NIEDZIELA, 13.07, 21:00, FINAL



NIEMCY

1:0

(0:0, 0:0)



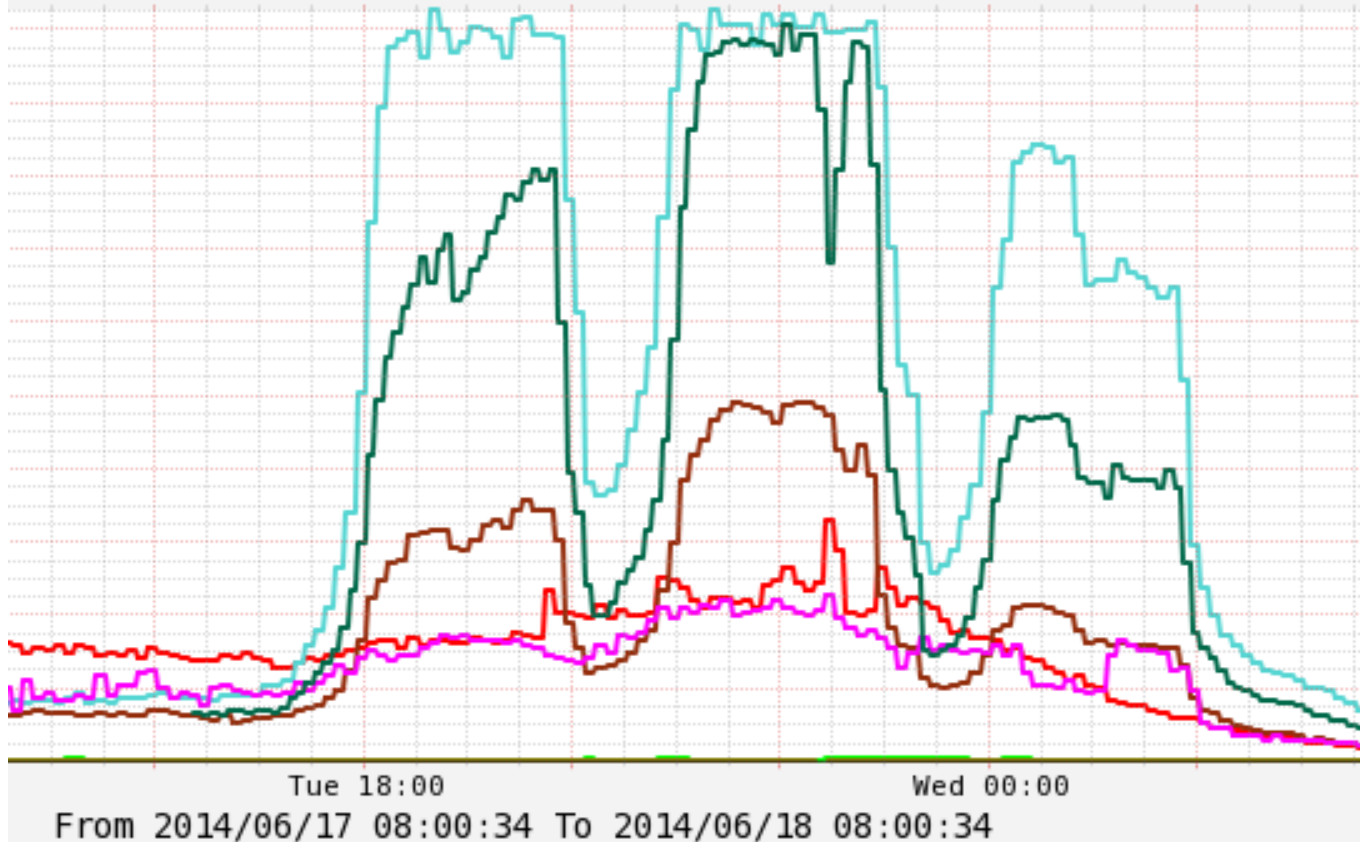
ARGENTYNA

TVP

SPORT
SPORT.TVP.PL

211,40
Gbit/s

TVP - Outbound



WTOREK, 17.06, 18:00, GRUPA H



BELGIA

2:1

(0:1)



ALGERIA



BRAZYLIA

0:0

WTOREK, 17.06, 21:00, GRUPA A



MEKSYK



ROSJA

ŚRODA, 18.06, 00:00, GRUPA H

1:1

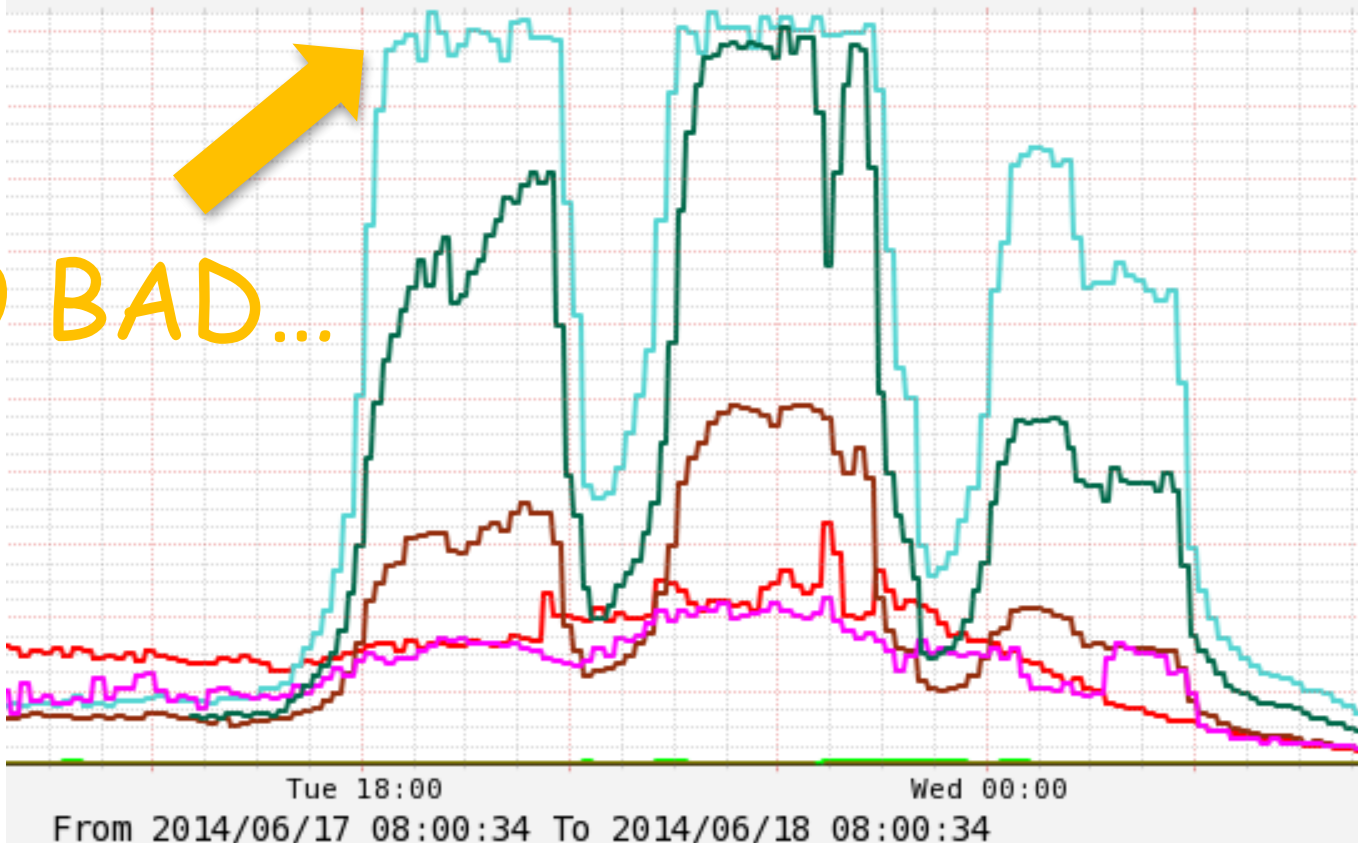
(0:0)



KOREA PŁD.

TVP - Outbound

TOO BAD...



