

EVALUATION OF MOBILE NETWORK PERFORMANCE

ITU-T QSDG workshop
Amman (Jordan) October 2022

ROHDE & SCHWARZ

Make ideas real



EVALUATION OF NETWORK PERFORMANCE

- ▶ There are many KPI's describing 'performance' in a single aspect of telecommunication
- ▶ Often 'network performance' is used equivalent to 'data speed' or 'bitrate'
- ▶ Network performance is more, it should consider all dimensions of network use
 - ▶ *What are use cases or services and how important are they?*
- ▶ A network is not a single point, it is deployed region- or country-wide
 - ▶ *How to aggregate performance measures across a region or a country?*
- ▶ A network is not homogenous, not geographically and not technology-wise.
 - ▶ *How to consider a wide variation of local performances*
 - ▶ *How to stay technology-agnostic?*

4G AND 5G NETWORK POLICIES TODAY

High attention on peak data rates in today's 4G/5G networks

- ▶ Today's mobile networks are designed and optimized for human users
- ▶ What human users are doing today?
 - ▶ Retrieving of web content
 - ▶ Streaming video
 - ▶ Posting to social media
 - ▶ Voice and video calls over IP
 - ▶ ...

- ▶ **Operators today mostly prioritize high data rates in DL direction**
- ▶ **'Performance' is often defined by 'maximum or average bitrate'. Is this sufficient?**

EVALUATION OF NETWORK PERFORMANCE

TYPICAL USE CLASSES IN PUBLIC NETWORKS

*P2P direct
real-time connection*

Telephony

*Continuous transfer
of media, real-time*

Streaming media
Online gaming

Up- or download files

Messaging
Browsing
Social media
File transfer

*Network performance
on low layer*

Data speed

- ▶ The use cases have different technical focusses on transport
- ▶ **Performance assessment and 'scoring' must cover all aspects of network use**
- ▶ Classification based on requirements on network not on 'App'
e.g. WhatsApp Messaging is a different class than WhatsApp Call

PERFORMANCE SCORE



COVERS ALL USE CASE CLASSES

P2P direct real-time connection

Telephony

- 2G/3G Call
- VoLTE Call
- WhatsApp (VoIP)

Focus on mobile-to-mobile

Receiving / sending media w/ motion, real-time

Streaming media

- YouTube Full HD
- YouTube 4K
- Facebook Watch

Up- or download files

Messaging

- SMS/RCS messaging
- WhatsApp messaging

Social media

- Browsing
- Facebook Posting
- Instagram Posting
- Twitter Posting
- Dropbox Up- / Download

File transfer

- HTTP file transfer
- FTP file transfer

Network performance on low layer

Data speed

- HTTP/TCP Capacity
- FTP Capacity
- UDP Capacity

Transport latency

- UDP latency / Interactivity
- HTTP/TCP latency

Transport continuity

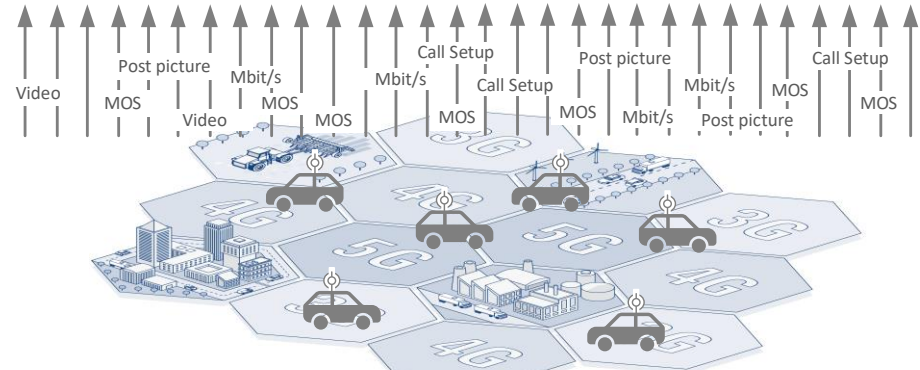
- iPerf3

SCORING NETWORK PERFORMANCE

Integrated score per 'service'

All technical KPIs 'as usual' are measured, accessible and reported

You will not lose any detail!



