Internet Trends & Challenges

IX.br – São José do Rio Preto
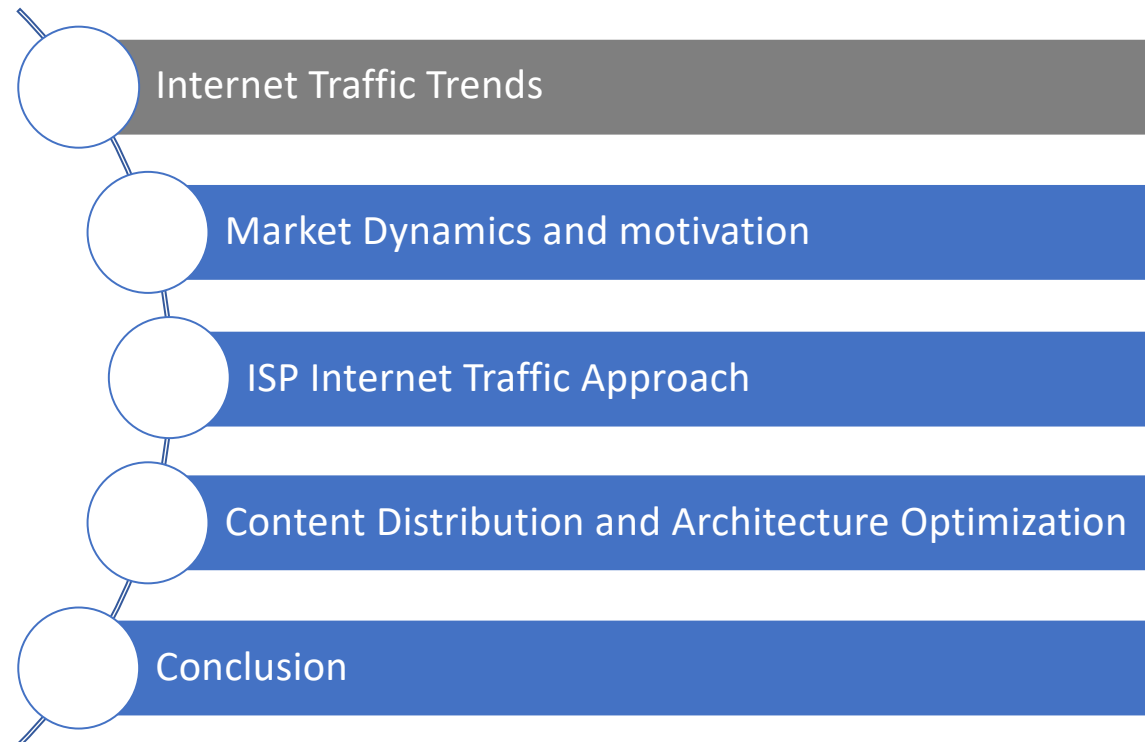
Rúben Fonte

Senior Network Architect

TIM

Internet Traffic Trends & Challenges

Agenda

Internet Traffic Trends

History

"Public" Internet circa 1995

- Low bandwidth clients, dial-up
- Many smaller regional Internet providers
- ~16M users
- Wireline only
- Static content
- More widespread content sources contributed to volume

Today's Internet

- High-speed Internet is widely available
- 100s of millions mobile users
- Approaching 4 billion users worldwide
- Static content replaced with video
- Traffic **volume** driven by fewer sources
- Leads to "flattening" of Internet: Direct interconnection between producer and consumer networks
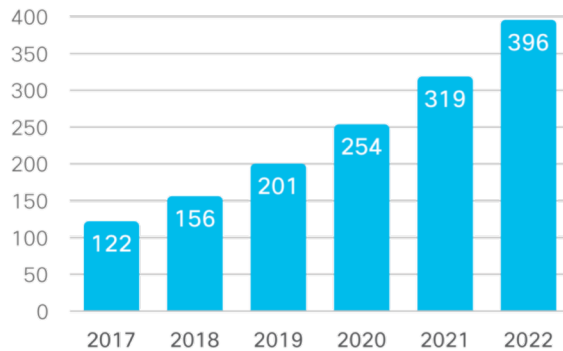
Internet Traffic Trends

Visual Network Index – VNI Cisco
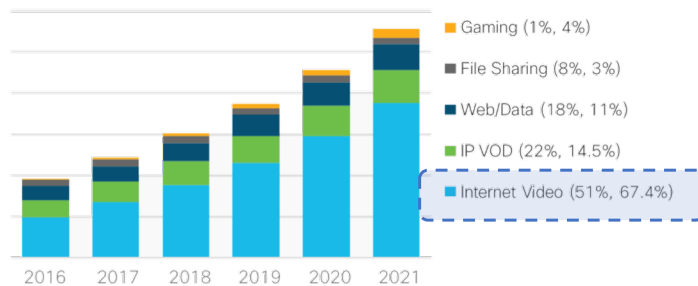
26% CAGR 2017–2022

Exabytes per Month

Year	Value
2017	122
2018	156
2019	201
2020	254
2021	319
2022	396

Source: Cisco VNI Global IP Traffic Forecast, 2017–2022

AGILITY
CAPEX   OPEX   ARPU

Year	Global internet traffic
1992	100 GB per day
1997	100 GB per hour
2002	100 GB per second
2007	2,000 GB per second
2017	46,600 GB per second
2022	150,700 GB per second