WTOREK, 17.06, 18:00, GRUPA H



BELGIA

2:1

(0:1)



ALGERIA



BRAZYLIA

0:0



MEKSYK



ROSJA

1:1

(0:0)

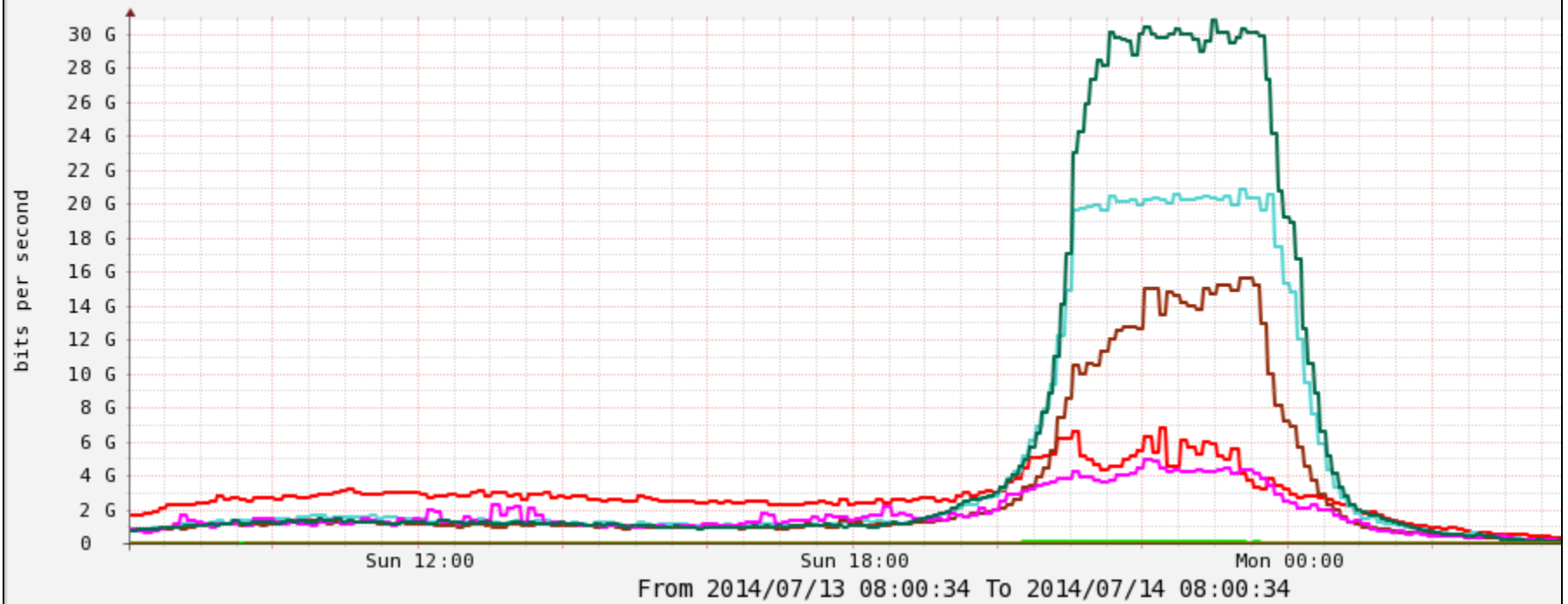


KOREA PŁD.

WTOREK, 17.06, 21:00, GRUPA A

ŚRODA, 18.06, 00:00, GRUPA H

TVP - Outbound



NIEDZIELA, 13.07, 21:00, FINAŁ

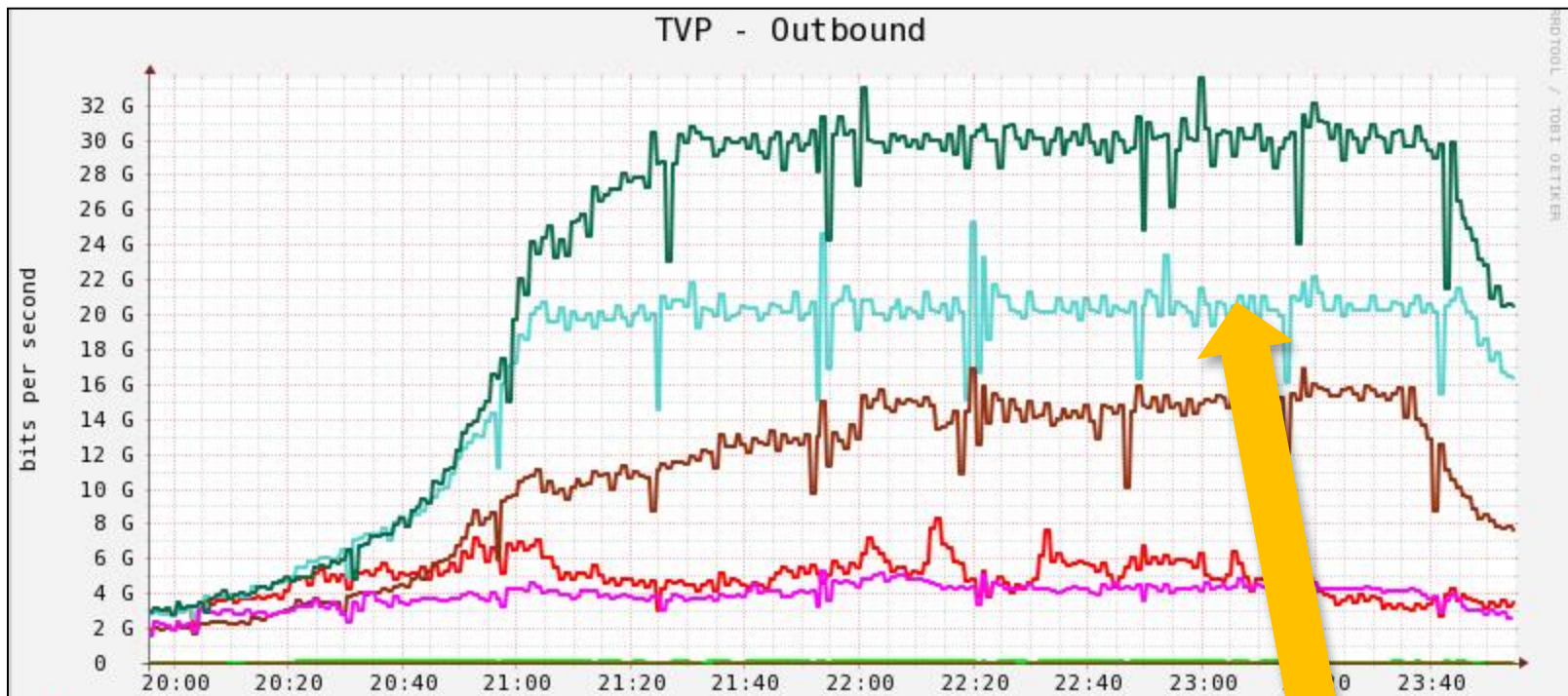


NIEMCY

1:0
(0:0, 0:0)



ARGENTYNA



NIEDZIELA, 13.07, 21:00, FINAŁ



NIEMCY

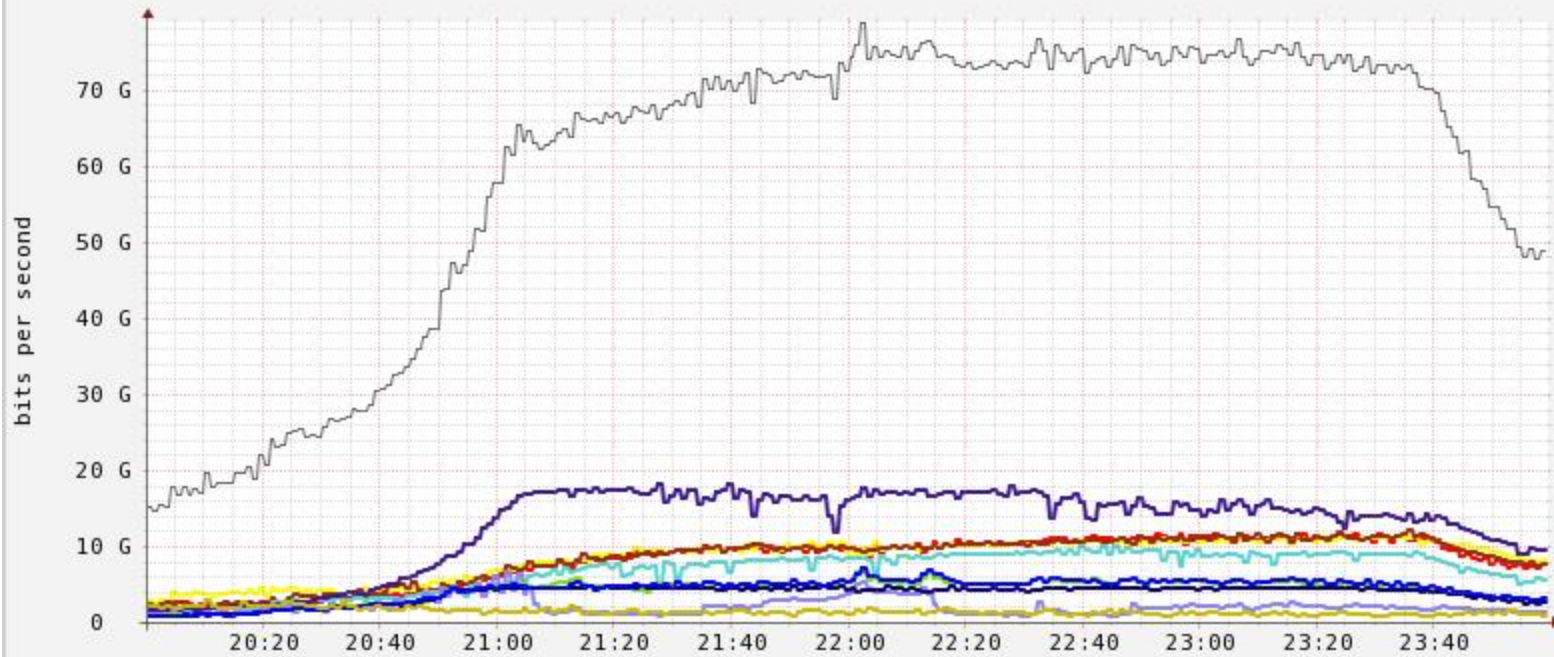
1:0
(0:0, 0:0)



