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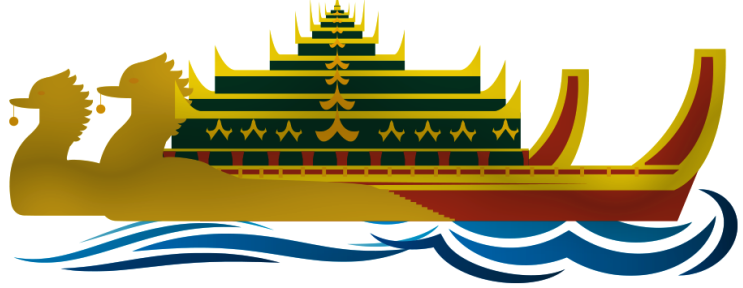

Quality of Experience (of Network Access)

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MMNOG 2020

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UNIVERSITY OF MORATUWA

Outline

- ITU definitions of QoS and QoE, QoS viewpoints
- Network Access as a utility and perceptions of Internet
- Few statistics from Digital Report 2019
- Analogies and stakeholder concerns
- Cloud Computing and QoE
- Net neutrality
- Operator challenges & Measurement of QoE
- Looking into future
- Conclusion

Why Quality of Experience (QoE) matters?

QoS/QoE problems are essentially due to bandwidth limitations but there are other reasons as well such as higher latency (due to amount of data transmitted)

QoS and QoE - ITU

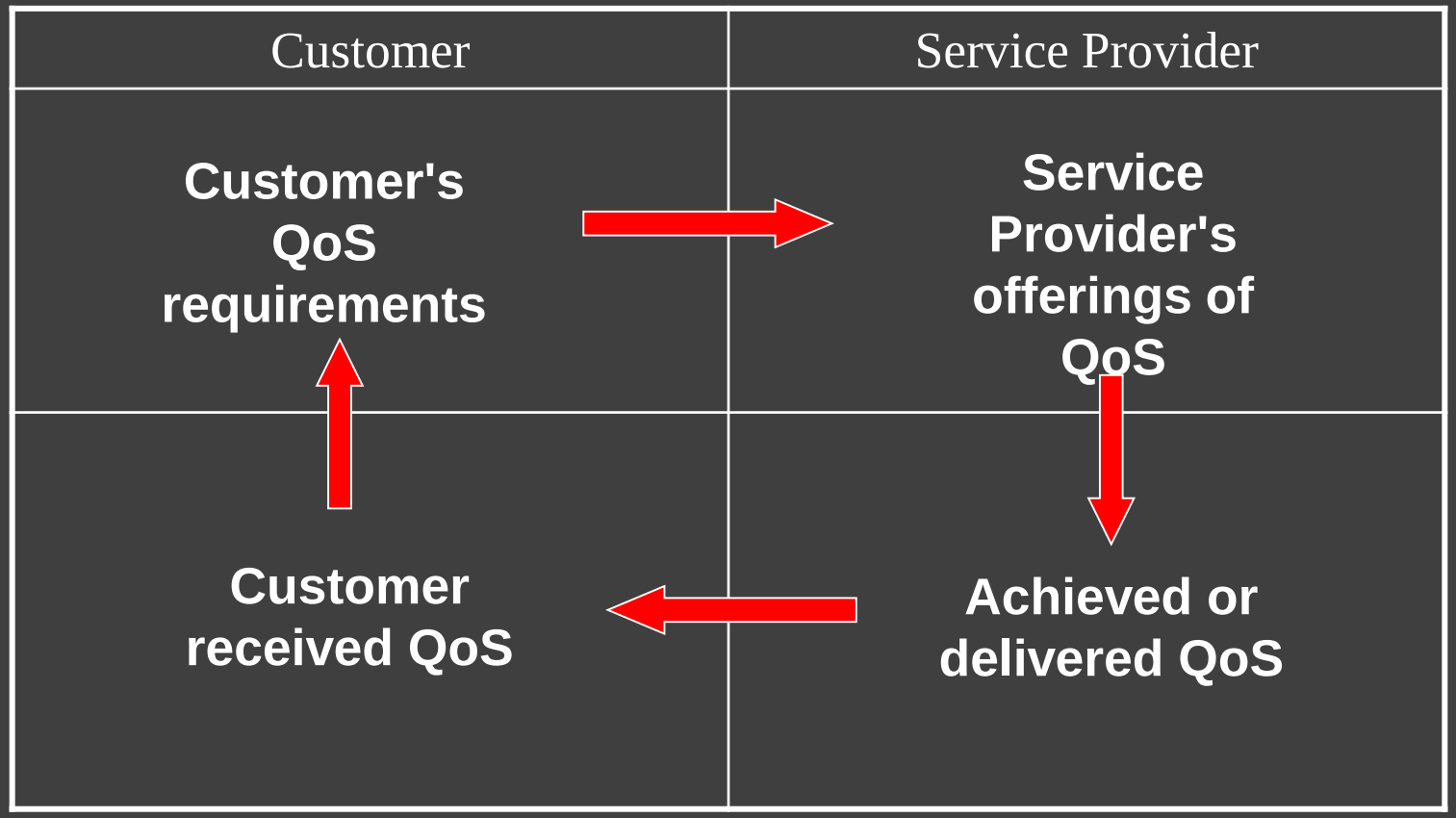
- ITU-T Rec. E. 800 defines **Quality of Service** (**QoS)** as “collective effect of service performance which determines the degree of satisfaction of a user of the service”
- ITU-T Recommendation P.10/G.100, defines **Quality of Experience (QoE)** as, “the overall acceptability of an application or service, as perceived subjectively by the end-user”
- QoE includes complete end-to-end system effects (client, terminal, network and service infrastructure)
- Overall acceptability may be influenced by user expectations and context.

