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Evaluating the internet end-user experience in the Russian Federation

Initial Findings

Research commissioned from Predictable Network Solutions by Euraisa:Peering

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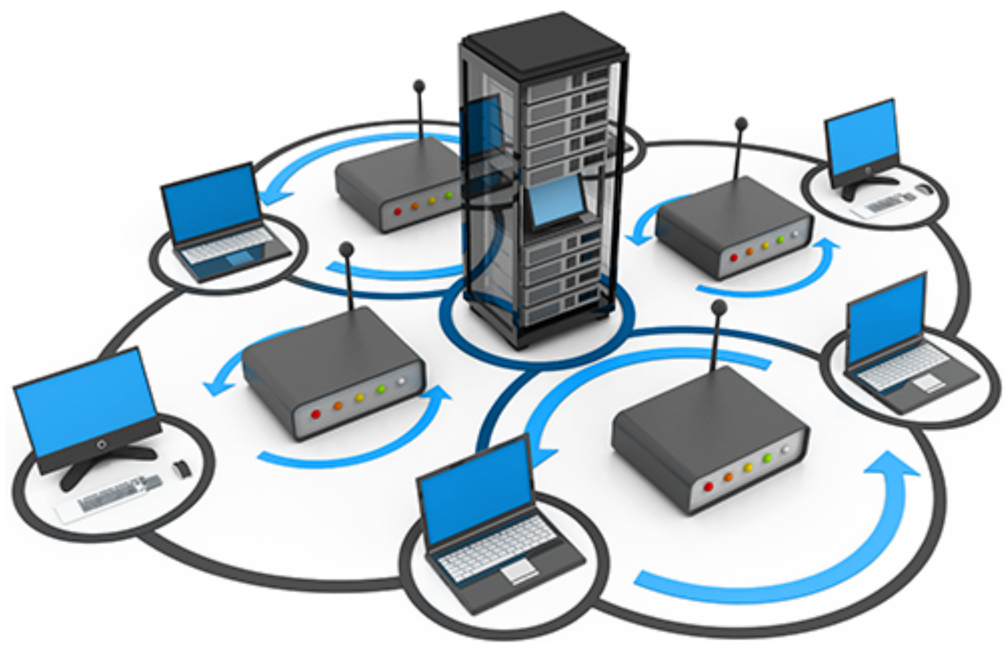
New peering point @ IXcellerate Moscow One data centre

- Private and public peering
- Connected to LINX and MSK-IX
- Where else do we need to be?

На площадке IXcellerate Moscow One доступна услуга «Частный пиринг» , отличительной особенностью, которой является соединение типа «один-с-одним» на основе двусторонней договоренности.



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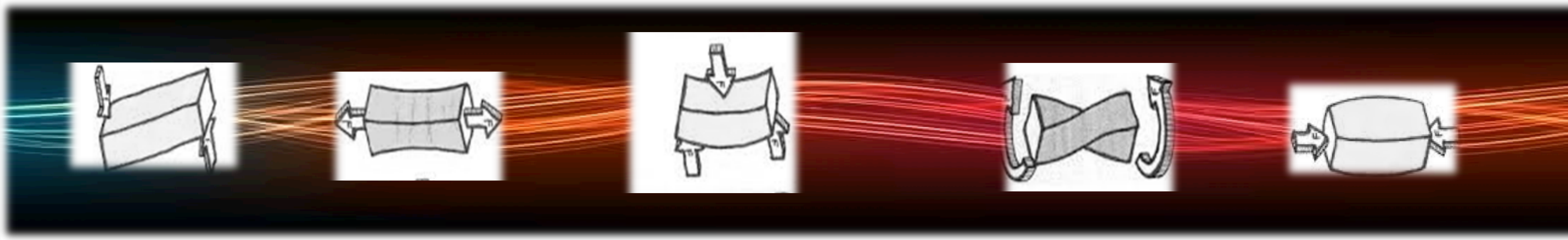
About me - Pete Cladingbowl - обо мне

- Mechanical engineer I инженер-механик
- Worked in the oil industry and manufacturing on process flows
- Then 15+ years in telecoms and data centres I 15 лет телекоммуникации
- Seek to understand what impacts flows in packet networks…..

What "forces" impact on network flows?



Воздействие сетевого потока?

ΔQ is what I use to inform me about flow and the forces impacting on it so I know where to put data centres and peering points….

Дельта Q = глубокое понимание

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ΔQ is *quality attenuation* of the user experience

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But what matters is - does the user notice?????