SCORING NETWORK PERFORMANCE

Integrated score 'overall'



Integrated score per 'region'



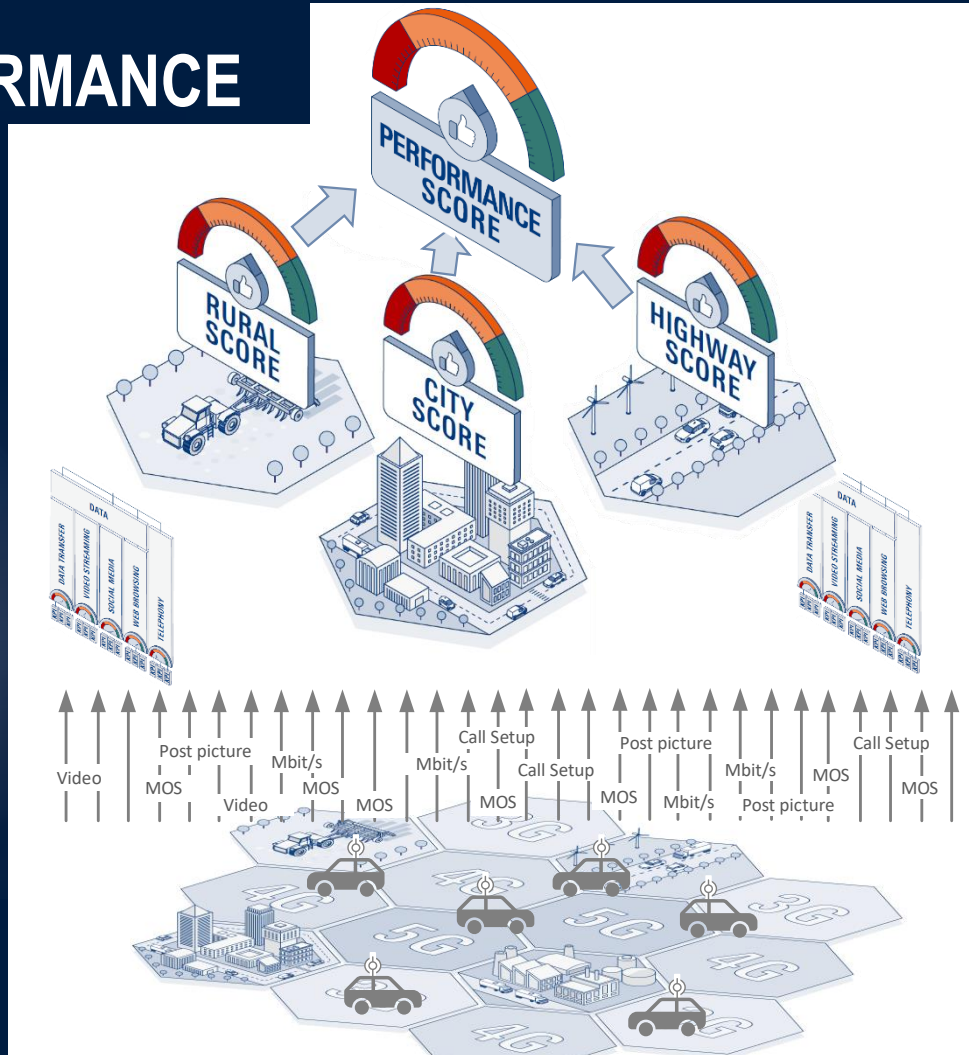
Integrated score per 'service'



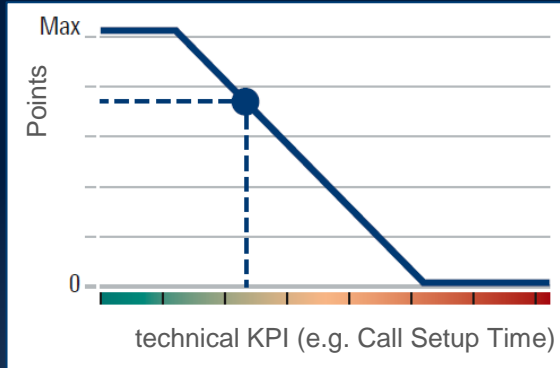
All technical KPIs 'as usual' are measured, accessible and reported



You will not lose any detail!