ITU – QoS Perspective

ITU-T Recommendation E.800 has four (4) QoS view points namely:

- Customer's QoS requirements;
- Service Provider's offerings of QoS (or planned/targeted QoS);
- QoS achieved or delivered;
- Customer Survey ratings of received QoS.

The closer the 4 view points are in a given service, the better the QoS delivered.



Network Access as a utility

- We all know our dependency on water and electricity and to what extent our work and personal lives be affected due to
  - Non-availability and
  - Poor quality of service

  of these essential services.
- Today, we take network access for granted.
  - It is “non-availability or lack” of this service or poor quality of service (QoS) such as slow speed which raise concerns
- Given the similarities, **can we consider “Network Access” as a utility?**
- Today we need water and electricity for virtually every conceivable domestic and industry requirements.
- What about “Internet”?

In 2019 we celebrated 30th anniversary of World Wide Web (invented by Tim Berners-Lee).


?
Information
Research
Post Millennials (Gen Z) ?
Business
What is Internet?
Entertain ment
Gaming
E-Commerce / Shopping
Education

Digital Report 2019 – Some statistics

- Numbers:
  - Population : 7.676 Billion
  - Unique mobile users : 5.112
  - Internet users : 4.388
  - Active social media users : 3.484
  - Mobile social media users : 3.256
  - 9-10% annual increase in Internet and social media users
- **Average on-line time per day – 6 hours 42 minutes**
- Applications
  - 92% watch video online
  - Playing games – 30% , Watching others playing games online (23%)
  - Watch eSports – 16%

Source: Hootsuite and We Are Social

Mobile Internet Traffic : Youtube : 37%,
Global Internet Traffic : Netflix : 15%

Source: Sandvine/Statista

Digital Report – Myanmar (2019)