The science bit:

- All packets experience delay and some packets are lost
- It is the distribution of delay and loss that applications are sensitive to
- ΔQ is a proxy for the quality of the user experience

Maxwell

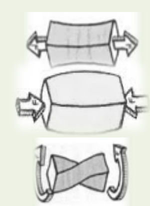
For more info - http://www.slideshare.net/mgeddes/introduction-to-q-extracts

ΔQ arises from two sources:

Structural
G - Network topology
S - Speed of links

Variable load
V - The applied load & its pattern

ΔQ - “Дельта Q”
качество затухания = “потери и задержки”
состоит из:



G – география
S – скорость
V - скопление

Measuring ΔQ

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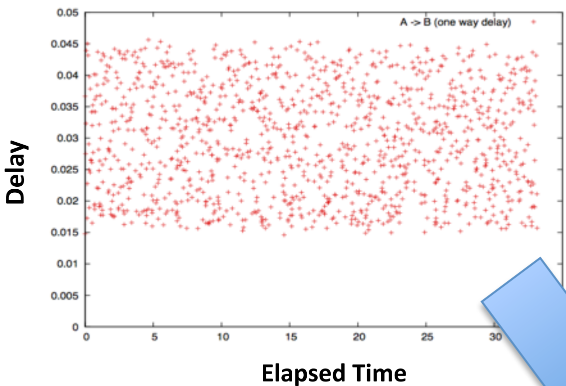
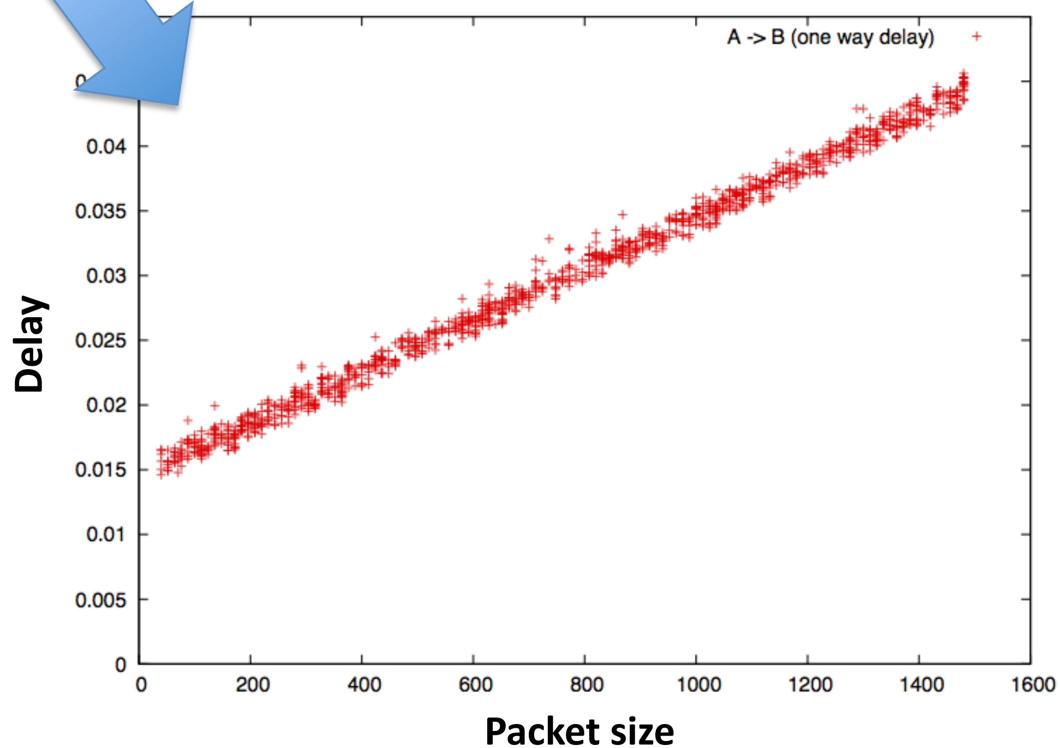