ARGENTYNA



SDT TVP - Outbound



RRD/TOOL / TOBI OETIKER

- Total: Current: 48.95 G Average: 59.86 G Maximum: 78.89 G
- SDT-81:
- SDT-82:
- SDT-83:
- SDT-84:
- SDT-85:
- SDT191
- SDT192
- SDT193
- SDT194
- SDT-3:
- SDT-2:

NIEDZIELA, 13.07, 21:00, FINAŁ



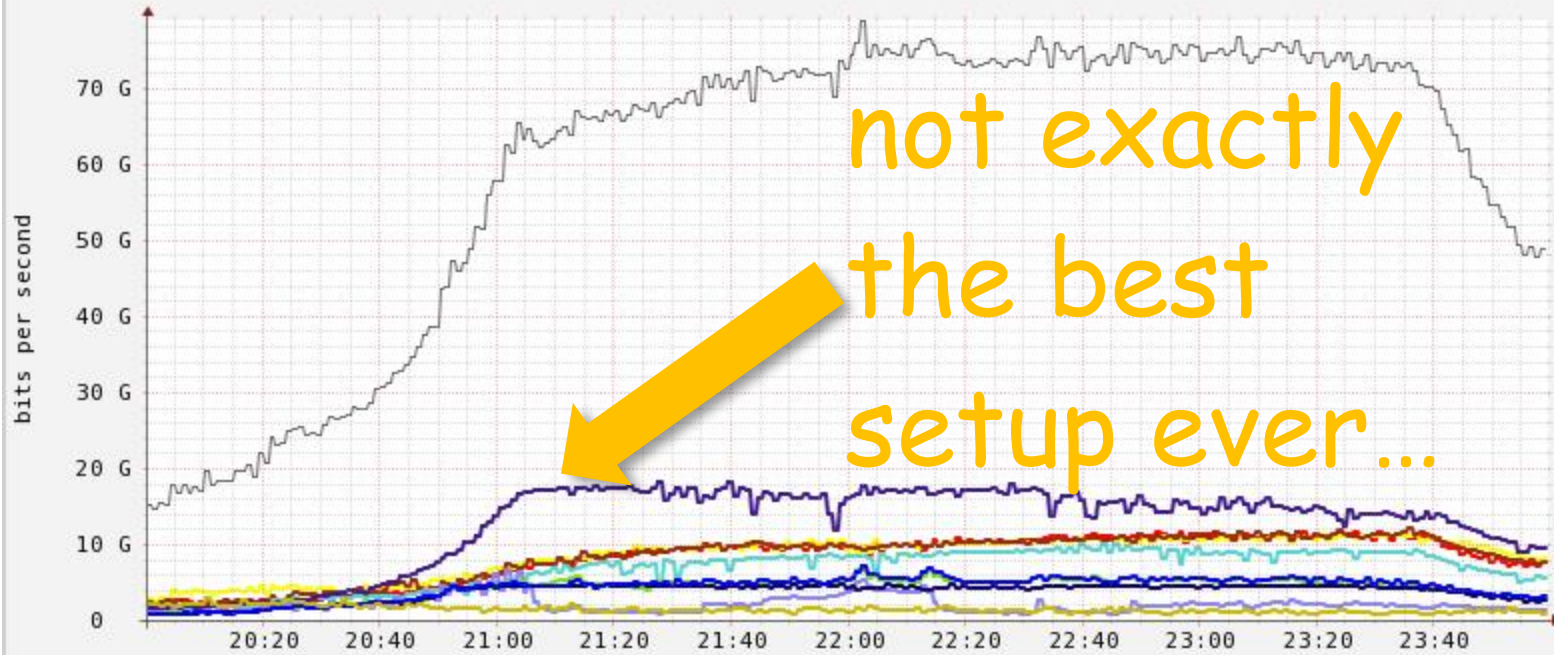
NIEMCY

1:0
(0:0, 0:0)



ARGENTYNA

SDT TVP - Outbound



- Total: Current: 48.95 G Average: 59.86 G Maximum: 78.89 G
- SDT-81:
 - SDT-82:
 - SDT-83:
 - SDT-84:
 - SDT-85:
 - SDT191
 - SDT192
 - SDT193
 - SDT194
 - SDT-3:
 - SDT-2:

NIEDZIELA, 13.07, 21:00, FINAŁ



NIEMCY

1:0
(0:0, 0:0)



ARGENTYNA

owany, Dostęp do Internetu

33	P
35	L
34	I
38	X

```
root@sdt-plex33:~# dmidecode |grep -A2 IBM
Vendor: IBM Corp.
Version: -[D6E154AUS-1.13]-
Release Date: 09/23/2011

--

Manufacturer: IBM
Product Name: System x3550 M3 -[794472G]-
Version: 00

--

Manufacturer: IBM
Product Name: 94Y7614
Version: (none)

--

Manufacturer: IBM
Type: Rack Mount Chassis
Lock: Not Present

--

String 1: IBM SystemX
```

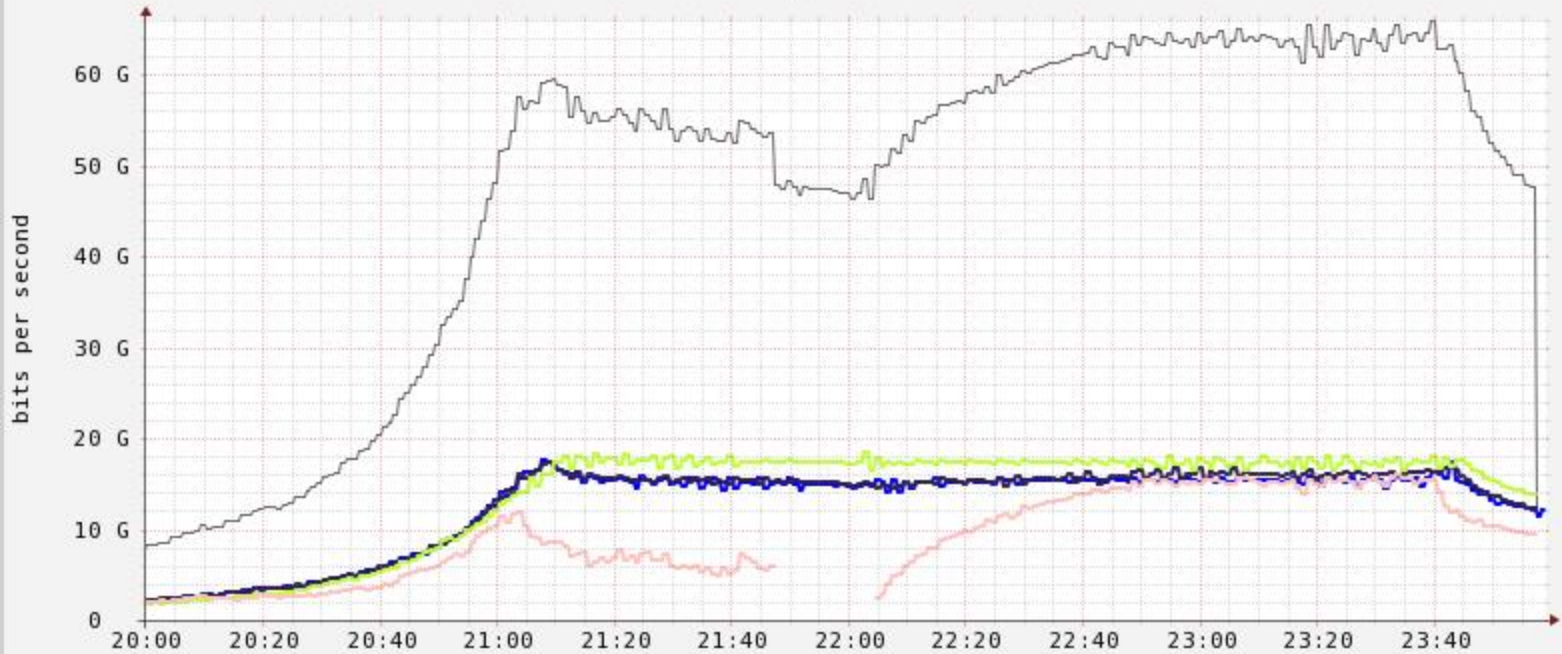
```
root@sdt-plex33:~# free
              total        used         free       shared    buffers     cached
Mem:      74375600    72792244    1583356       316700     384128     63873076
-/+ buffers/cache:    8535040    65840560
Swap:      974844         19108         955736
```

```
root@sdt-plex33:~# lspci|grep Emu
1a:00.0 Ethernet controller: Emulex Corporation OneConnect 10Gb NIC (rev 02)
1a:00.1 Ethernet controller: Emulex Corporation OneConnect 10Gb NIC (rev 02)
```

```
root@sdt-plex33:~# df
Filesystem                1K-blocks      Used Available Use% Mounted on
/dev/mapper/vg1-ROOT         19092180    1807968  16291344  10% /
udev                       10240         0      10240    0% /dev
tmpfs                       7437560       3216   7434344    1% /run
tmpfs                       5120         0       5120    0% /run/lock
tmpfs                      14875120         0  14875120    0% /run/shm
/dev/mapper/vgssd-lvssd    576240192   450214876 126008932  79% /ssd
/dev/mapper/vg1-STORAGE 1607230788 1141295040 465919364  72% /storage
/dev/mapper/vg1-VAR         95987468    61887636  29200812  68% /var
```