JAN 2019

ANNUAL DIGITAL GROWTH

THE YEAR-ON-YEAR CHANGE IN KEY STATISTICAL INDICATORS

TOTAL POPULATION	MOBILE SUBSCRIPTIONS	INTERNET USERS	ACTIVE SOCIAL MEDIA USERS	MOBILE SOCIAL MEDIA USERS
+0.9%	+7.2%	+17%	+17%	+31%
JAN 2018 – JAN 2019	JAN 2018 – JAN 2019	JAN 2018 – JAN 2019	JAN 2018 – JAN 2019	JAN 2018 – JAN 2019
+487 THOUSAND	+4 MILLION	+3 MILLION	+3 MILLION	+5 MILLION

SOURCES: POPULATION: UNITED NATIONS; U.S. CENSUS BUREAU. MOBILE: GSMA INTELLIGENCE. INTERNET: INTERNETWORLDSTATS; ITU; WORLD BANK; CIA WORLD FACTBOOK; EUROSTAT; LOCAL GOVERNMENT BODIES AND REGULATORY AUTHORITIES; MEDEASTMEDIA.ORG; REPORTS IN REPUTABLE MEDIA. SOCIAL MEDIA: PLATFORMS' SELF-SERVE ADVERTISING TOOLS; PRESS RELEASES AND INVESTOR EARNINGS ANNOUNCEMENTS; ASIAN SOCIAL MEDIA REPORT; TECHINASIA; NIKKEI ASIA PACIFIC; BOSSELTU. (ALL LATEST AVAILABLE DATA IN JANUARY 2019).

JAN 2019

INTERNET USE: DEVICE PERSPECTIVE

BASED ON ACTIVE INTERNET USER DATA, AND ACTIVE USE OF INTERNET-POWERED MOBILE SERVICES

TOTAL NUMBER OF ACTIVE INTERNET USERS

21.00
MILLION

INTERNET USERS AS A PERCENTAGE OF TOTAL POPULATION

39%

TOTAL NUMBER OF ACTIVE MOBILE INTERNET USERS

20.79
MILLION

MOBILE INTERNET USERS AS A PERCENTAGE OF TOTAL POPULATION

38%

SOURCES: INTERNETWORLDSTATS; ITU; WORLD BANK; CIA WORLD FACTBOOK; LOCAL GOVERNMENT BODIES AND REGULATORY AUTHORITIES; MEDIAEASTMEDIA.ORG; REPORTS IN REPUTABLE MEDIA. MOBILE SHARE DATA: GLOBALWEBINDEX (Q2 & Q3 2018); AND EXTRAPOLATIONS OF DATA PUBLISHED BY THE WORLD'S LARGEST SOCIAL MEDIA PLATFORMS VIA EARNINGS RELEASES AND SELF-SERVE ADVERTISING TOOLS. GLOBALWEBINDEX FIGURES REPRESENT THE FINDINGS OF A BROAD SURVEY OF INTERNET USERS AGED 16-64.