Viewing the data by packet size shows the structure



Просмотр данных по размеру пакета показана структура

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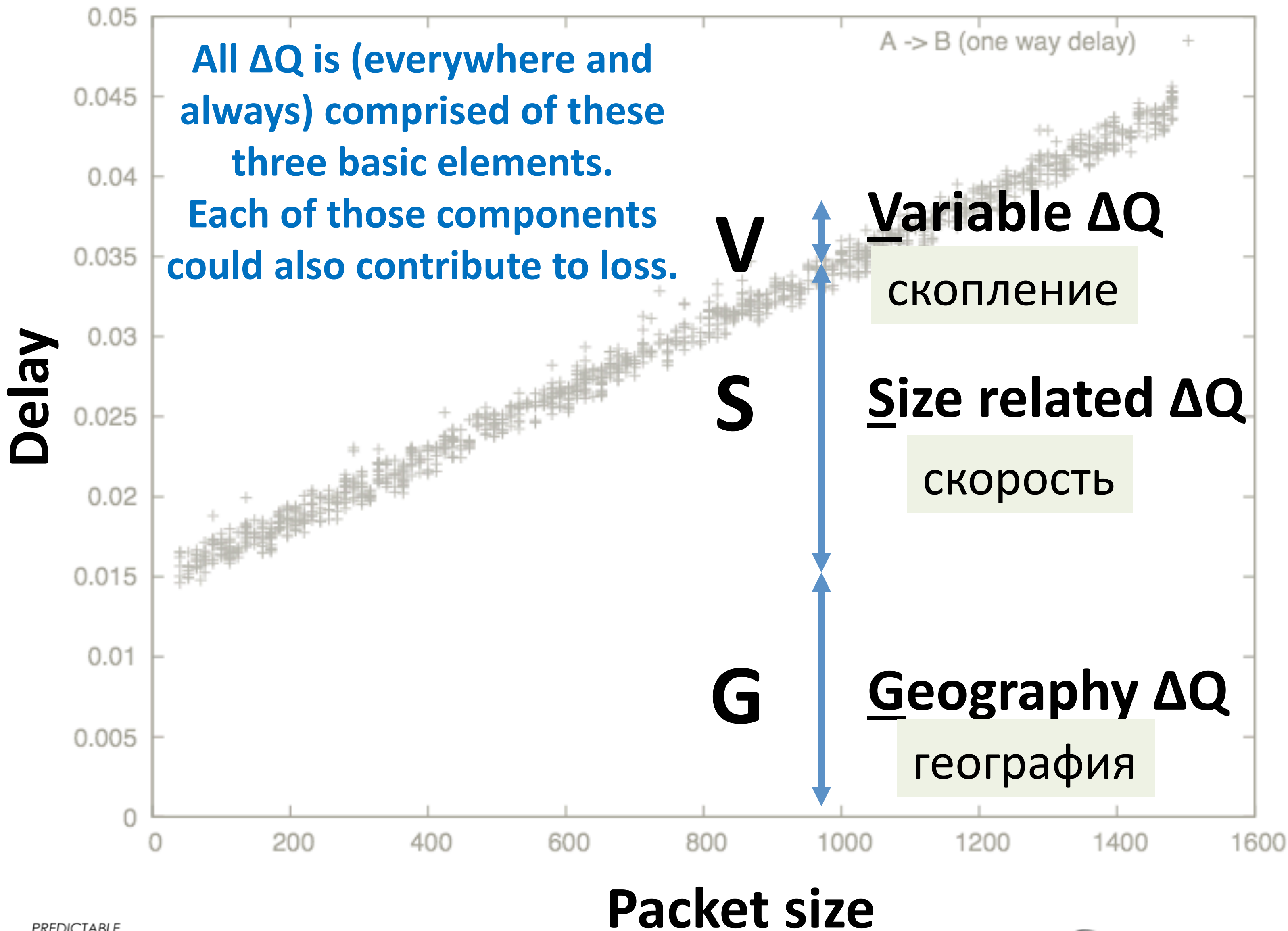
The “forces” impacting flow



How do we establish the impact on the User's experience from the measurement of ΔQ?

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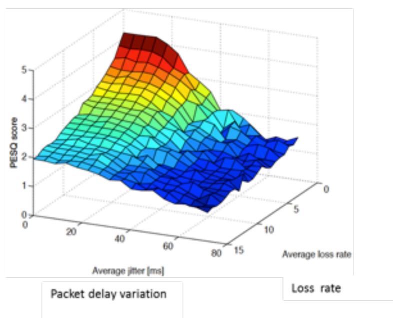
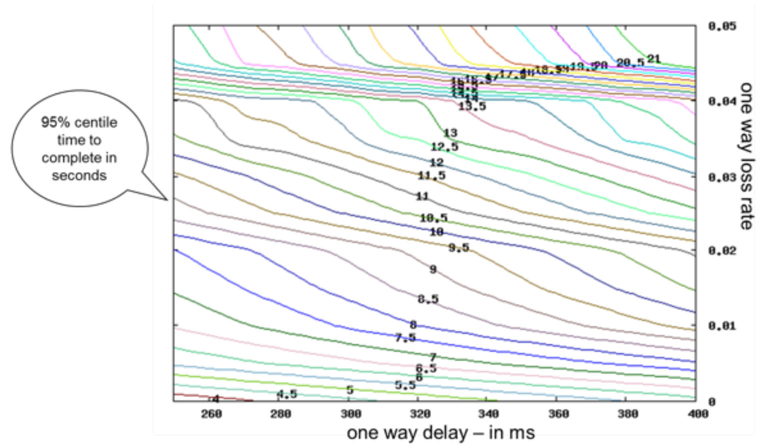
It depends on the application……..