Internet Traffic Trends

Visual Network Index – VNI Cisco
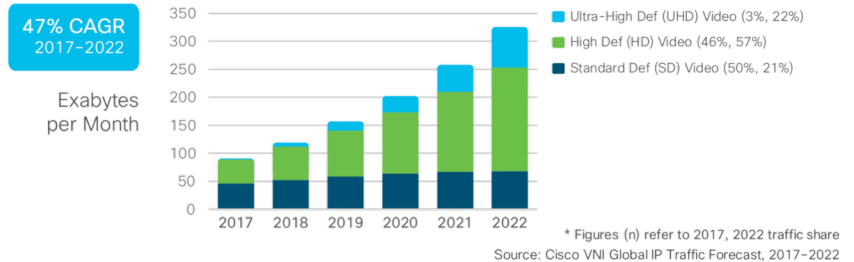

World Wide Total Traffic

- Gaming (1%, 4%)
- File Sharing (8%, 3%)
- Web/Data (18%, 11%)
- IP VOD (22%, 14.5%)
- Internet Video (51%, 67.4%)

53% CAGR 2015-2020

- Mobile File Sharing (1%, 2%)
- Mobile Audio (8%, 6%)
- Mobile Web/Data/VoIP (36%, 17%)
- Mobile Video (55%, 75%)
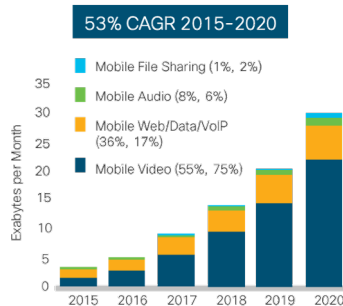
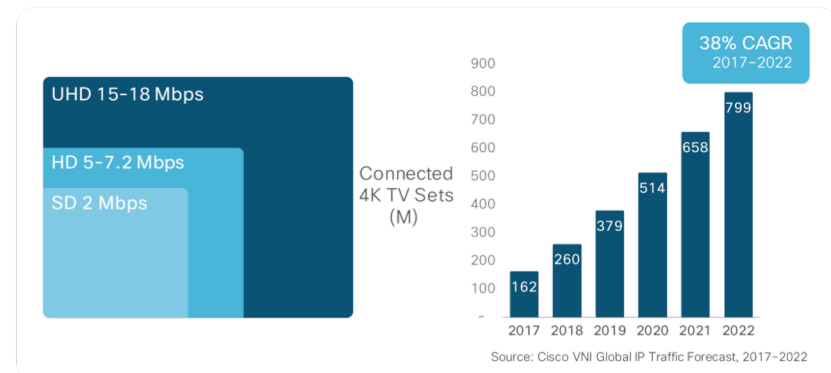Video drives traffic... but not revenue

World Wide Mobile Traffic

… Traffic demands keep growing at fixed and mobile broadband perspective.

(IP Video accounted 73% of all internet in 2016, and 2921 will account for 82%

47% CAGR 2017-2022

Exabytes per Month

- Ultra-High Def (UHD) Video (3%, 22%)
- High Def (HD) Video (46%, 57%)
- Standard Def (SD) Video (50%, 21%)

* Figures (n) refer to 2017, 2022 traffic share
Source: Cisco VNI Global IP Traffic Forecast, 2017-2022

Global UHD IP video traffic

UHD 15-18 Mbps
HD 5-7.2 Mbps
SD 2 Mbps

Connected 4K TV Sets (M)
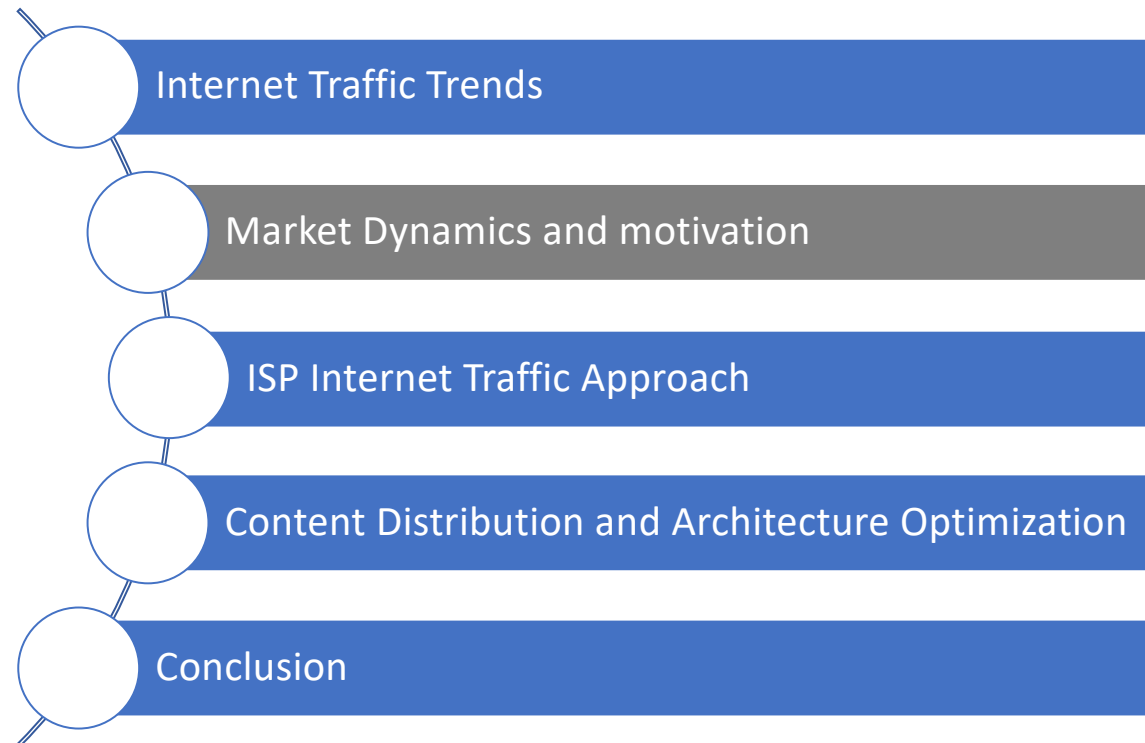
38% CAGR 2017-2022