JAN 2019

SOCIAL MEDIA OVERVIEW

BASED ON MONTHLY ACTIVE USERS OF THE MOST ACTIVE SOCIAL MEDIA PLATFORMS

TOTAL NUMBER OF ACTIVE SOCIAL MEDIA USERS

21.00
MILLION

ACTIVE SOCIAL MEDIA USERS AS A PERCENTAGE OF TOTAL POPULATION

39%

TOTAL NUMBER OF ACTIVE SOCIAL USERS ACCESSING VIA MOBILE DEVICES

21.00
MILLION

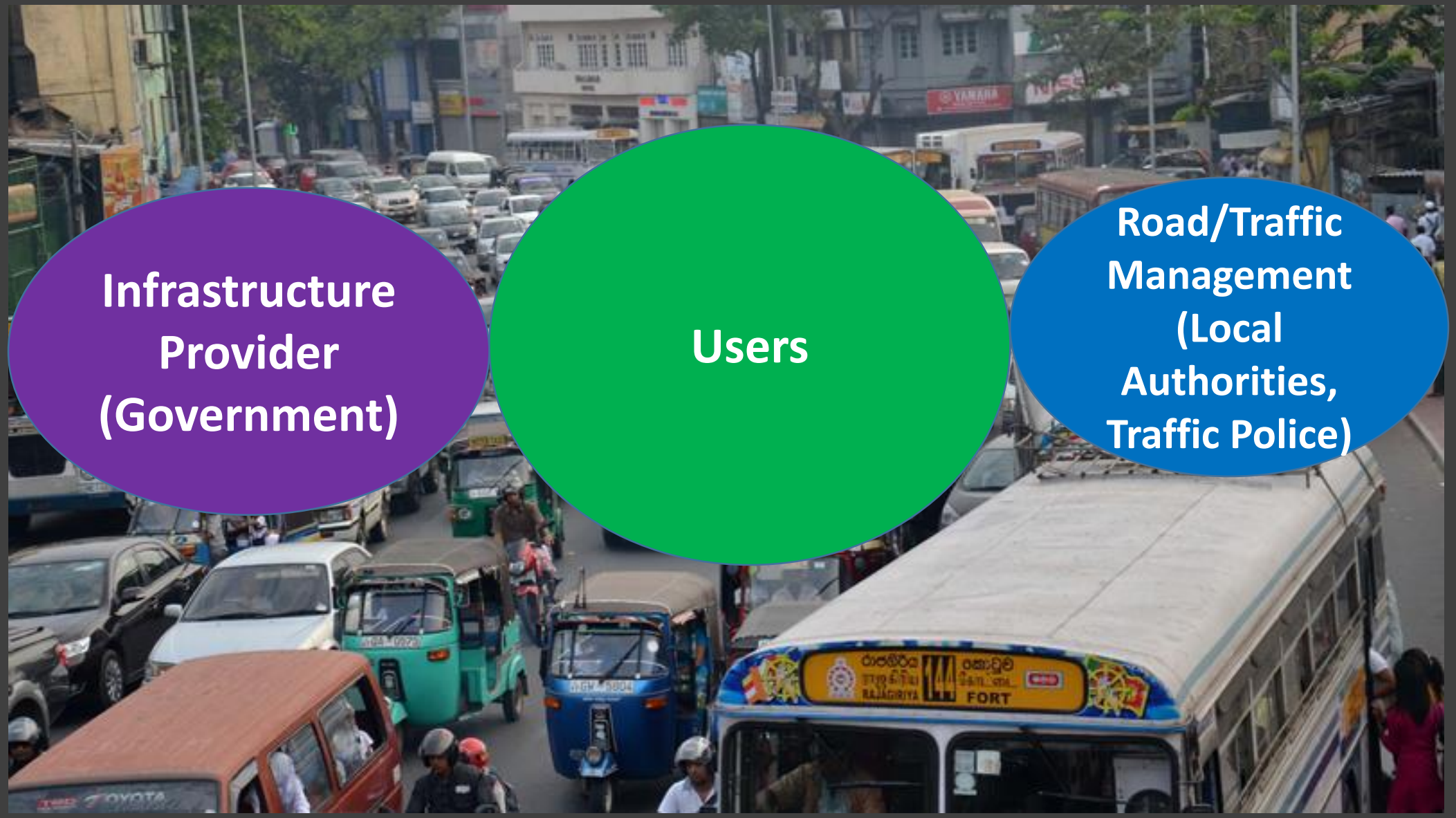
ACTIVE MOBILE SOCIAL USERS AS A PERCENTAGE OF THE TOTAL POPULATION

39%

SOURCES: LATEST DATA PUBLISHED BY SOCIAL MEDIA PLATFORMS VIA PRESS RELEASES, INVESTOR EARNINGS ANNOUNCEMENTS, AND IN SELF-SERVE ADVERTISING TOOLS; ARAB SOCIAL MEDIA REPORT; TECHRASA; NIXI; ACMA(B); ROSELRU; KEPIOS ANALYSIS.