PLIX Hosting - Outbound

RRD TOOL / TOBI OETIKER



■ Total:	Current:	11.39 G	Average:	47.75 G	Maximum:	65.99 G
■ sdt-plix33:	Current:	12.00 G	Average:	12.63 G	Maximum:	17.56 G
■ sdt-plix35:	Current:	12.38 G	Average:	12.86 G	Maximum:	17.34 G
■ sdt-plix37:	Current:	13.81 G	Average:	13.93 G	Maximum:	18.52 G
■ sdt-plix39:	Current:	9.43 G	Average:	9.13 G	Maximum:	16.05 G

NIEDZIELA, 13.07, 21:00, FINAL



NIEMCY

1:0

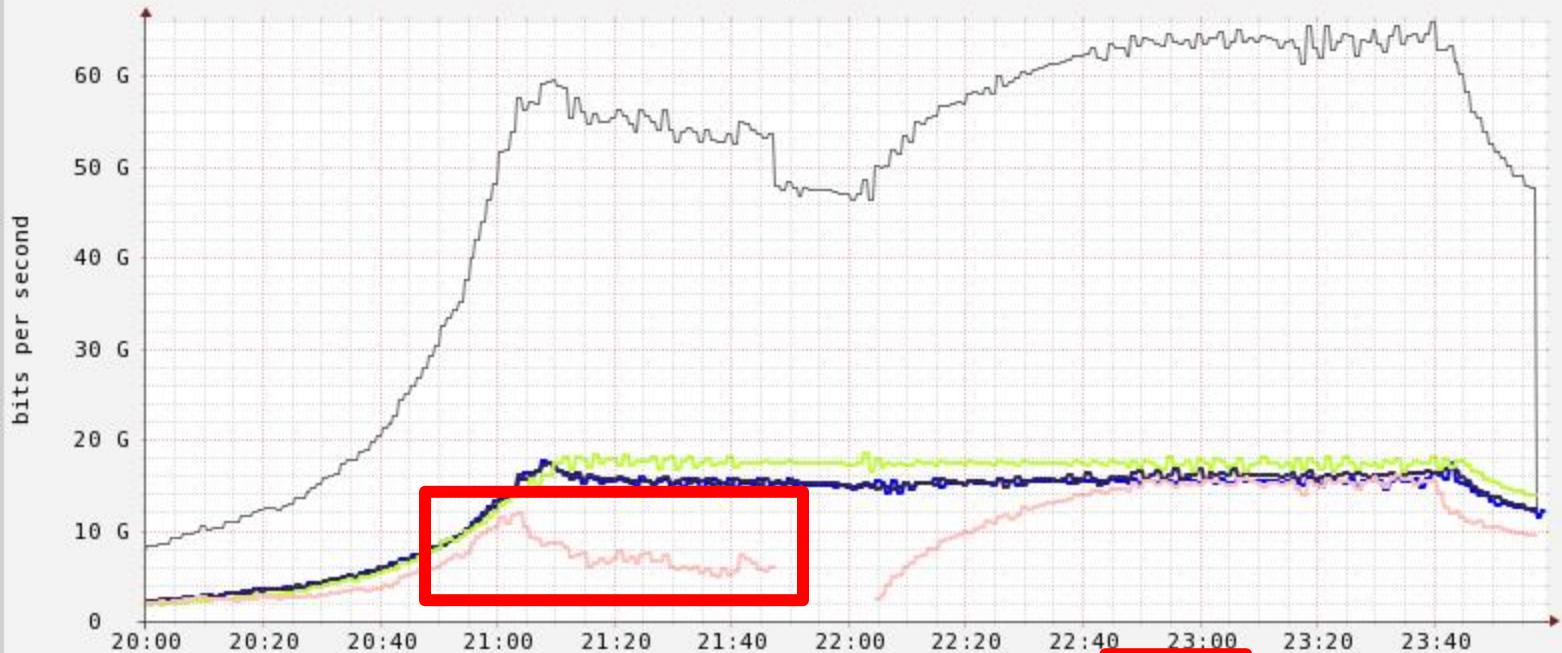
(0:0, 0:0)



ARGENTYNA

PLIX Hosting - Outbound

RRD TOOL / TOBI OETIKER



■ Total:	Current:	11.39 G	Average:	47.75 G	Maximum:	65.99 G
■ sdt-plix33:	Current:	12.00 G	Average:	12.63 G	Maximum:	17.56 G
■ sdt-plix35:	Current:	12.38 G	Average:	12.86 G	Maximum:	17.34 G
■ sdt-plix37:	Current:	13.81 G	Average:	13.93 G	Maximum:	18.52 G
■ sdt-plix39:	Current:	9.43 G	Average:	9.13 G	Maximum:	16.05 G

NIEDZIELA, 13.07, 21:00, FINAL



NIEMCY

1:0
(0:0, 0:0)



ARGENTYNA

PLIX Hosting - Outbound

RRD TOOL / TOBI OETIKER



7.75 G	Maximum:	65.99 G
2.63 G	Maximum:	17.56 G
2.86 G	Maximum:	17.34 G
3.93 G	Maximum:	18.52 G
9.13 G	Maximum:	16.05 G

07, 21:00, FINAL

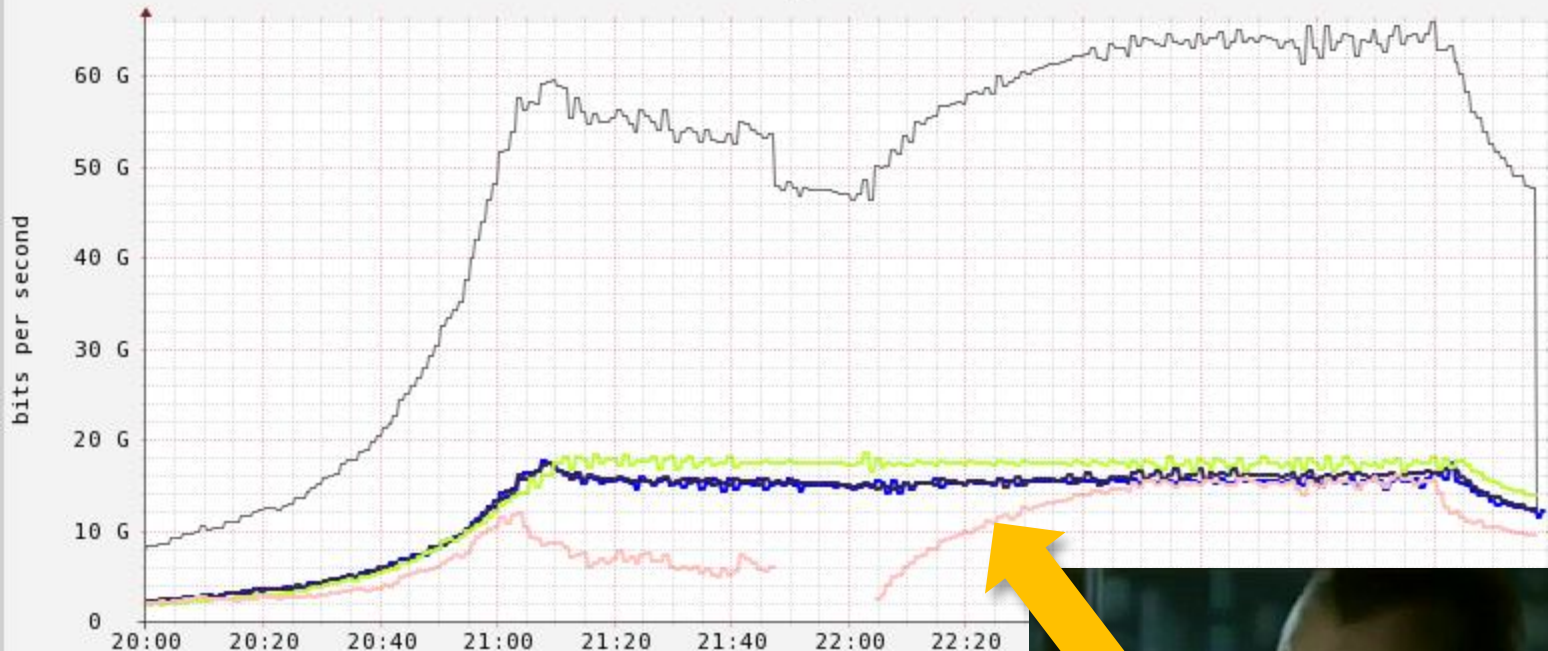
0
0:0)



