Large Scale Customer Experience Management

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Prelude

- Big Data — The Big Picture

- Customer Experience Management (CEM)

  - Quality of Experience (QoE)

- Spin-offs of CEM

Big Data — The Big Picture

▶ The Big Five

▶ The Big Plan
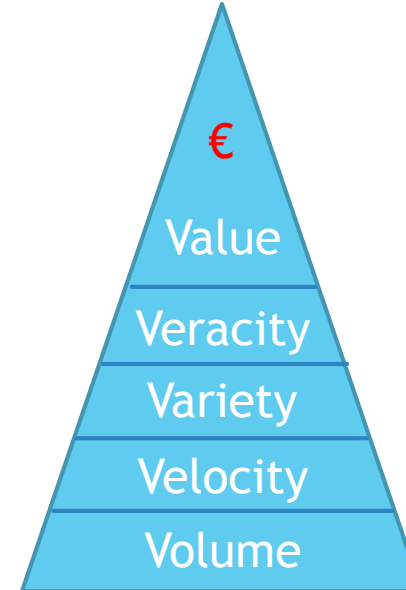
  ▶ Storage system

    ▶ Distributed and scalable: seek operations << data transfer

  ▶ Distributed vs Grid computing

    ▶ Co-locate data with the computing node: *MapReduce*

  ▶ Single view to query all data

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Value

Veracity

Variety

Velocity

Volume

The Big Fuss

DISTRIBUTIONS

On-Premise
- Cloudera
- Hortonworks
- MapR
- IBM

On-Cloud
- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform

Data Scientist
- Problem Formulation
- Algorithm Design
- Data Privacy
- Usually PhD.

Data Engineer
- Big Data Tools
- Architecture Design
- Deployment & Maint.
- Software Engineers

ROLES

The job of a <u>data</u> <u>scientist</u> is to get <u>business</u> <u>value</u> out of the raw data and the biggest value for a <u>cooperate</u> is to understand their <u>customers</u>.

Customer Experience Management (CEM) in Telecom Sector

- Customers buy service not the technology that delivers it: focus on the performance measurement of service we sell

- In telecommunication, performance is measured in terms of:

  - *Accessibility*: covers access to network resources, e.g., call set-up or data channel assignment

  - *Retainability*: covers ability to keep up resources, e.g., call drop

  - *Quality*: measures the quality (satisfied or not) of service, *QoE*

- Service-based performance indicators rather network-based

  - Aspects of service directly impacting end-user experience, i.e., throughput, latency, packet drop rate, etc.