Source: Cisco VNI Global IP Traffic Forecast, 2017-2022

UHD (or 4K) video will account for 22 percent of global IP Video traffic by 2022 (Figure 7). UHD as a percentage of IP VoD traffic will be higher at 35 percent by 2022.
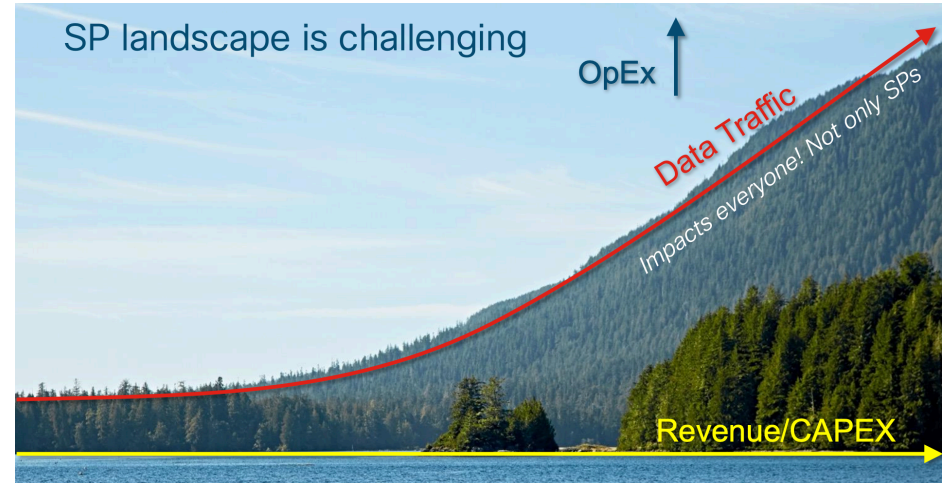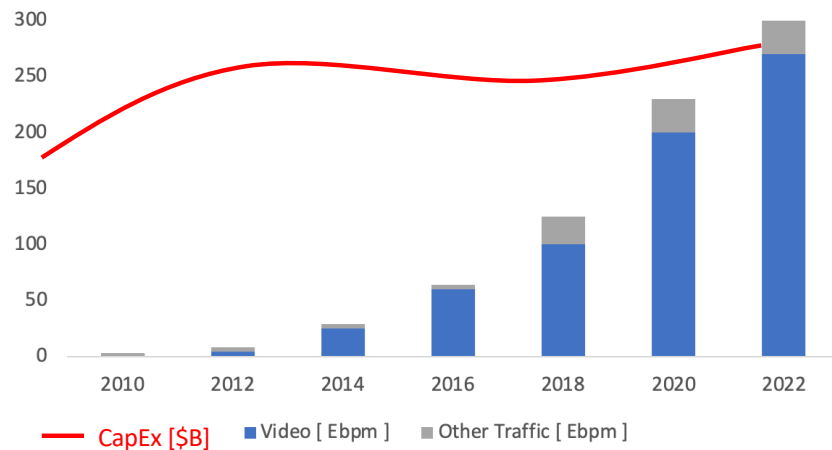
Internet Traffic Trends & Challenges

Agenda

- Internet Traffic Trends
- Market Dynamics and motivation
- ISP Internet Traffic Approach
- Content Distribution and Architecture Optimization
- Conclusion

Market Dynamics and Motivation

Visual Network Index – VNI Cisco

... Overall ISP ARPUs <u>have been flat or declining</u>:

- Pressure to drive greatest efficiency in delivering services

- Pressure to expand beyond consumer services

Exabytes / month

(chart axis values: 300, 250, 200, 150, 100, 50, 0 — years 2010, 2012, 2014, 2016, 2018, 2020, 2022)

— CapEx [$B] ■ Video [Ebpm] ■ Other Traffic [Ebpm]

SP landscape is challenging
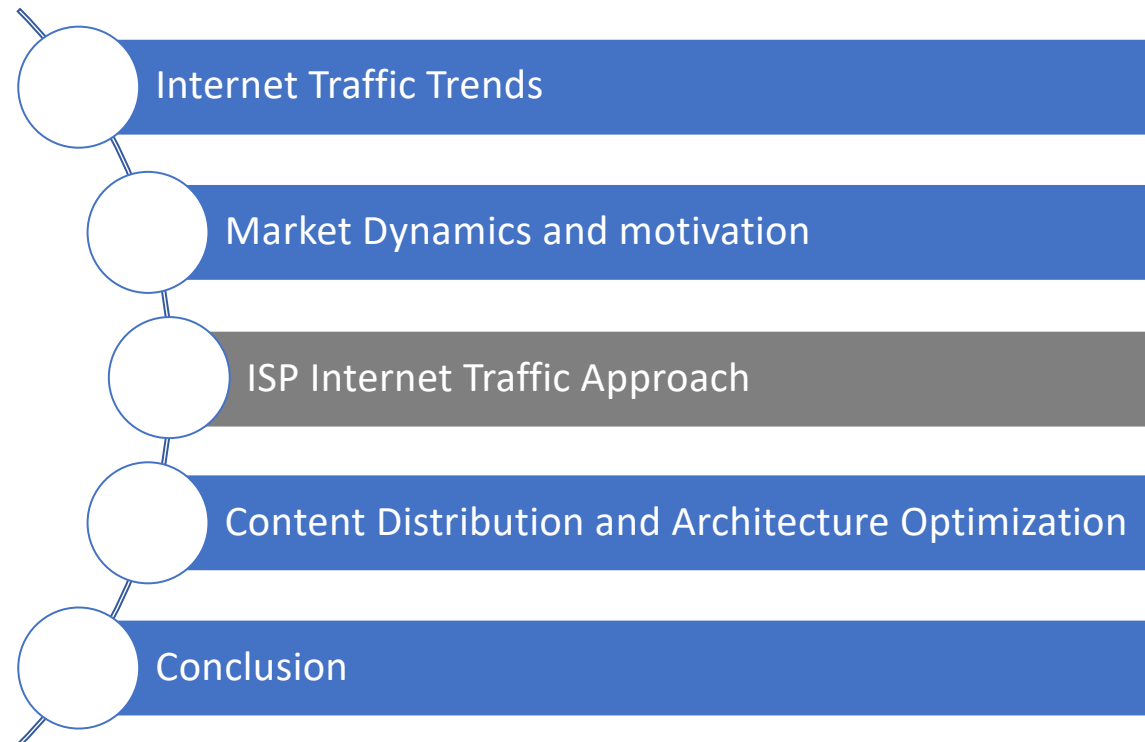
OpEx

Data Traffic

Impacts everyone! Not only SPs

Revenue/CAPEX

... To achieve this challenge, Service Provider must reinvent itself...