ARGENTYNA

PLIX Hosting - Outbound

RRD TOOL / TOBI OETIKER



	Current:	Average:	Maxim
■ Total:	11.39 G	47.75 G	Maxim
■ sdt-plix33:	12.00 G	12.63 G	Maxim
■ sdt-plix35:	12.38 G	12.86 G	Maxim
■ sdt-plix37:	13.81 G	13.93 G	Maxim
■ sdt-plix39:	9.43 G	9.13 G	Maxim

NIEDZIELA, 13.07, 21:00, FI



NIEMCY

1:0
(0:0, 0:0)

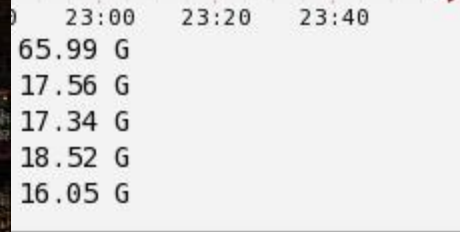


ARGENTINA



PLIX Hosting - Outbound

RRD TOOL / TOBI OETIKER



23:00 23:20 23:40
65.99 G
17.56 G
17.34 G
18.52 G
16.05 G

NIEMCY

ARGENTYNA

A 2011 server sending 17,579 Gbit/s

```

ATOP - sdt-plex37          2014/07/13 22:50:17          F-----          2s elapsed
PRC sys 14.79s user 1.44s #proc 420 #trun 19 #ts1pi 12e3 #ts1pu 0 #zombie 0 clones 1 #exit ?
CPU sys 190% user 62% irq 700% idle 1437% wait 4% steal 0% guest 0% avgf 2.00GHz avgscal 68%
cpu sys 0% user 0% irq 100% idle 0% cpu023 w 0% steal 0% guest 0% avgf 3.06GHz avgscal 100%
cpu sys 2% user 0% irq 96% idle 2% cpu009 w 0% steal 0% guest 0% avgf 3.06GHz avgscal 100%
cpu sys 2% user 1% irq 95% idle 2% cpu021 w 0% steal 0% guest 0% avgf 3.06GHz avgscal 100%
cpu sys 4% user 1% irq 92% idle 4% cpu011 w 0% steal 0% guest 0% avgf 3.05GHz avgscal 99%
cpu sys 4% user 1% irq 91% idle 4% cpu015 w 0% steal 0% guest 0% avgf 3.06GHz avgscal 100%
cpu sys 8% user 1% irq 75% idle 16% cpu017 w 0% steal 0% guest 0% avgf 2.86GHz avgscal 93%
cpu sys 9% user 1% irq 73% idle 17% cpu019 w 0% steal 0% guest 0% avgf 2.83GHz avgscal 92%
cpu sys 7% user 2% irq 73% idle 19% cpu013 w 0% steal 0% guest 0% avgf 2.77GHz avgscal 90%
cpu sys 17% user 6% irq 0% idle 77% cpu003 w 1% steal 0% guest 0% avgf 1.85GHz avgscal 60%
cpu sys 16% user 5% irq 1% idle 79% cpu006 w 0% steal 0% guest 0% avgf 1.67GHz avgscal 54%
cpu sys 14% user 4% irq 10% idle 71% cpu000 w 0% steal 0% guest 0% avgf 1.64GHz avgscal 53%
cpu sys 14% user 5% irq 0% idle 81% cpu008 w 0% steal 0% guest 0% avgf 1.61GHz avgscal 52%
cpu sys 12% user 6% irq 0% idle 82% cpu010 w 0% steal 0% guest 0% avgf 1.60GHz avgscal 52%
cpu sys 13% user 5% irq 1% idle 80% cpu002 w 0% steal 0% guest 0% avgf 1.60GHz avgscal 52%
cpu sys 11% user 5% irq 0% idle 84% cpu007 w 0% steal 0% guest 0% avgf 1.60GHz avgscal 52%
CPL avg1 12.53 avg5 12.90 avg15 12.38 csw 172953 intr 275491 vmcom 15.4G vmlim 48.2G
MEM tot 94.6G free 11.7G cache 72.4G dirty 0.0M buff 1.2G slab 1.7G swin 0 swout 0
SWP tot 952.0M free 647.7M
PAG scan 0 stall 0
LUM vg1-UAR busy 10% read 0 write 211 KiB/r 0 KiB/w 85 MBr/s 0.00 MBw/s 8.79 avq 6.78 avio 0.97 ms
LUM vg1-STORAGE busy 6% read 0 write 228 KiB/r 0 KiB/w 4 MBr/s 0.00 MBw/s 0.53 avq 61.93 avio 0.53 ms
LUM UGSSD-LUSSD busy 2% read 38 write 23 KiB/r 81 KiB/w 72 MBr/s 1.52 MBw/s 0.81 avq 2.60 avio 0.66 ms
LUM vg1-ROOT busy 0% read 0 write 0 KiB/r 0 KiB/w 0 MBr/s 0.00 MBw/s 0.00 avq 0.00 avio 0.00 ms
LUM vg1-SWAP busy 0% read 0 write 0 KiB/r 0 KiB/w 0 MBr/s 0.00 MBw/s 0.00 avq 0.00 avio 0.00 ms
MDD md0 busy 0% read 0 write 440 KiB/r 0 KiB/w 43 MBr/s 0.00 MBw/s 9.32 avq 0.00 avio 0.00 ms
MDD md1 busy 0% read 38 write 23 KiB/r 81 KiB/w 72 MBr/s 1.52 MBw/s 0.81 avq 0.00 avio 0.00 ms
DSK sdf busy 10% read 156 write 216 KiB/r 26 KiB/w 28 MBr/s 2.00 MBw/s 3.00 avq 9.31 avio 0.52 ms
DSK sdh busy 9% read 157 write 136 KiB/r 31 KiB/w 28 MBr/s 2.39 MBw/s 1.88 avq 8.00 avio 0.61 ms
DSK sdd busy 9% read 198 write 114 KiB/r 25 KiB/w 50 MBr/s 2.50 MBw/s 2.80 avq 10.37 avio 0.55 ms
NET transport tcpi 1524901 tcpo 2998738 udpi 0 udpo 0 tcpao 61 tcppo 7244 tcprs 143869 tcpie 2 udpip 0
NET network ipi 1524922 ipo 1157052 ipfrw 0 deliv 1525e3 icmpi 17 icmpo 0
NET eth0 0% pcki 0 pcko 0 si 0 Kbps so 0 Kbps coll 0 erri 0 erro 0 drpi 0 drpo 0
NET bond10 ---- pcki 1543739 pcko 3027175 si 538 Mbps so 17 Gbps coll 0 erri 0 erro 0 drpi 19376 drpo 0
NET eth10 ---- pcki 759939 pcko 1572852 si 244 Mbps so 9114 Mbps coll 0 erri 0 erro 0 drpi 2463 drpo 0
NET eth11 ---- pcki 783790 pcko 1454306 si 293 Mbps so 8465 Mbps coll 0 erri 0 erro 0 drpi 16913 drpo 0
NET lo ---- pcki 408 pcko 408 si 400 Kbps so 400 Kbps coll 0 erri 0 erro 0 drpi 0 drpo 0

PID SYSCPU USRCPU UGROW RGROW RUID EUID THR ST EXC S CPU CMD 1/54
3355 10.27s 1.09s 17408K 10220K varnish varnish 11323 -- - S 577% varnishd
125 1.40s 0.00s 0K 0K root root 1 -- - R 71% ksoftirqd/23
540 0.51s 0.00s 0K 0K root root 1 -- - R 26% kworker/23:2
    
```