Business Value

- QoE is the measure of customer (un)satisfaction

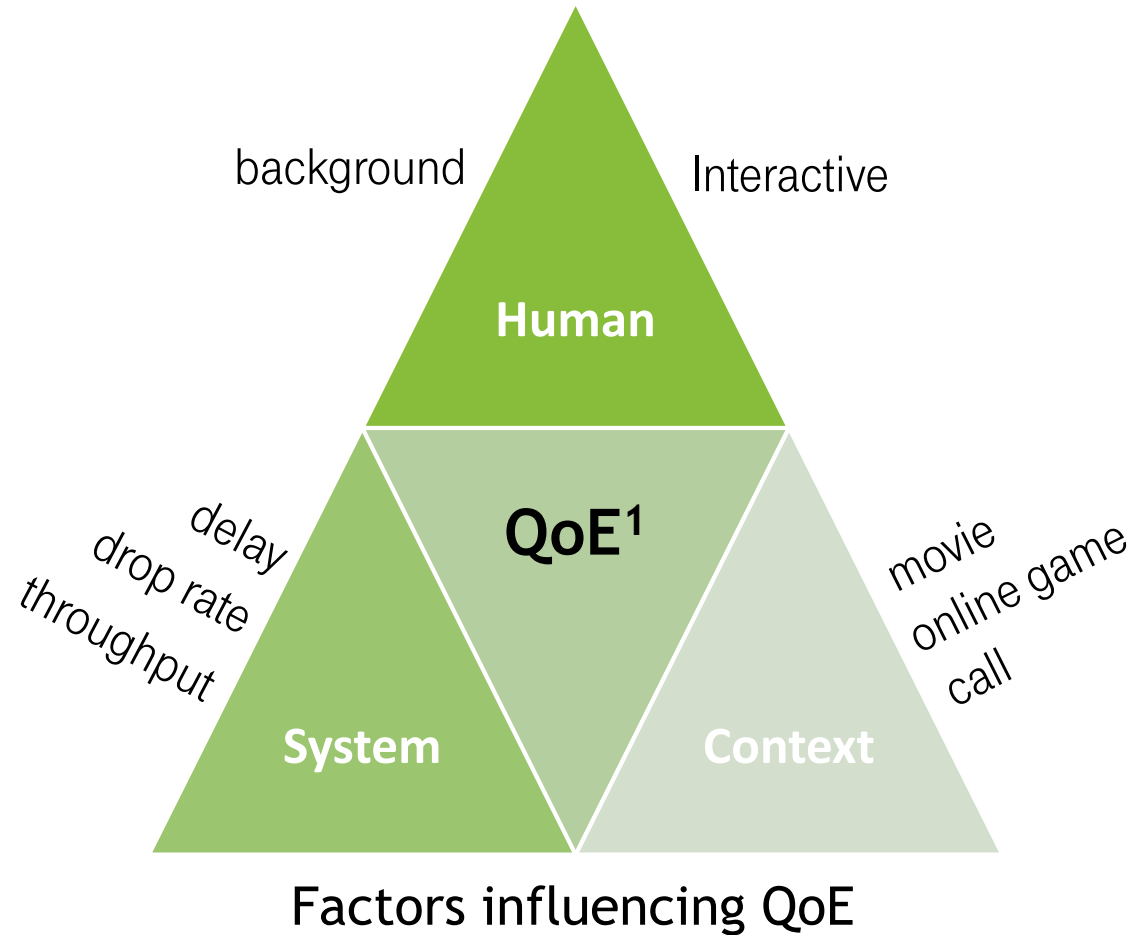 - Unhappy customers ➡️ churn

  - Churn ➡️ **decreased** revenue

  - Measure disappointment ➡️ ramification

    … ➡️ …

- "If you cannot define it, you cannot measure it"

                              [Touradj Ebrahimi]

Quality of Experience (QoE)

background   Interactive

Human

delay
drop rate
throughput

QoE^1

movie
online game
call

System   **Context**

Factors influencing QoE

[1] Patrick Le Callet, Sebastian Möller, and Andrew Perkis (eds). *Qualinet White Paper on Definitions of Quality of Experience (2012)*. Lausanne, Switzerland, June 2012.

Human Influence Factors [SME2012]

- Intangible and strongly interrelated with system and contextual factors [CMP2012].

  - High-Level Processing [Gol2009]

    - Cognitive processing to understand and interpret external stimuli. E.g., attention, mood, emotions, attitude — willingness to pay[SEZ2012]

    - Perception based on mood, motivation and time [Fri1994], expectation [SME2012], prior knowledge and skills [SPR2010]

  - Low-Level Processing [Jum2011]

    - Early sensory — characters that are closely related to external stimuli. E.g., in human visual system, visual sensitivity is the most important factor and several video and image compression algorithms are built on that [YXP2012]

Context Influence Factors [JV2010]

▶ The factors that embrace any situational property to describe the user's environment [CMP2012]

  ▶ Physical Context

    ▶ Location, space, mobility; outdoor, indoor, personal, professional; sensed environmental attributes, e.g., peaceful vs. noisy, light and temperature; movement, e.g., sitting, standing, walking or jogging [WKC2007]

  ▶ Temporal Context

    ▶ Time of day, day of week, week of month, seasons. Frequency of usage [BRS2013]

  ▶ Social [RSG2011], Economical [CF2010], Task [P1999] and Technical Context

System Influence Factors

- Technically produced quality versus perceptual quality

    - Content-Related

        - Auditory traffic: bandwidth and latency which also varies between voice and music

        - Video: amount of detail and motion in the scene and for 3D viewing comfort [CFB2013]