Internet Trends & Challenges

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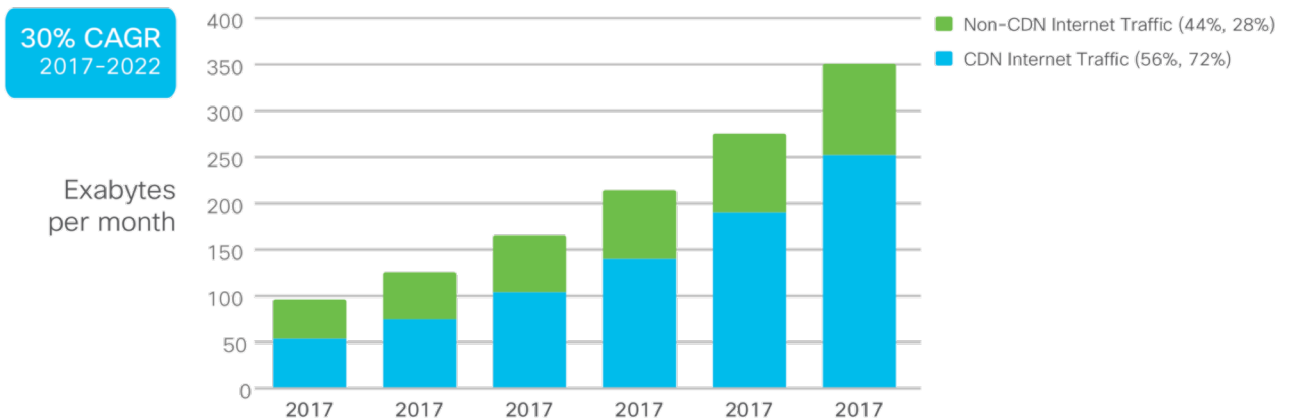- Conclusion

ISP Internet Traffic Approach

Intenet Traffic Trends & Challenges

What is Network Efficiency?

Network efficiency in this context refers to minimizing the cost and consumption of network resources such as physical fiber, wavelengths,and IP interfaces to deliver unicast video content to end users. The equation to delivering video traffic efficiently is to create a network model reducing the distance, network hops, and network layer transitions

Reducing the distance and network hops between where unicast video packets enter your network and exit to the consumer is a key priority for service providers in reducing network cost.

30% CAGR 2017-2022

Exabytes per month

■ Non-CDN Internet Traffic (44%, 28%)
■ CDN Internet Traffic (56%, 72%)

400
350
300
250
200
150
100
50
0

2017 2017 2017 2017 2017 2017

* Figures (n) refer to 2017, 2022 traffic share
Source: Cisco VNI Global IP Traffic Forecast, 2017-2022

ISP Internet Traffic Approach

Service Provider activities
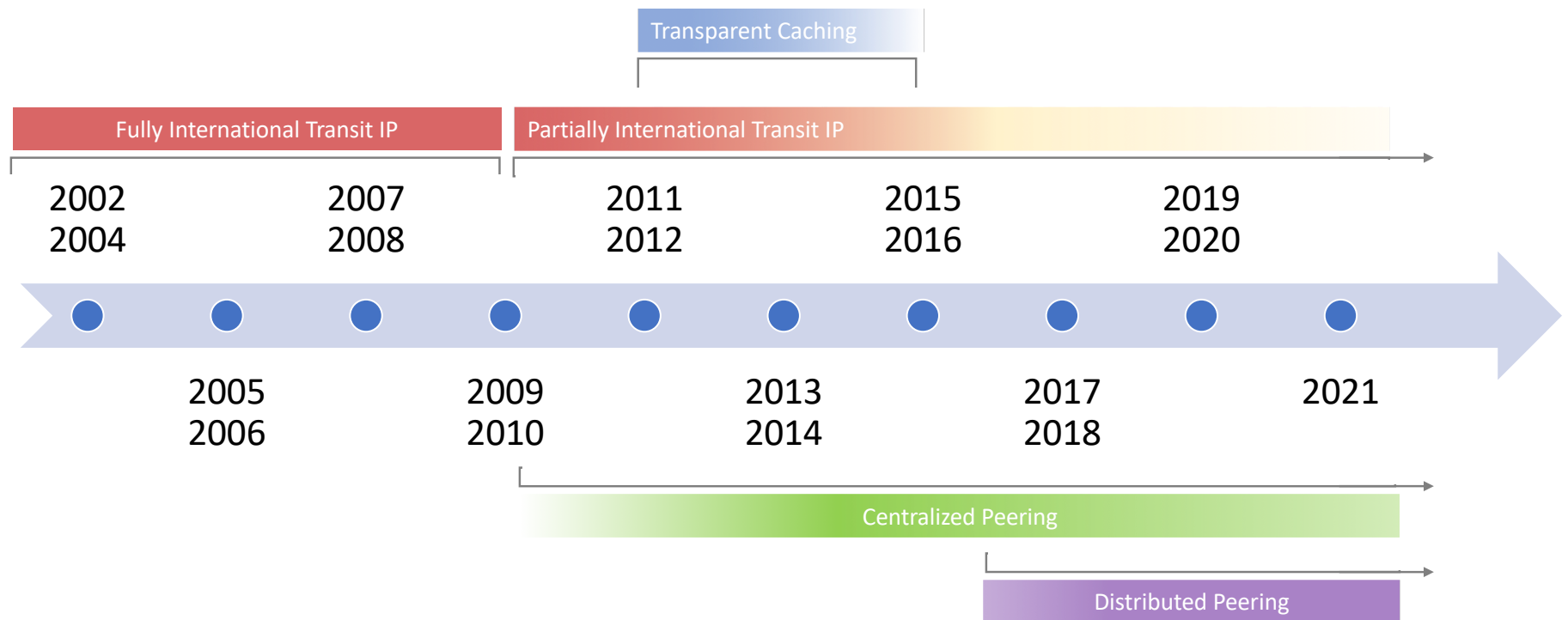
ISP Initiatives:

▶ To support the traffic growth cost effectively, delivery efficiently and with high quality of experience the Network has been working continuously on:

    ▶ **IP Transit** - Reduce the Traffic and the Cost;

    ▶ **Direct Peering** - Agreements with the main Content Providers;

    ▶ **Content Distribution** – Bringing the content as near as possible to users.

ISP Internet Traffic Approach
Internet Video Traffic Growth and Content Distribution Strategy Timeline

Transparent Caching

Fully International Transit IP | Partially International Transit IP

| 2002 | | 2007 | | 2011 | | 2015 | | 2019 |
| 2004 | | 2008 | | 2012 | | 2016 | | 2020 |

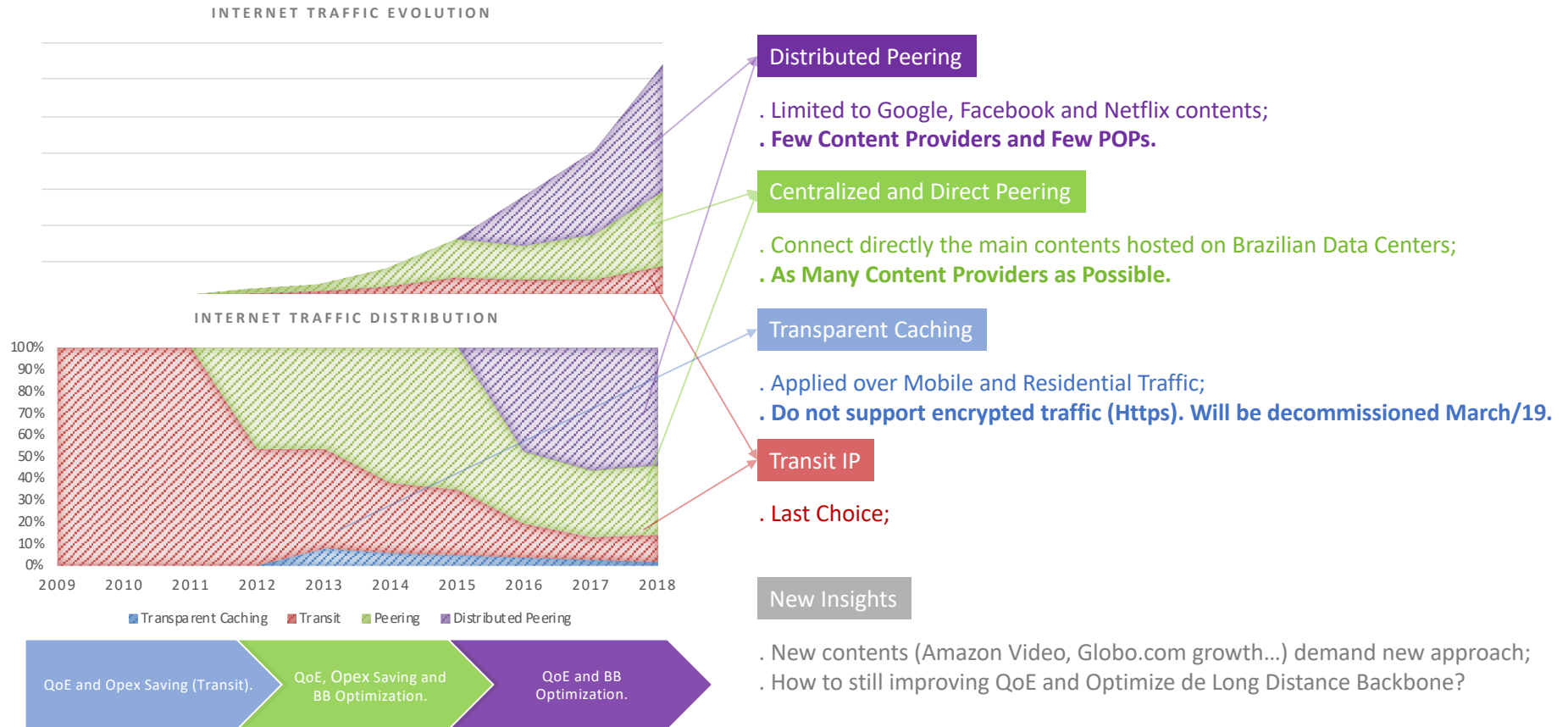| | 2005 | | 2009 | | 2013 | | 2017 | | 2021 |
| | 2006 | | 2010 | | 2014 | | 2018 | |

Centralized Peering

Distributed Peering

ISP Internet Traffic Approach
Internet Video Traffic Growth and Content Distribution Strategy

INTERNET TRAFFIC EVOLUTION

INTERNET TRAFFIC DISTRIBUTION

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

2009   2010   2011   2012   2013   2014   2015   2016   2017   2018

- Transparent Caching
- Transit
- Peering
- Distributed Peering

QoE and Opex Saving (Transit).

QoE, Opex Saving and BB Optimization.

QoE and BB Optimization.

Distributed Peering

. Limited to Google, Facebook and Netflix contents;
. Few Content Providers and Few POPs.