Sensitivity of VoIP to delay and loss

- Plot of PESQ value vs packet delay variation and loss rate
- Interaction between delivered ΔQ and user perceived quality.
- Network quality to user quality 'surface' is one approach to capture the relationship.



HTTP



IPTV

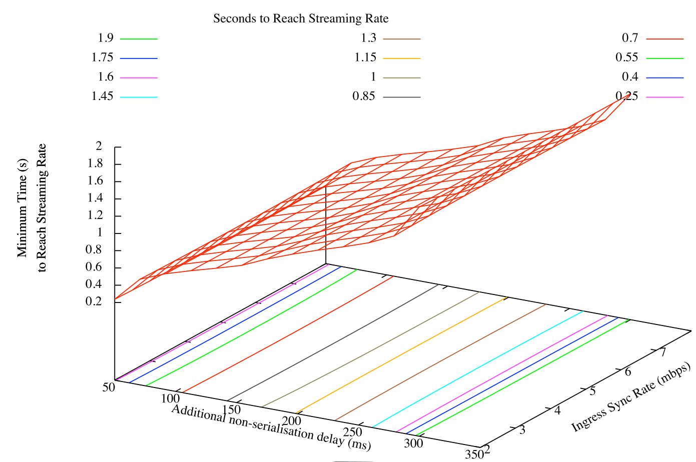
Time to first frame

- Time from pressing "play" to the first frame of the image being rendered
- There are player specific behavioural issues
  - Analytics (STB/TV manufacturer and BBC)
  - DNS interaction dynamics (serial or parallel)
- All have the issue of they cannot stream until the delivered data rate (over TCP) exceeds the render requirements

Buffer exhaustion ("circle of death")

- Players have a double buffer arrangement
  - This translates to sequence of on/off demands for approx 2mb data over TCP
- Circle of death appears if a buffer can not be filled in the requisite interval
  - Every 20s – 30s – image resolution dependent
  - TCP slow start for each buffer loading operation as (for most end users) the inter-request idle intervals are large enough to cause past control data to be invalidated

Time to first frame



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Initial data gathered and the user experience

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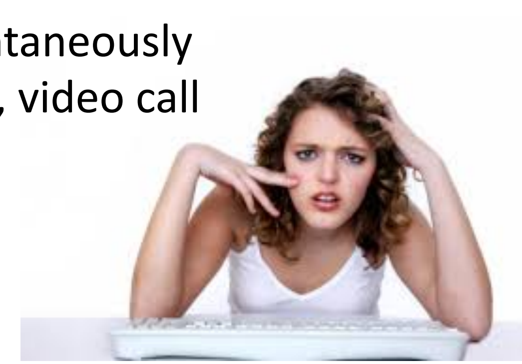
Date gathered to/from

- Moscow
- Chelyabinsk
- London
- Dublin
- Frankfurt
- Singapore

Nielsen study on user experience

- 0.1 seconds - the user feels that the system is reacting instantaneously
- 1.0 second - the user loses interest in the game, transaction , video call



RTT times in milliseconds derived from ΔQ

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двусторонняя задержка

Path	Fiber time	G	Ratio	S(MTU)	V50	V75	V95	GSV95 Total
Moscow-Frankfurt	19.52	45.22	2.32	1.09	0.21	0.31	10.34	57
Moscow-London	24.15	53.10	2.20	1.09	0.32	0.80	2.35	57
Moscow-Chelyabinsk	14.40	24.30	1.69	2.00	0.61	0.76	1.04	27
Moscow-Singapore	81.29	303.19	3.73	1.15	0.23	0.30	0.46	305
Moscow-Ireland	26.99	63.60	2.36	1.14	0.22	0.30	0.48	65
Chelyabinsk-Frankfurt	33.91	65.80	1.94	1.04	0.23	0.30	0.50	67
Chelyabinsk-Ireland	40.78	78.20	1.92	1.07	0.26	0.34	0.95	80
Chelyabinsk-Singapore	68.52	326.83	4.77	2.28	0.29	0.42	0.77	330
Chelyabinsk-London	38.34	85.28	2.22	1.64	0.30	0.38	0.57	87

For comparison "low latency" RTT from specialists are

- Moscow - London 48 ms
- Moscow – Frankfurt 36 ms

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What does the initial data say?