    - Media-Related

        - Refers to media related configuration factors i.e., encoding, sampling, resolution, frame rate, media synchronization [JMK2012]. Lossy vs. Lossless compression; H.264. Audio voice compression; telephone codecs (G.711,G.729) [ITU2010]. Audio media codecs MP3, AC-3 and Vorbis. Media synchronization for movies [ITUBT.1359]
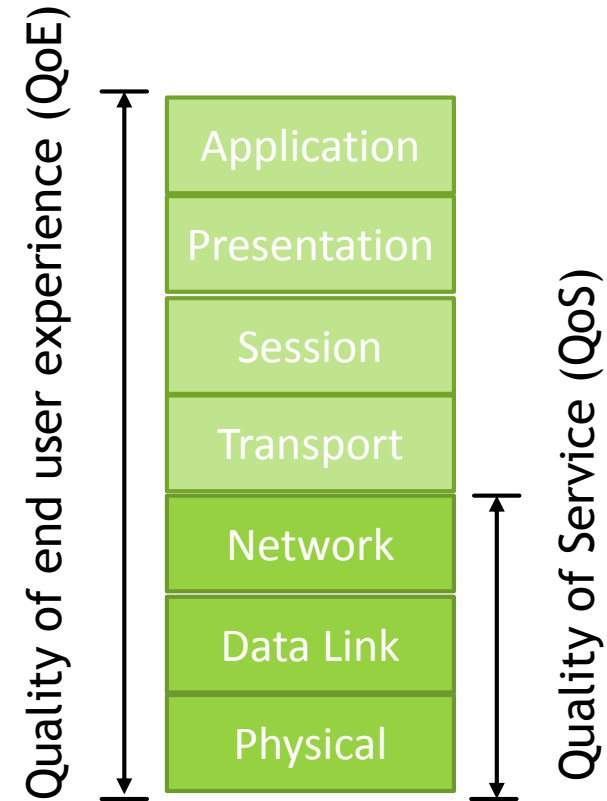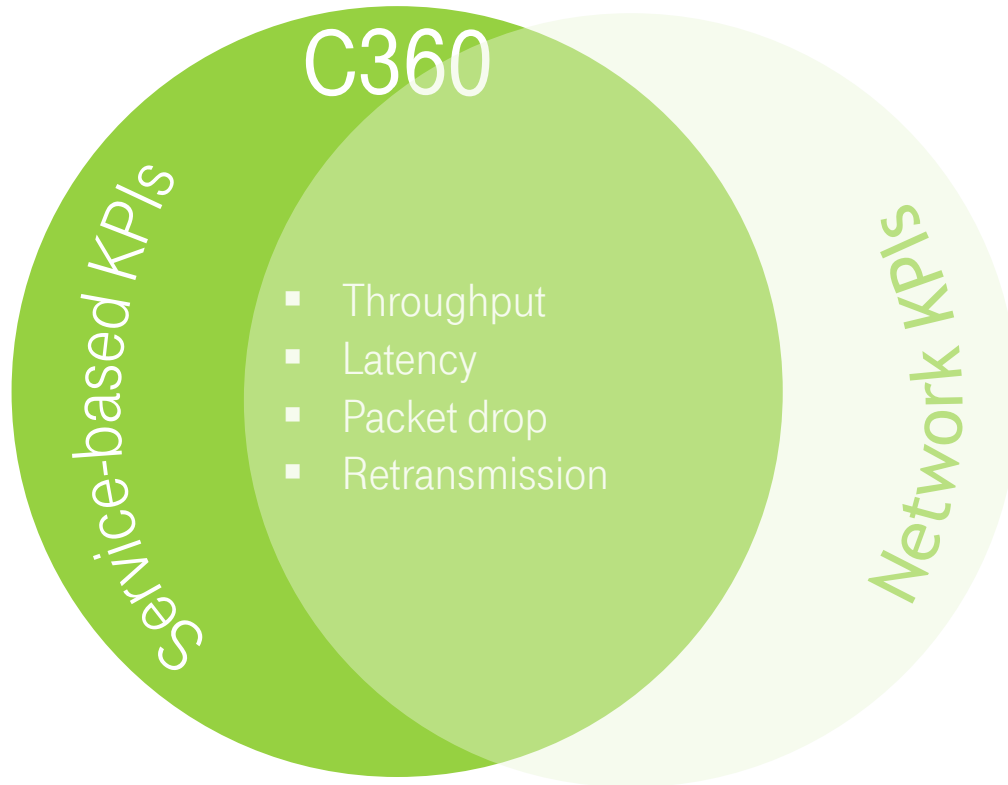
System Influence Factors

- Network-Related

  - Main factors are bandwidth, delay, jitter, packet loss, error rate and throughput [FHT2010]. Also defines Quality of Service (QoS) of a network.