Centralized and Direct Peering

. Connect directly the main contents hosted on Brazilian Data Centers;
. As Many Content Providers as Possible.

Transparent Caching

. Applied over Mobile and Residential Traffic;
. Do not support encrypted traffic (Https). Will be decommissioned March/19.

Transit IP

. Last Choice;

New Insights

. New contents (Amazon Video, Globo.com growth...) demand new approach;
. How to still improving QoE and Optimize de Long Distance Backbone?

Internet Trends & Challenges
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Internet Traffic Trends

Market Dynamics and motivation

ISP Internet Traffic Approach

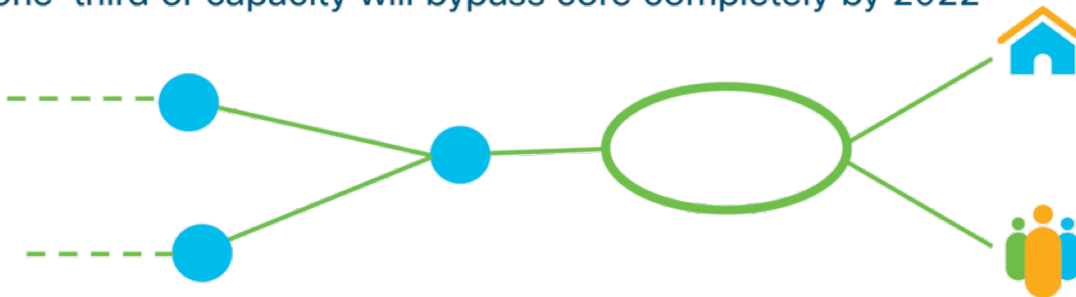Content Distribution and Architecture Optimization

Conclusion

Content Distribution and Architecture Optimization

Traffic Distribution

SP Network Capacity Moving Closer to the Edge
Over one-third of capacity will bypass core completely by 2022

Core-Cross-Country
48% in 2017
43% in 2022
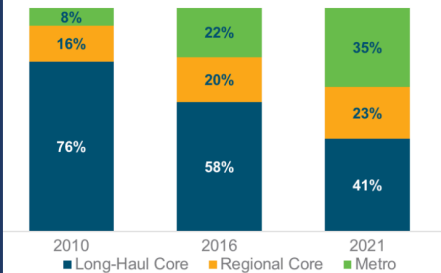
Core-Regional
25% in 2017
24% in 2022