Analogies

- Physical road infrastructure has striking similarities to cyber infrastructure (electronic highways) – particularly in this part of the world where everyday new users come online.
  - Contrast this with developed countries where virtually everyone is online.
- In this part of the world traffic is chaotic.
- What is its impact and what are the possible solutions?


Infrastructure Provider (Government)
Users
Road/Traffic Management (Local Authorities, Traffic Police)


Visibility
Security
Productivity
Quality of Access/ Quality of Experience
Return on Investment ?
Uncertainty
Costs

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Stakeholder concerns

- Users
  - Lack of predictability, consistency leads to productivity loss
- Infrastructure provider (Government)
  - Budgetary constraints – the best for a given budget
  - Return on Investment - This might not be direct but still important (E.g. improved economic activity due to a new highway)
- Road/Traffic Management
  - Daily task of managing the traffic
  - Need some form of control, policies – E.g. what vehicles are allowed (no containers during busy period), priority lanes for buses (public transport) at busy times
  - Handling of emergency vehicles

Solutions

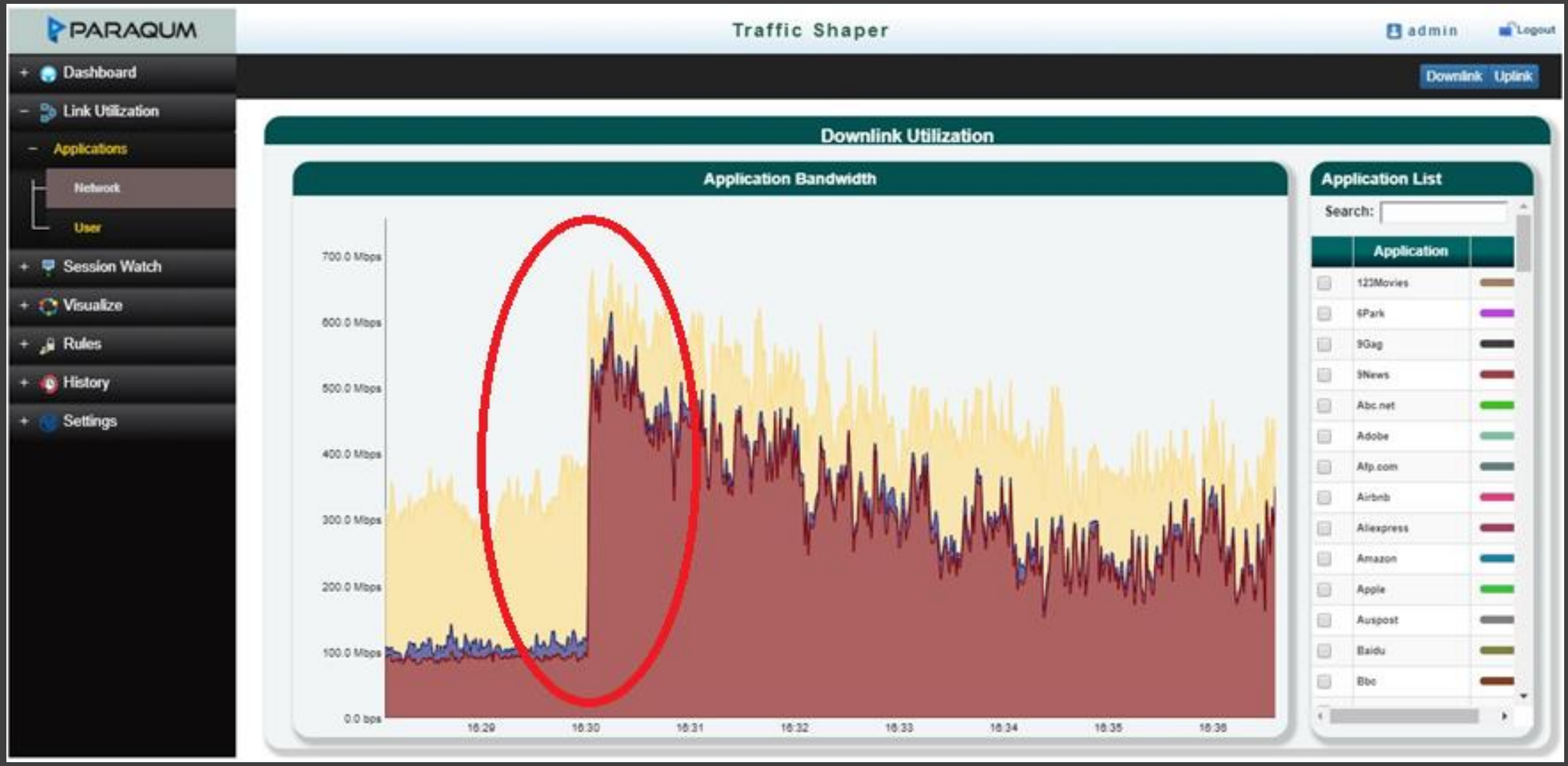
- Intuitively what many governments do as a solution is to build new roads or widen existing roads.
- This gives a temporary solution but traffic invariably catches up with new roads.
- We need a long term sustainable solutions – control of traffic is absolutely essential.