  - TCP based traffic most severe error is latency [ITU2010] and for UDP and RTP its packet loss [BSP2010] but changes completely for OTT services like Youtube [TGG2013]

- Device-Related

  - Display; scaling, rendering and dynamic capabilities of the screen for producing motion [Klo2006], HD and 3D videos demand very high throughput [CFB2013]
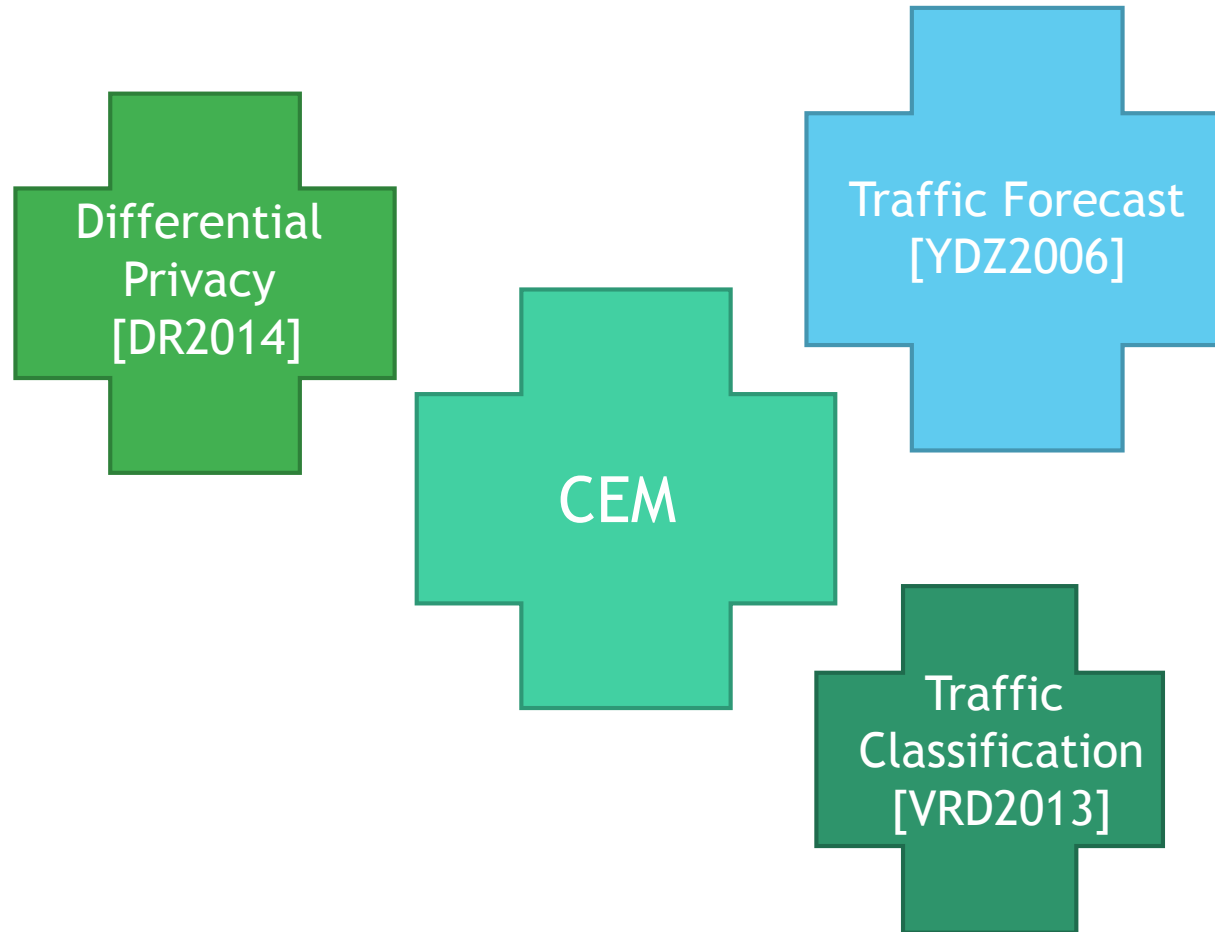
QoE is not QoS

C360

Service-based KPIs

Network KPIs

- Throughput
- Latency
- Packet drop
- Retransmission

Quality of end user experience (QoE)

Quality of Service (QoS)

| Application |
| Presentation |
| Session |
| Transport |
| Network |
| Data Link |
| Physical |

OSI 7 Layer Model

- Fiedler M, Hossfield T, Tran.Gia P. IEEE Netw. 2010.

CEM Spin-offs

Differential Privacy [DR2014]

CEM

Traffic Forecast [YDZ2006]

Traffic Classification [VRD2013]

Thanks for your attention!

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