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Severe Congestion for 5% of traffic = poor video call or gaming

Bandwidth looks sufficient

The “G” is almost four times the direct route, rather than around two

The “G” is almost five times the direct route, rather than around two

The data tells different stories depending on what the impact of quality attenuation is on the application

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Looking at "distance" only

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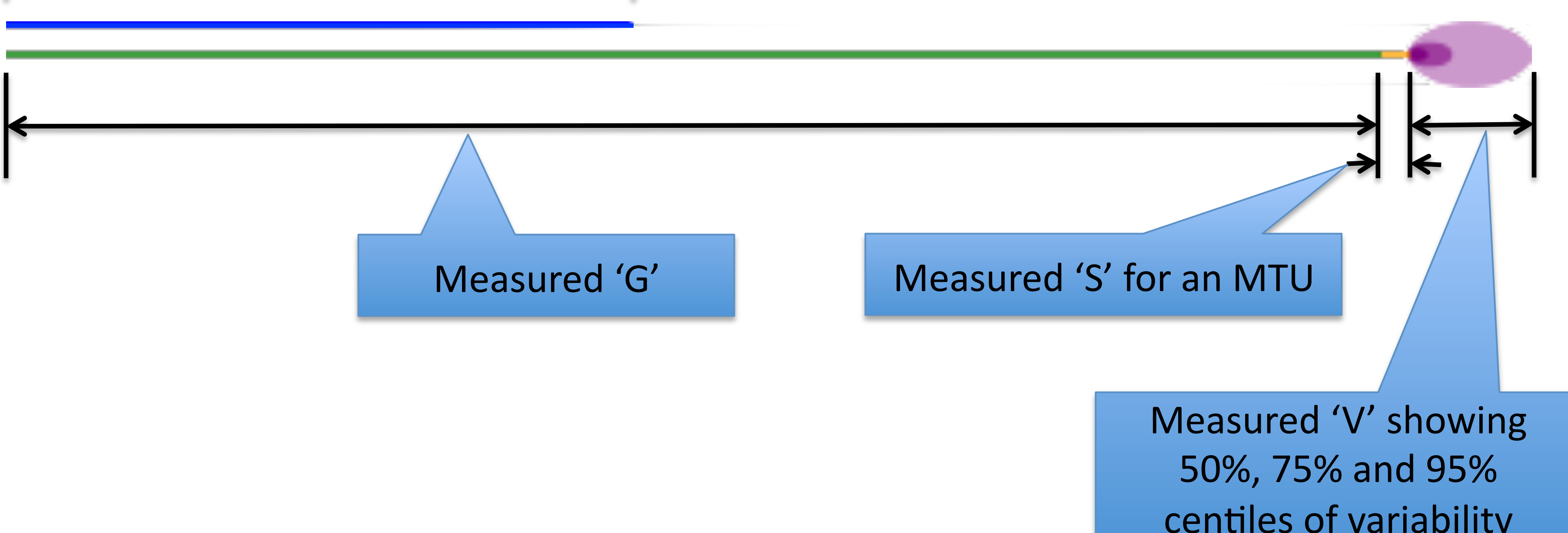
Moscow and Chelyabinsk to/from

- London
- Dublin
- Frankfurt
- Singapore



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RTT for zero packet size in direct fibre route