Fundamental Rule of Traffic : People tend to drive more in new and newly widened roads.

Image credit: Vox.com

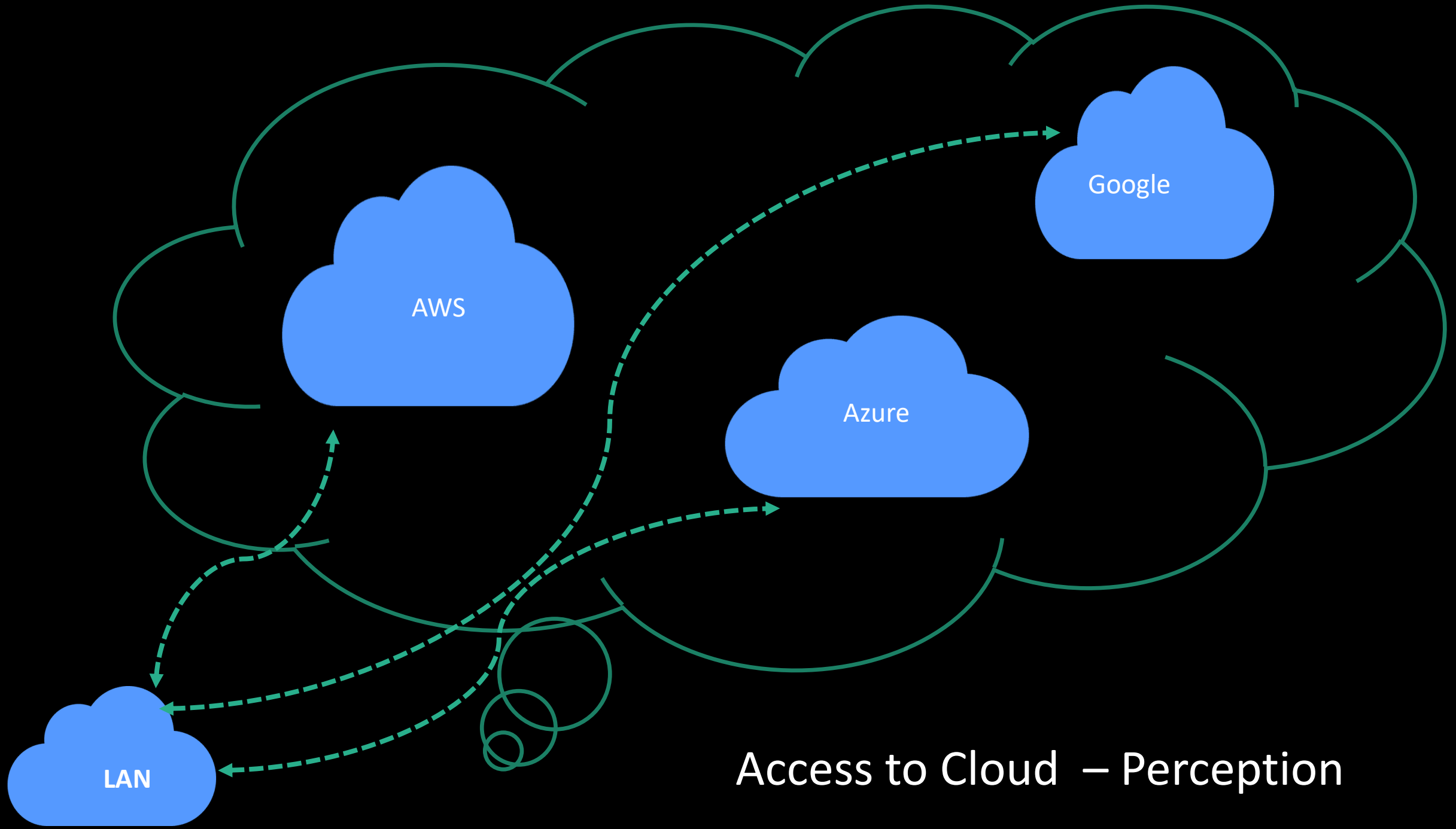
Visualizing Network Traffic Congestion

Impact of Youtube on Internet Traffic

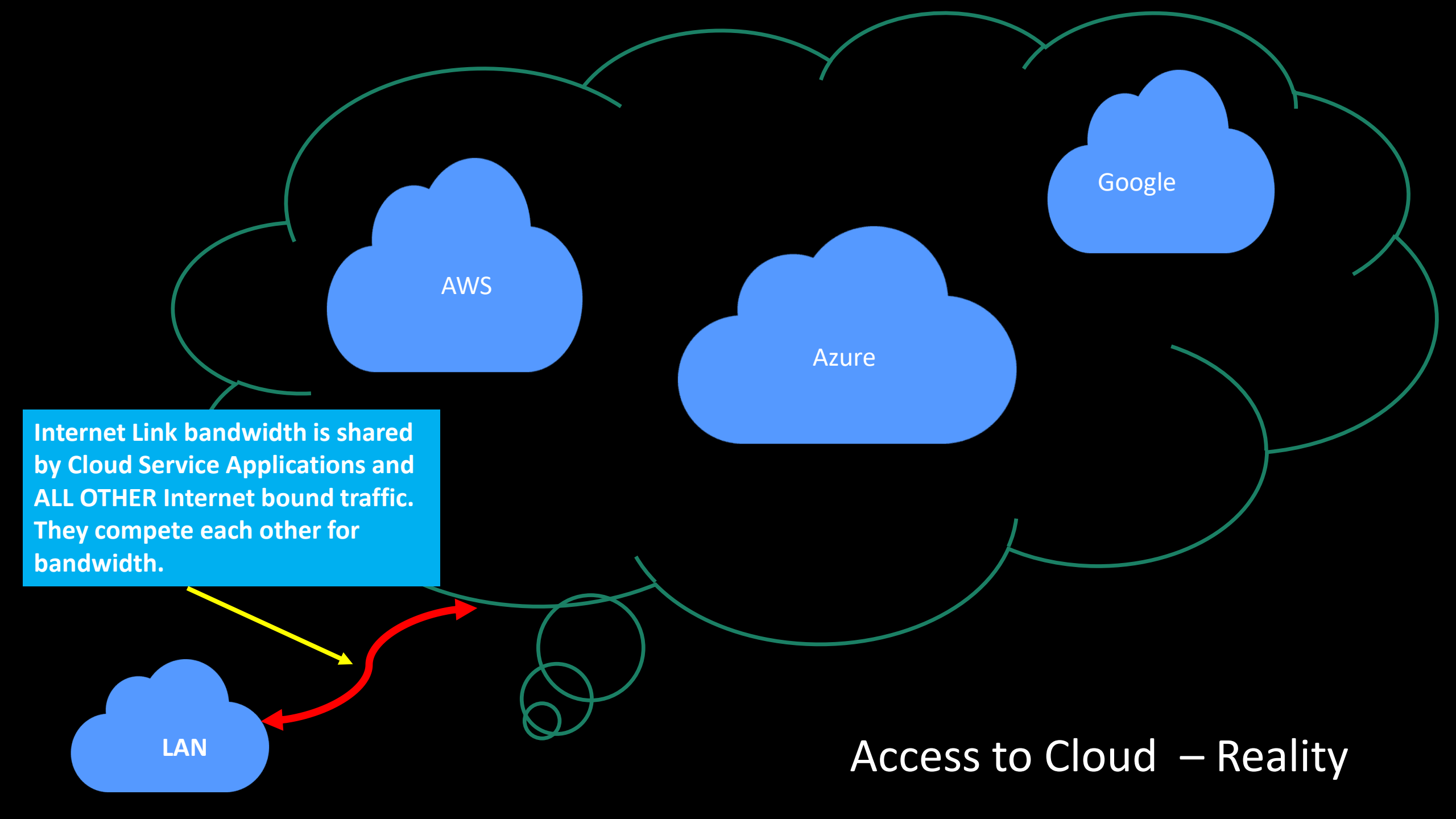


Cloud Computing and QoE

- Key element in Digital Infrastructure
- Migration to Cloud has started and not reversible.
  - Numerous benefits
- What about the Quality of Experience?
  - Core Applications – ERP etc.,
  - Office Productivity – Office 365, Google Docs



Access to Cloud – Perception



Access to Cloud – Reality

Net Neutrality

- The principle that Internet service providers (ISPs) must treat all Internet communications equally, and not discriminate or charge differently based on user, content, website, platform, application, type of equipment, source address, destination address, or method of communication.