2 x Intel x520 NIC PLEX SERVERS

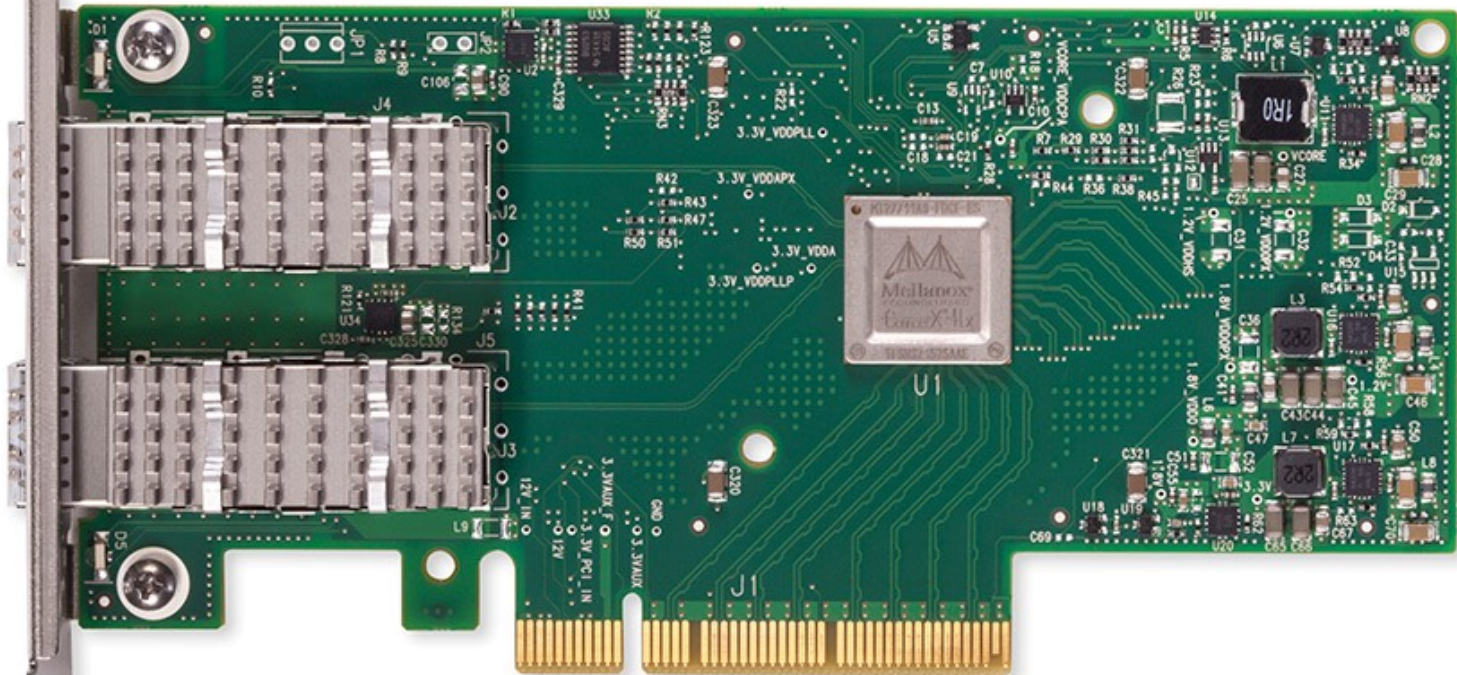
A 2011 server sending 17,579 Gbit/s

```

ATOP - sdt-plex37          2014/07/13 22:50:17          F-----          2s elapsed
PRC  sys  14.79s  user  1.44s  #proc  420  #trun  19  #tslpi 12e3  #tslpu  0  #zombie  0  clones  1  #exit  ?
CPU  sys  190%   user  62%   irq  700%  idle  1437% wait  4%
cpu001 sys  0%   user  0%   irq  100%  idle  0%   cpu023 w 0%
cpu002 sys  2%   user  0%   irq  96%   idle  2%   cpu009 w 0%
cpu003 sys  2%   user  1%   irq  95%   idle  2%   cpu021 w 0%
cpu004 sys  4%   user  1%   irq  92%   idle  4%   cpu011 w 0%
cpu005 sys  4%   user  1%   irq  91%   idle  4%   cpu015 w 0%
cpu006 sys  8%   user  1%   irq  75%   idle  16%  cpu017 w 0%
cpu007 sys  9%   user  1%   irq  73%   idle  17%  cpu019 w 0%
cpu008 sys  7%   user  2%   irq  73%   idle  19%  cpu013 w 0%
cpu009 sys  17%  user  6%   irq  0%   idle  77%  cpu003 w 1%
cpu010 sys  16%  user  5%   irq  1%   idle  79%  cpu006 w 0%
cpu011 sys  14%  user  4%   irq  10%  idle  71%  cpu000 w 0%
cpu012 sys  14%  user  5%   irq  0%   idle  81%  cpu008 w 0%
cpu013 sys  12%  user  6%   irq  0%   idle  82%  cpu010 w 0%
cpu014 sys  13%  user  5%   irq  1%   idle  80%  cpu002 w 0%
cpu015 sys  11%  user  5%   irq  0%   idle  84%  cpu007 w 0%
CPL  avg1  12.53  avg5  12.90  avg15  12.38  csw  172953  intr  275491
MEM  tot  94.6G  free  11.7G  cache  72.4G  dirty  0.0M  buff  1.2G  slab  1.7G
SMP  tot  952.0M  free  647.7M
PAG  scan  0
LUM  un1-UAR  husu  10%  read  0  write  211  KiB/r  0  KiB/w  85  MB/r/s  0.00  MB/w/s  8.70  avg  6.78  avw  0.97 ms
LUM  NET | transport | tcpi 1524901 | tcpo 2998738 | udpi 0 | udpo 0
LUM  NET | network | ipi 1524922 | ipo 1157052 | ipfrw 0 | deliv 1525e3
LUM  NET | eth0 0% | pcki 0 | pcko 0 | si 0 Kbps | so 0 Kbps
MDD  NET | bond10 ---- | pcki 1543739 | pcko 3027175 | si 538 Mbps | so 17 Gbps
DSK  NET | eth10 ---- | pcki 759939 | pcko 1572852 | si 244 Mbps | so 9114 Mbps
DSK  NET | eth11 ---- | pcki 783790 | pcko 1454306 | si 293 Mbps | so 8465 Mbps
NET  NET | lo ---- | pcki 408 | pcko 408 | si 400 Kbps | so 400 Kbps
NET  eth10 ---- | pcki 759939 | pcko 1572852 | si 244 Mbps | so 9114 Mbps | coll 0 | errr 0 | erro 0 | drpi 2463 | drpo 0
NET  eth11 ---- | pcki 783790 | pcko 1454306 | si 293 Mbps | so 8465 Mbps | coll 0 | errr 0 | erro 0 | drpi 16913 | drpo 0
NET  lo ---- | pcki 408 | pcko 408 | si 400 Kbps | so 400 Kbps | coll 0 | errr 0 | erro 0 | drpi 0 | drpo 0

PID  SYSCPU  USRCPU  UGROW  RGROW  RUID  EUID  THR  ST  EXC  S  CPU  CMD  1/54
3355 10.27s  1.09s  17408K  10220K  varnish  varnish  11323 -- - S 577%  varnishd
125  1.40s  0.00s  0K  0K  root  root  1 -- - R 71%  ksoftirqd/23
540  0.51s  0.00s  0K  0K  root  root  1 -- - R 26%  kworker/23:2
    
```