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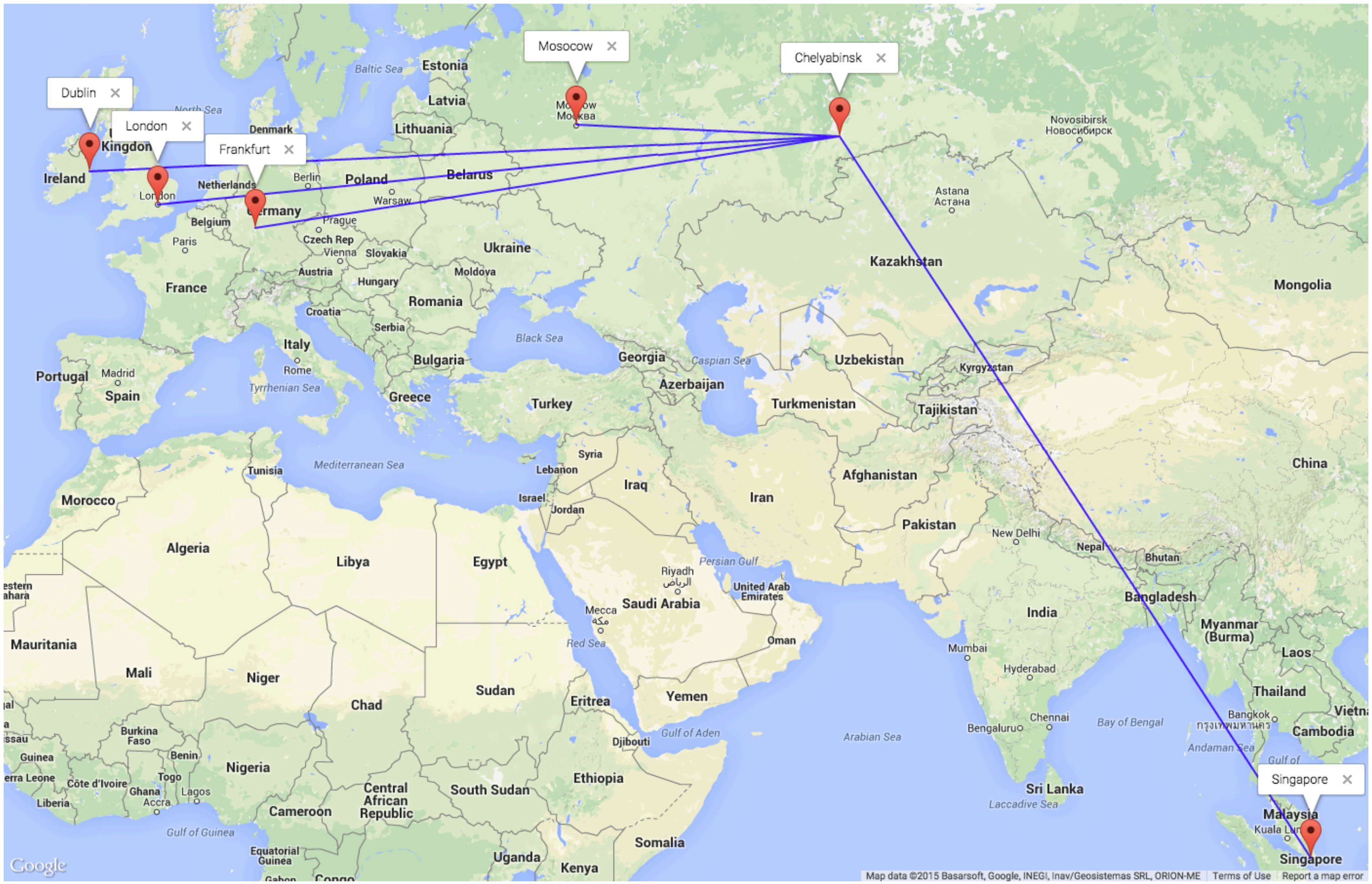
двусторонняя задержка прямой маршрут



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Actual RTT for MTU packet with congestion

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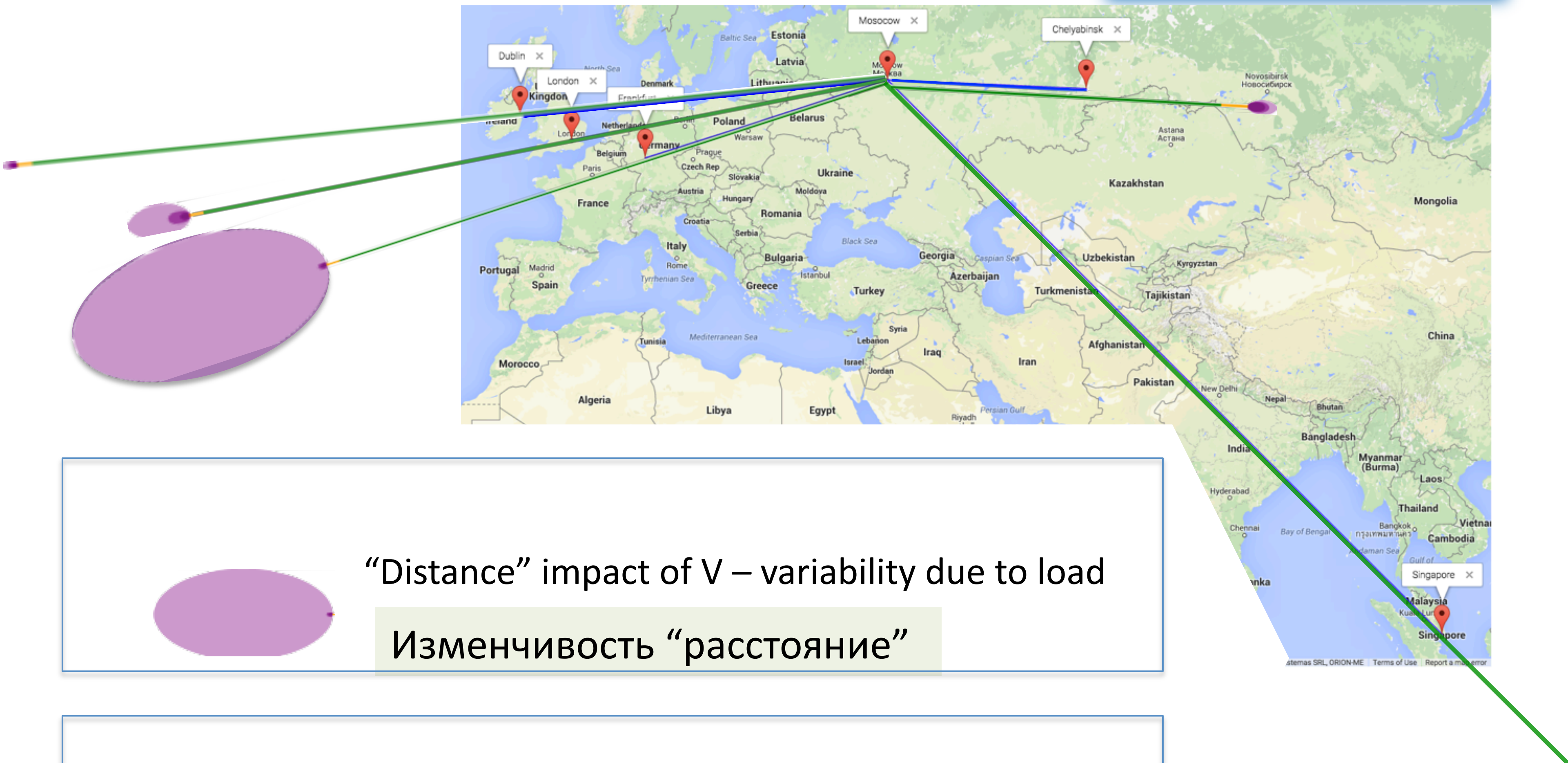