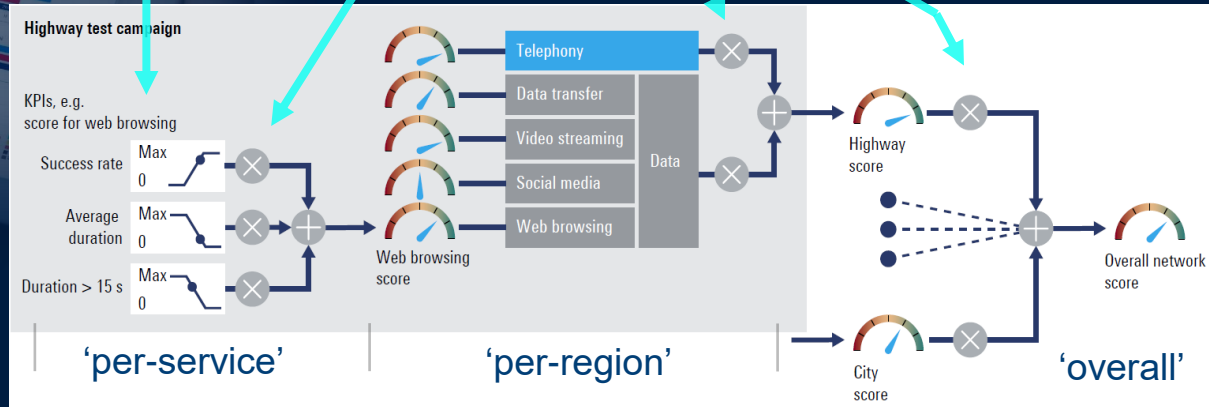


NETWORK PERFORMANCE SCORE IN PRINCIPLE: AN AGGREGATION MODEL



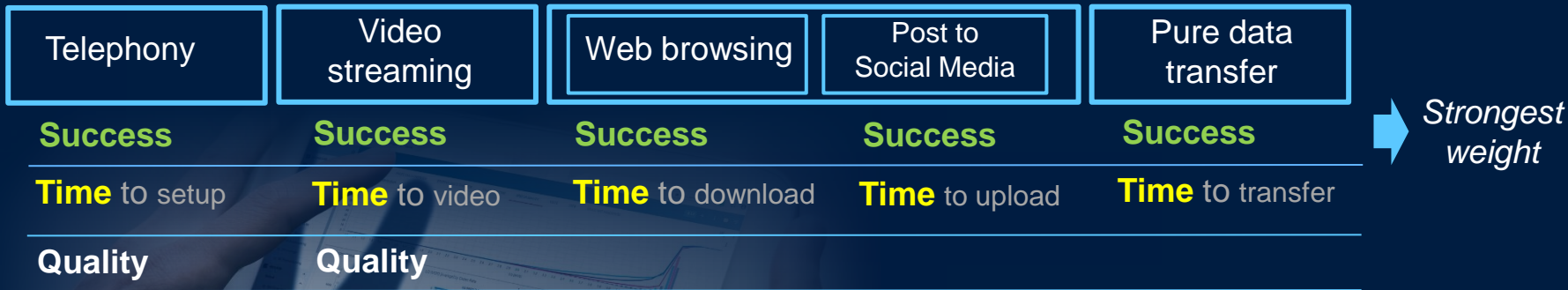
Each technical KPI is transformed to a perceptual point scale. This makes the KPIs directly comparable (same scale).

Each KPI is weighted according to its importance and further combined and aggregated with other KPIs.



NETWORK PERFORMANCE SCORE

SIMPLE CONSTRUCTION PRINCIPLE



40% in overall

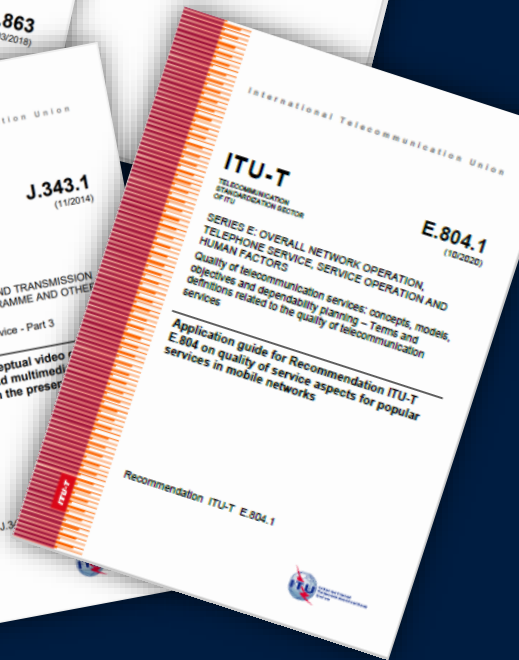
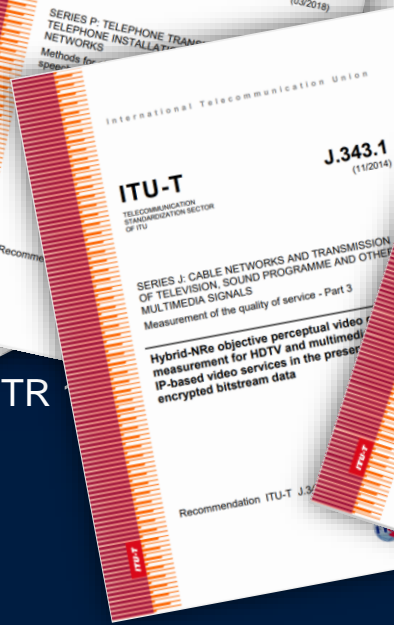
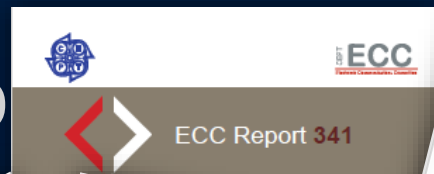
Strongest weight of data services