OK, LET'S TRY 40 G



Mellanox MCX414A-BCAT

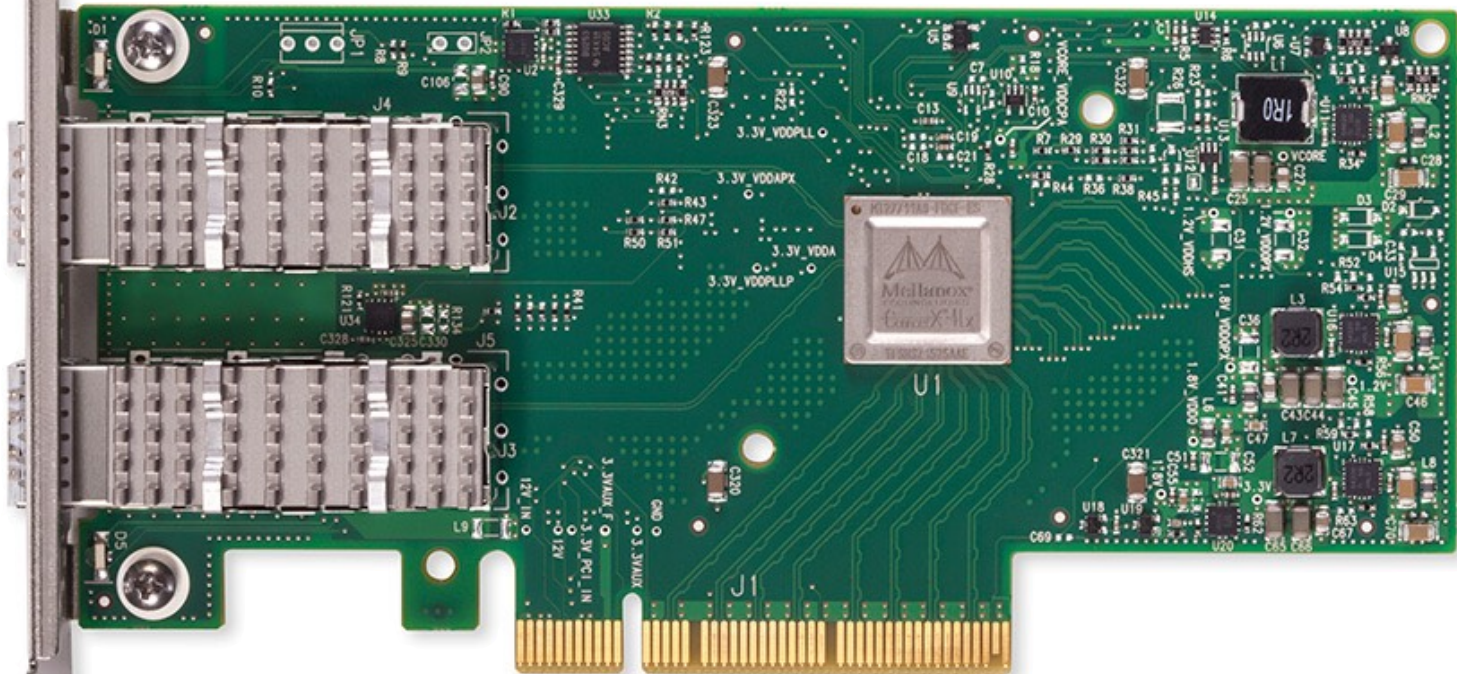


Table 9 - MCX414A-BCAT Specifications Table

Physical	Size: 2.71 in. x 5.6 in. (68.90mm x 142.24 mm) – low profile
	Connector: Dual QSFP28 (Copper and optical)
Protocol Support	Ethernet: 56GBASE-R4, 50GBASE-R2, 50GBASE-R4, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 40GBASE-R2, 25GBASE-R, 20GBASE-KR2, 1000BASE-CX, 1000BASE-KX, 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBASE-CX4, 10GBASE-KX4, 10GBASE-CR, 10GBASE-KR, SGMII
	Data Rate: 1/10/25/40/56 Gb/s – Ethernet
	PCI Express Gen3: SERDES @ 8.0GT/s, 8 lanes (2.0 and 1.1 compatible)
Power and Environmental	Voltage: 12V, 3.3V
	Typical Power: Passive Cables: 40GbE – 11.86W 26W
	Maximum Power: Passive Cables: 40GbE – 13.50W 56GbE – 13.98W 1.5W Active Cables: 40GbE – 16.83W 56GbE – 17.31W
	Maximum power available through QSFP28 port: 3.5W
	Temperature: Operational 0°C to 55°C Non-operational -40°C to 70°C
	Humidity: 90% relative humidity ^b
	Air Flow: See Airflow Specifications on page 65
Regulatory	Safety: CB / cTUVus / CE
	EMC: CE / FCC / VCCI / ICES / RCM
	RoHS: RoHS-R6

PCI Express 3.0 8x

a. Typical power for ATIS traffic load.

b. For both operational and non-operational states.

PCI Express 3.0 8x

PCI Express link performance^{[27][30]}

PCI Express version	Line code	Transfer rate ^[i]	Throughput ^[i]			
			x1	x4	x8	x16
1.0	8b/10b	2.5 GT/s	250 MB/s	1 GB/s	2 GB/s	4 GB/s
2.0	8b/10b	5 GT/s	500 MB/s	2 GB/s	4 GB/s	8 GB/s
3.0	128b/130b	8 GT/s	984.6 MB/s	3.938 GB/s	7.877 GB/s	15.754 GB/s
4.0 (expected in 2017)	128b/130b	16 GT/s	1.969 GB/s	7.877 GB/s	15.754 GB/s	31.508 GB/s
5.0 (far future) ^{[28][29]}	128b/130b	32 or 25 GT/s ^[ii]	3.9, or 8.0 GB/s	15.8, or 31.5 GB/s	31.5, or 63.0 GB/s	63.0, or 126.0 GB/s

Theoretically a dual port 40 GbE 8x PCIe card can do only ~63 Gbit/s due to 8 PCIe lanes being used

- i. ^{a b} In each direction (each lane is a dual simplex channel)
- ii. ^a Both rates are being considered for technical feasibility

source: https://en.wikipedia.org/wiki/PCI_Express

PCI Express 3.0 8x

PCI Express link performance^{[27][30]}

PCI Express version	Line code	Transfer rate ^[i]	Throughput ^[i]			
			x1	x4	x8	x16
1.0	8b/10b	2.5 GT/s	250 MB/s	1 GB/s	2 GB/s	4 GB/s
2.0	8b/10b	5 GT/s	500 MB/s	2 GB/s	4 GB/s	8 GB/s
3.0	128b/130b	8 GT/s	984.6 MB/s	3.938 GB/s	7.877 GB/s	15.754 GB/s
4.0 (expected in 2017)	128b/130b	16 GT/s	1.969 GB/s	7.877 GB/s	15.754 GB/s	31.508 GB/s
5.0 (far future) ^{[28][29]}	128b/130b	32 or 25 GT/s ^[ii]	3.9, or 3.08 GB/s	15.8, or 12.3 GB/s	31.5, or 24.6 GB/s	63.0, or 49.2 GB/s

i. ^a ^b In each direction (each lane is a dual simplex channel).

ii. ^a Both rates are being considered for technical feasibility.

In practice you can
can squeeze

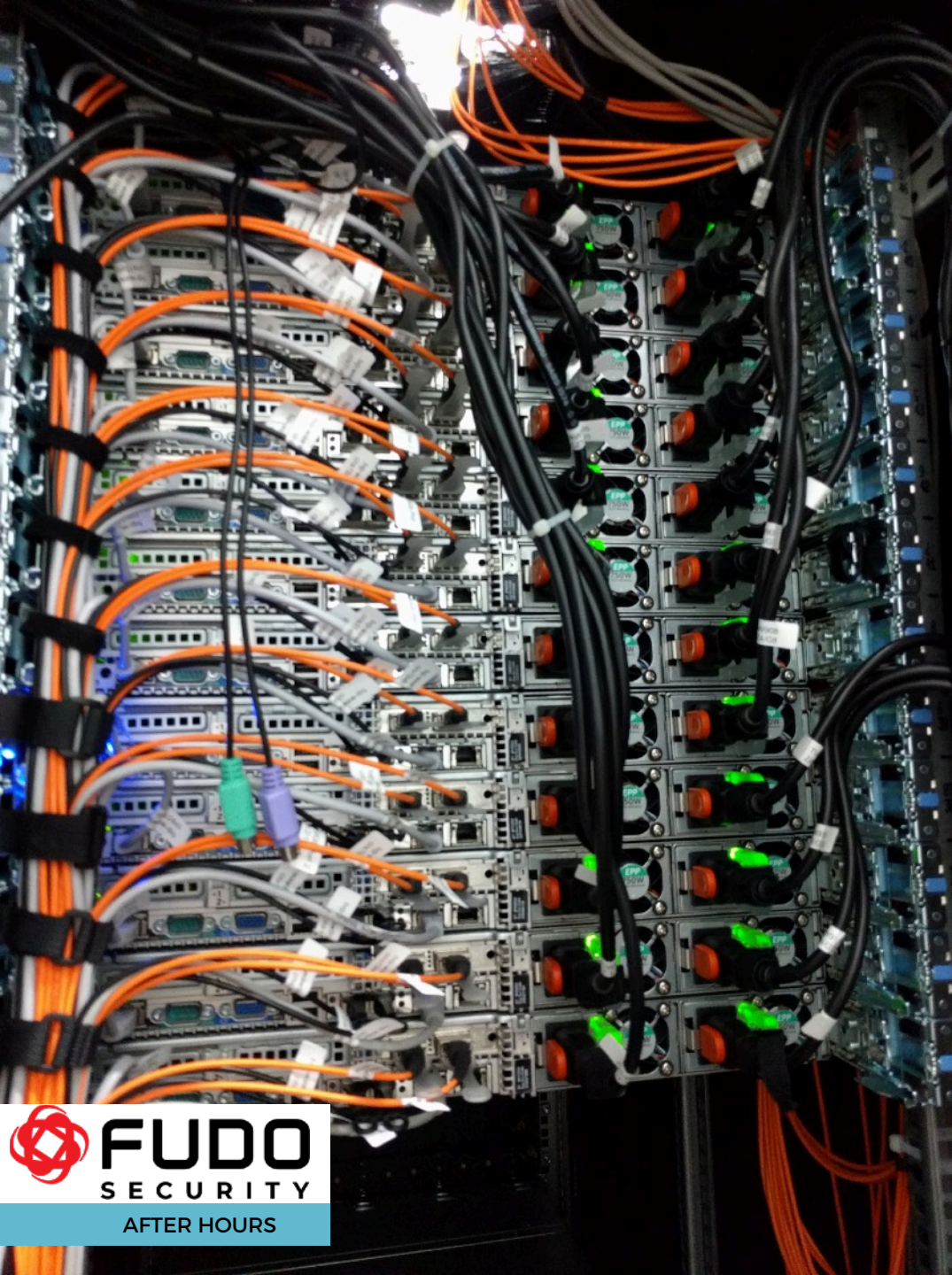
50-55 Gbit/s max

out of Linux
with NOTRACK

2016

And here comes 2018...