“Distance” impact of V – variability due to load

Изменчивость “расстояние”

“Distance” impact of S – bandwidth restriction

ширина полосы “расстояние”

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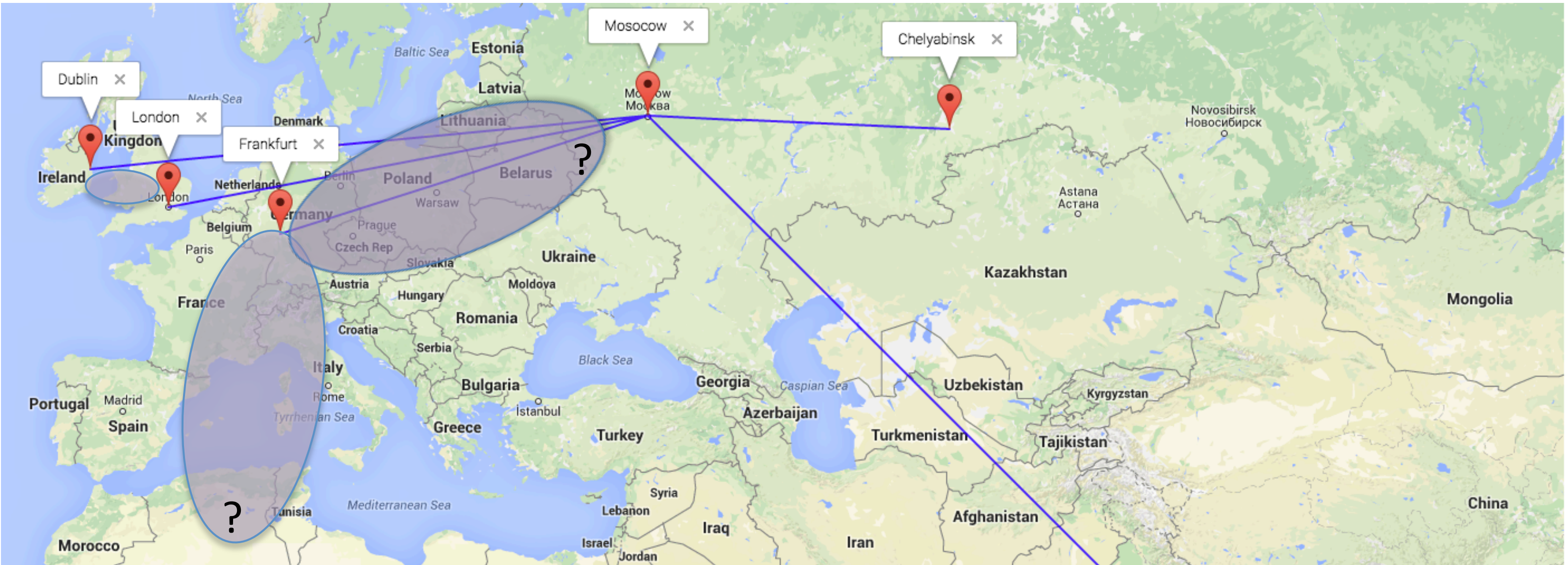
внере есть Frankfurt? I Where is Frankfurt?