- **With net neutrality, ISPs may not intentionally block, slow down, or charge money for specific online content**. Without net neutrality, ISPs may prioritize certain types of traffic, meter others, or potentially block traffic from specific services, while charging consumers for various tiers of service.

Source: Wikipedia

Operator Challenges

- Diversity of expectations of Internet access (user perceptions)
- Measurement of QoE
- Best methodologies to meet user QoE expectations
- Maximize ROI of existing infrastructure
- Net Neutrality and QoE? Can they co-exist?

Measurement of QoE

- Subjective indicator
- How do we measure?
  - Mean Opinion Score (MOS)
- No universally agreeable measurement technique to this date.
- ITU has provided a guideline:
  - ITU-T G.1011 - Reference guide to quality of experience assessment methodologies
- Active research area
- Rating systems developed by different vendors
  - No uniformity

How do we fulfill user expectations in this context?

Looking into the future

With 5G

- Billions of new devices (IOT) will add to network traffic
- Higher Access Speeds will lead to creation of high bandwidth applications (E.g. 4K or 8K Video Streaming, High Resolution & Realistic VR Applications etc.,)

We need our future Digital Infrastructure to display

- Predictability
- Consistency
- Reliability

Future Digital Infrastructure will only be meaningful if it brings

- Higher Quality of Life/Quality of Experience to all its users.

Conclusion

- QoE to be used as the basis for provision of Internet Services
  - Customer (subscriber) retention becomes easy – no reason to switch providers!!
- Assurance of Quality of Experience for all users of Cyber infrastructure? Is this realistic?
- Higher bandwidth (or increasing bandwidth) is not a guaranteed way of assuring QoE
  - When number of users sharing such bandwidth is quite high and
  - When number of new users keep on increasing

Thank You!!

Q & A