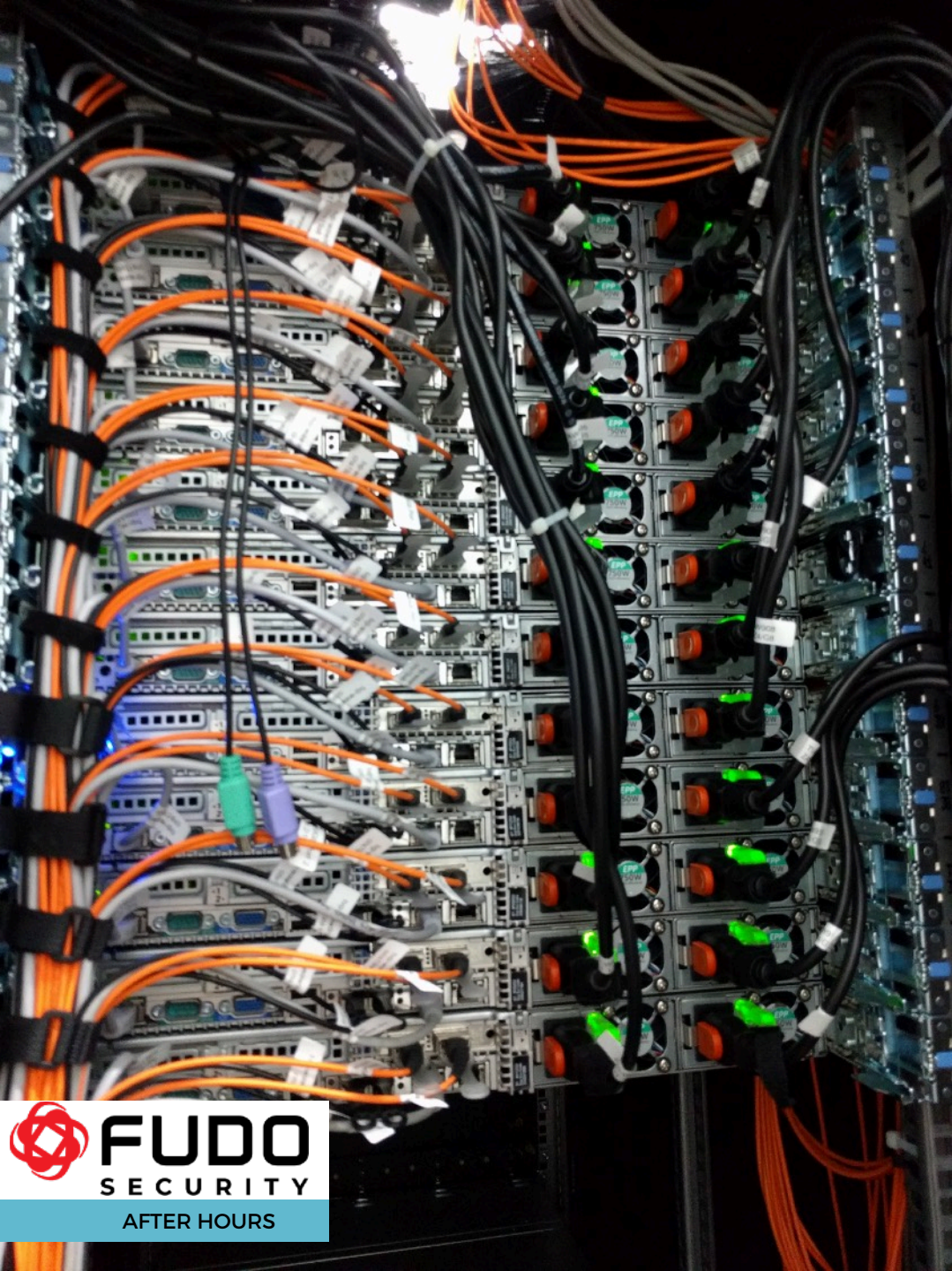


IN 2018...

12 servers

- each one having 2x40 Gbit/s NIC
- and 2x10 Gbit/s NIC

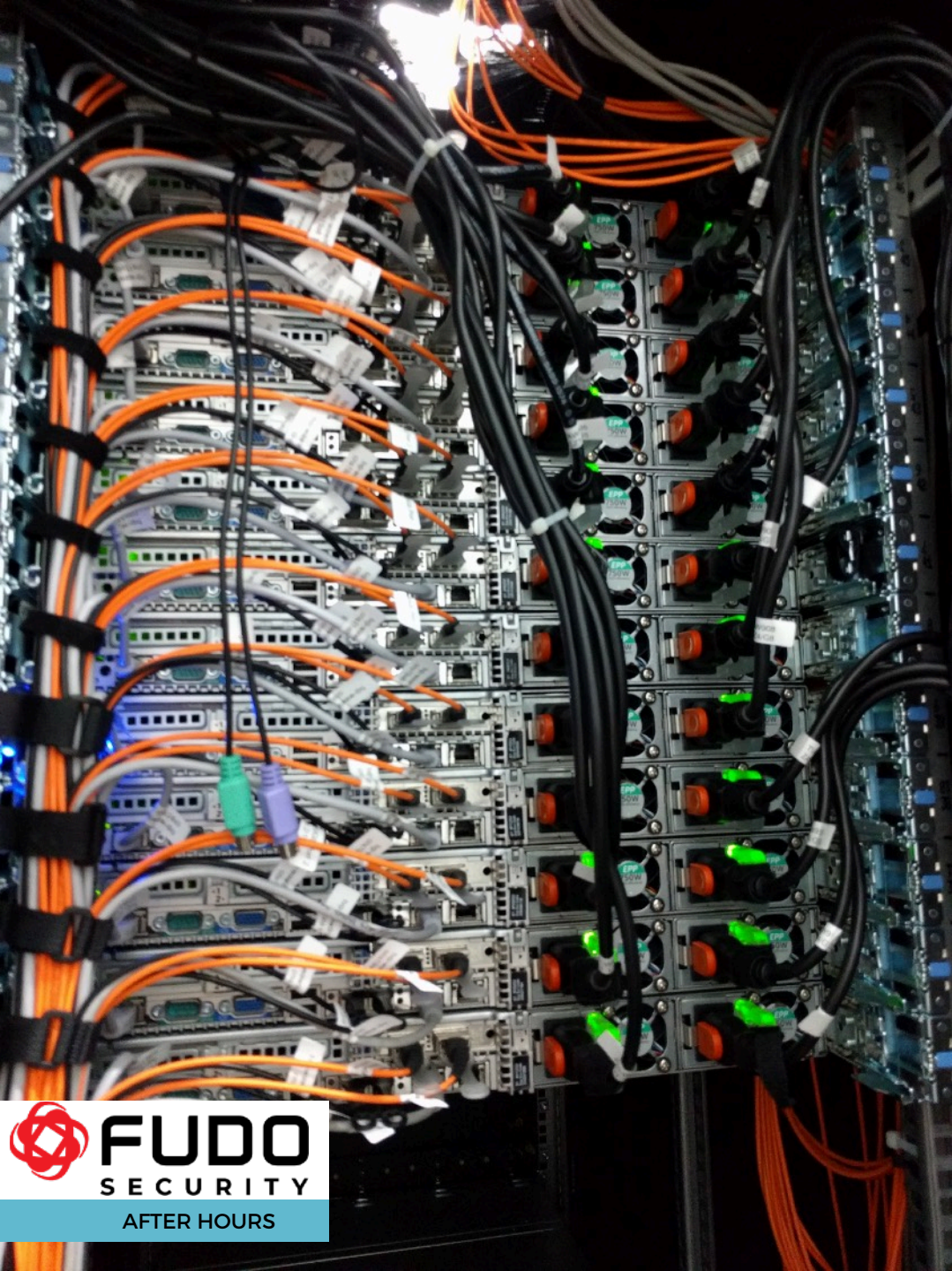
this gives over 800 Gbit/s of real "internet broadcasting power"



2014
211+ Gbit/s

2018
463+ Gbit/s

2018
? Gbit/s



2014
211+ Gbit/s

2018
463+ Gbit/s

2018
860+ Gbit/s*

*does not include NCplus' internet broadcasts



Source: internet