within Metro
27% in 2017
33% in 2022

Source: Cisco VNI Global IP Traffic Forecast, 2017-2022

Traffic Distribution

2010   2016   2021
■ Long-Haul Core   ■ Regional Core   ■ Metro

8%
16%
76%

22%
20%
58%

35%
23%
41%

CDNs will carry traffic closer to the end user, but presently much CDN traffic is deposited onto regional core networks. However, metro-capacity of the service provider networks is growing faster than core-capacity and will account for a third or 33 percent of total service provider network capacity by 2022, up from 27 percent in 2017
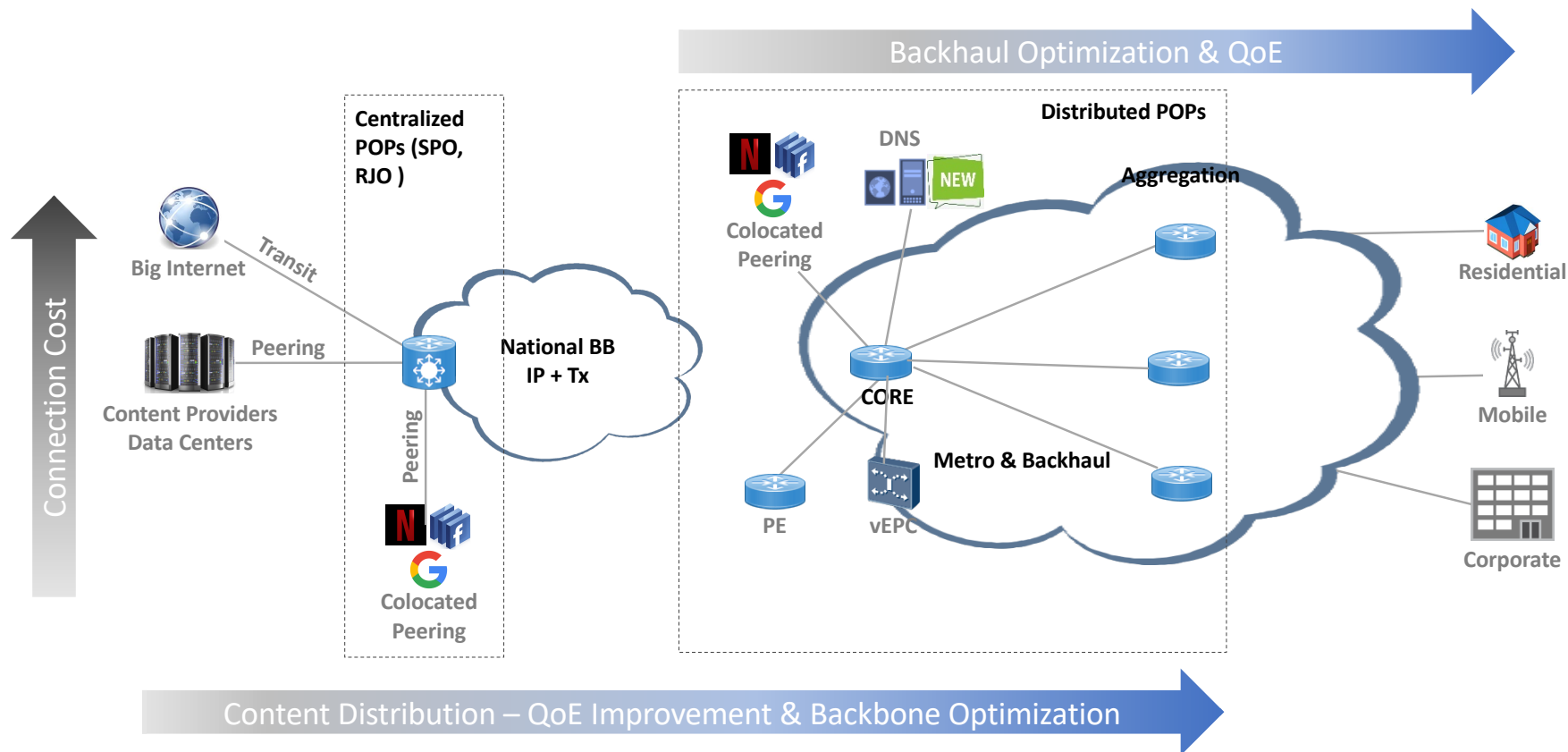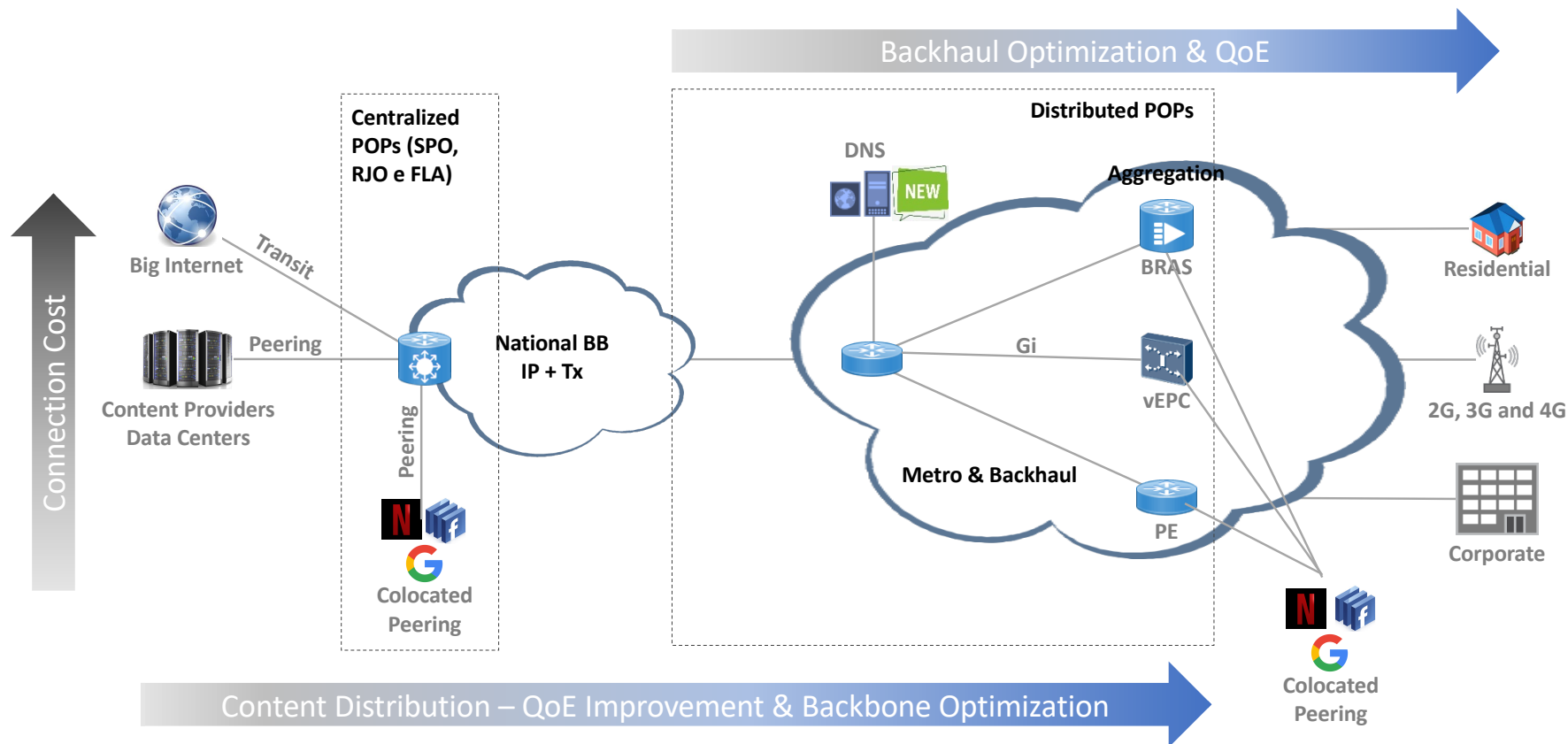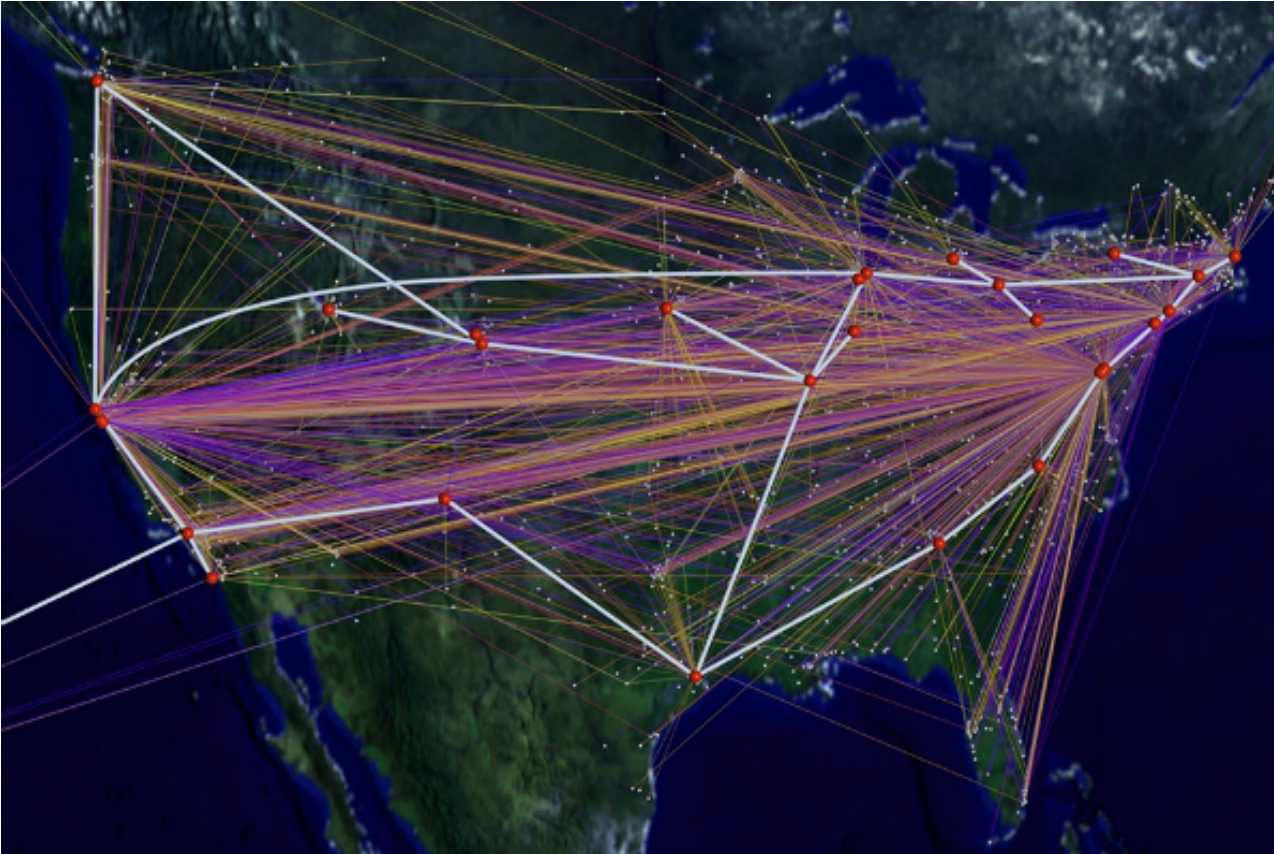
Content Distribution and Architecture Optimization
Network Tune Up for Best Performance and QoE