General

- Success counts most for all services
- Time to complete is second most important for all services
- Earning extra points for extraordinary performance
- Losing extra points for weak performance

ETSI TR 103 559 ROBUST SCORING NETWORK PERFO

- ▶ TR 103 559 describes the methodology, the test methods and the guidance for scoring network's end-to-end performance
- ▶ TR 103 559 methodology is technically aligned with ITU-T E.804.1
- ▶ Referenced in ITU-T E.804.1 and ITU-T J.343.1
- ▶ Scoring is based on standardized test methods:
 - ▶ Telephony: ETSI TR 103 559
 - ▶ Speech Quality: ITU-T P.863
 - ▶ Video/YouTube: ETSI TR 103 559
 - ▶ Video Quality: ITU-T J.343.1
 - ▶ Data Transfer: ETSI TS 102 230
 - ▶ Browsing: ETSI TS 102 230



EVALUATION OF NETWORK PERFORMANCE

WHAT IS BAD, WHAT IS GOOD, WHAT IS MAXIMUM?

- ▶ Legacy scoring methods
 - Maximum scores defined by today's available real-field capabilities
 - Re-adjusted 'annually', often customized for dedicated networks
 - no comparison, no general use, no differentiation if thresholds are exceeded



EVALUATION OF NETWORK PERFORMANCE

WHAT IS BAD, WHAT IS GOOD, WHAT IS MAXIMUM?

- ▶ Legacy scoring methods
 - Maximum scores defined by today's available real-field capabilities
 - Re-adjusted 'annually', often customized for dedicated networks
 - no comparison, no general use, no differentiation if thresholds are exceeded
- ▶ Application of limits defined by perceptual or physical limits
 - TR 103 559 allows a general, technology-agnostic parametrization
 - Use of physical limits for 100% score (and not 'today's maximum')
 - Use of perceptual limits and saturation for human-based QoE KPIs e.g. Voice- and Video MOS, longest acceptable waiting download or setup times,...)
 - **Long-term stable method, comparison, general usage**
 - 'Short come': Even best field-networks today will not get maximum points

EXPECTED MAJOR TRENDS TO BE CONSIDERED FOR 5G

▶ Telephony / conferencing

- Stays a relevant service, transition to **VoNR** requires field testing
- **OTT VoIP** telephony services become equivalent in use and quality
- Telephony extends towards **interactive and audio-visual** experience



▶ Media / Web content delivery

- Streaming stays very relevant, transition to **interactive use cases**
- Online and **cloud gaming** require very short interaction times
- Social Media become more **interactive**



▶ 5G beyond smartphones

- Mobile networks as access point for home networks
- Office applications, **connected cars**, smart home
- **Private 5G networks**



PERFORMANCE SCORE STAYING CONSISTENT



TOWARDS 5G / 6G

P2P direct real-time connection

Telephony

- 2G/3G Call
- VoLTE Call
- WhatsApp (VoIP)

Video conferencing

*Real Applications
(Teams, Skype, Zoom,...)*

Focus on mobile-to-mobile

Receiving / sending media w/ motion, real-time

Streaming media

- YouTube Full HD
- YouTube 4K
- Facebook Watr

Cloud gaming

*Real games, interaction
(X-Box,...)*

Up- or download files

Messaging

- SMS/RCS messaging
- WhatsApp mess

Social media

- Browsing
- Facebook Posting
- Instagram Posting
- Twitter Posting
- Dropbox Up- / Download

File transfer

- HTTP file transfer
- FTP file transfer

Network performance on low layer

Data speed

- HTTP/TCP Capacity
- FTP Capacity
- UDP Capacity

Transport latency

- UDP latency / Interactivity
- HTTP/TCP latency

Transport continuity

- iPerf3

HOW TO EVALUATE E2E NETWORK PERFORMANCE

- ▶ **Covering relevant use cases**
 - Demanding the network as a user would do
- ▶ **Applying limits based on perceptual or physical limits**
 - To get a long-term stable method
- ▶ **Staying technology agnostic**
 - Perception is independent from technology
 - Real-field networks are multi-technology – one method for all
- ▶ **Preparation for 5G / 6G**
 - Increase interactive use cases
 - Extend to non-human users
- ▶ Inclusion of 'smart KPIs' based on **Machine Learning** and **Artificial Intelligence**

THANK YOU!

ROHDE & SCHWARZ

Make ideas real