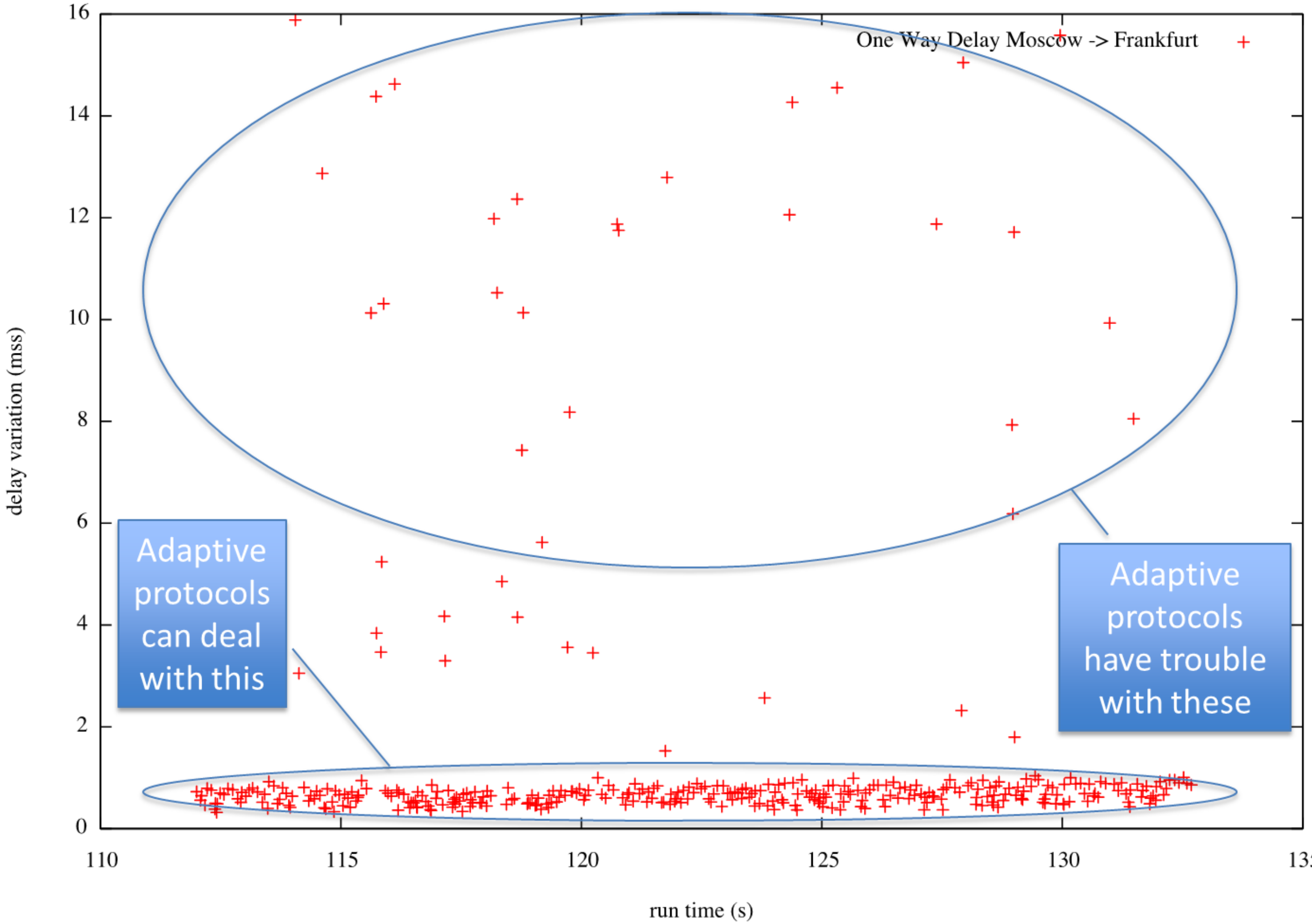
Congestion due to load can have a bigger impact that distance

- Frankfurt could be in Africa or Russia
- London could be in Dublin

Note that the impact of load "V" can be measured (and hence managed) to deliver quality to the end user.

Averages do not tell the whole story....

И это только верхушка айсберга



Summary of initial findings

Internet users can get decent www performance from servers outside of Russia (in western Europe) i.e. < 100 ms delay

But…..

- Applications that don't like "V", variability, should avoid Frankfurt and London - video, gaming etc
- Adding bandwidth will not reduce the congestion

Further research will determine the variability of ΔQ and how certain applications are impacted in different parts of Russia and Eurasia and answer questions like:

- Where to put what applications
- Where to handoff traffic

Thanks!

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