Content Distribution and Architecture Optimization
Network Tune Up for Best Performance and QoE

Backhaul Optimization & QoE

Centralized POPs (SPO, RJO e FLA)

Distributed POPs

DNS

NEW

Aggregation

BRAS

Big Internet

Transit

Peering

Content Providers Data Centers

Peering

National BB IP + Tx

Gi

vEPC

Metro & Backhaul

PE

Colocated Peering

Connection Cost

Residential

2G, 3G and 4G

Corporate

Colocated Peering

Content Distribution – QoE Improvement & Backbone Optimization

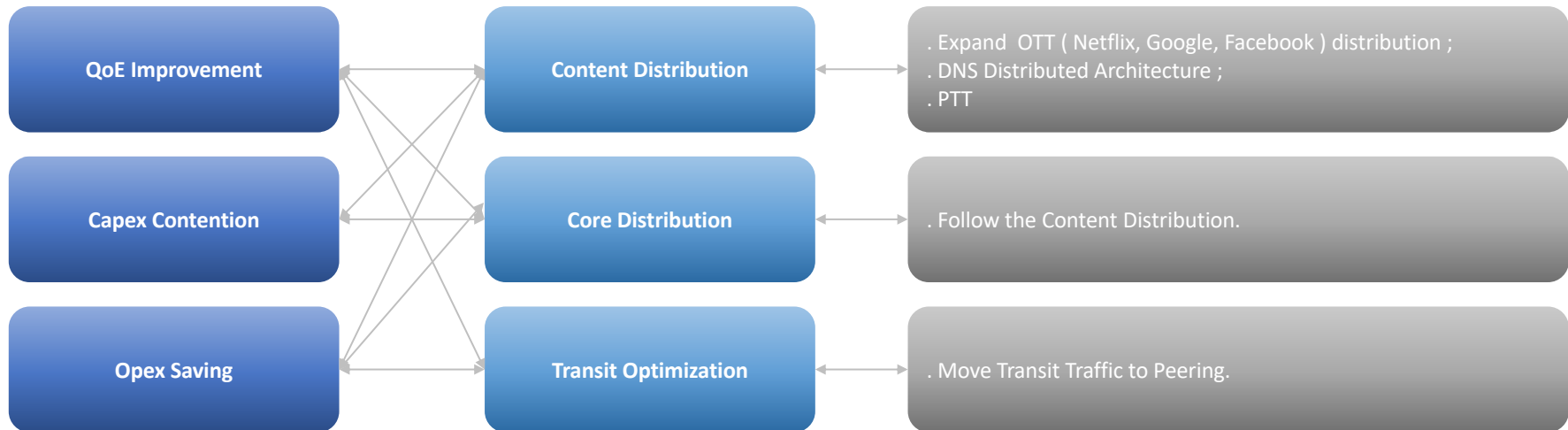# Content Distribution and Architecture Optimization
IX.br

IX.br

- Better Traffic Distribution;
- Traffic Efficiency;
- OPEX/CAPEX Savings;
- QoE;

Content Distribution and Architecture Optimization

So What? – New Opportunities - New Technologies - New Approach

QoE Improvement	**Content Distribution**	. Expand OTT (Netflix, Google, Facebook) distribution ; . DNS Distributed Architecture ; . PTT
Capex Contention	**Core Distribution**	. Follow the Content Distribution.
Opex Saving	**Transit Optimization**	. Move Transit Traffic to Peering.

OBRIGADO!!!

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