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Applying Quality-of-Service Parametrization for Medium-to-medium Conversion

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Mobility and service integration characterize the merging worlds of multimedia telecommunication and computing. The mobile user, who becomes suddenly reachable everywhere by means of mobile communication services, needs control over who may reach him in a specific situation. On the other hand, he may want to employ an available or carried device for handling more aspects of communication than the device was primarily designed to. For the consistency of communication the integration of different services would be desirable and could be combined with maximum flexibility of the devices used for access. E.g., speech services are of particular interest because the terminal type 'telephone' can be expected anywhere on this planet. [1]

The vision for future communication environments is to deliver ***"information any time, any place, in any form"***, based on the idea of an open "electronic" market of services, where an unlimited spectrum of communication and information services will be offered at different qualities and costs by different service providers. This service spectrum ranges from simple communication services up to complex distributed applications. For these reasons, a TMN-based Personal Communication Support System (PCSS) is being prototyped by the Deutsche Telekom [2], which supports user mobility, service customization and service integration to an open set of communication services within Customer Premises Networks.

Embedded in this project is research on fulfilling the third part of the motto, to deliver information in any form. This requires to **convert** certain communication **media into another** medium or at least into another format of the same medium, leading to a support of a higher flexibility of terminal devices as well as service integration. Such conversions are currently done in stand-alone products, e.g. performing Optical Character Recognition (OCR), Text-to-Speech conversion (TTS), speech recognition, image content recognition, etc. In a personalized communication environment, lots of different conversions must be possible, qualified by unified interfaces and capable of arbitrary combination.

Providing these services in an integrated framework with possible **concatenation** of various conversions (e.g. telefax -> bitmap conversion -> OCR -> text format conversion -> TTS -> audio format conversion) leads to the problem of **evaluating the quality** of the outcome, not only regarding its intelligibility, but also such merits as delay and cost, because the user (or his automated agents) wants to chose a path of conversions tailored to his needs.

The range of possible conversions varies tremendously in effort, cost and required resources. Some kinds are simple to implement with two lines of C code without any patent or license requirements, while others are highly complex and require sophisticated solutions that might be available only as commercial products. Some conversions are purely algorithmic, while other require approaches of artificial intelligence, or require pipelined processes of decoding, editing, and re-encoding. Consequently, the error rate ranges from lossless format conversions to error-prone speech recognition.

This submission will compare the established concept of **Quality-of-Service** (QoS) in network environments with the requirements of evaluating media conversions. It presents a matrix of specific QoS-Parameters suiting this context. It derives rules for calculating each of them, achieving a final set of parameters for a certain combination of conversions.

After various conversion paths have been made comparable, the one which is most appropriate to the actual needs of the user and the resources available to him can finally be chosen.

[1] Eckardt, T.; Magedanz, T.; Pfeifer, T.: On the Convergence of Distributed Computing and Telecommunications in the Filed of Personal Communications. - in Proc. of KIVS'95, Franke, K. et al. (Ed.): Kommunikation in Verteilten Systemen, Springer: Feb. 1995, Chemnitz, Germany, pp. 46-60, ISBN: 3-540-58960-0

[2] T. Magedanz; T. Eckardt: The Role of Personal Communications in Distributed Computing Environments. - in: Yau, S.; Urban, J. (eds.) Proc. of the 2nd IEEE International Symposium on Autonomous Decentralized Systems (ISADS 95), 25. - 27. April 1995, IEEE Computer Society Press: Los Alamitos, California (USA), pp. 316 - 322, ISBN: 0-8186-7087-8

Call handling

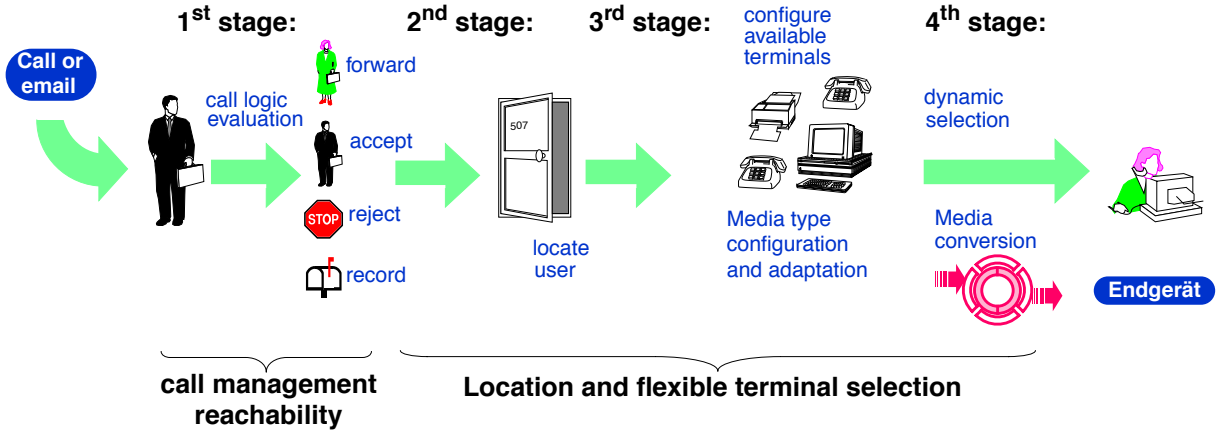


FIGURE 1 Personal Communication Support System (PCSS)

Possible media conversions

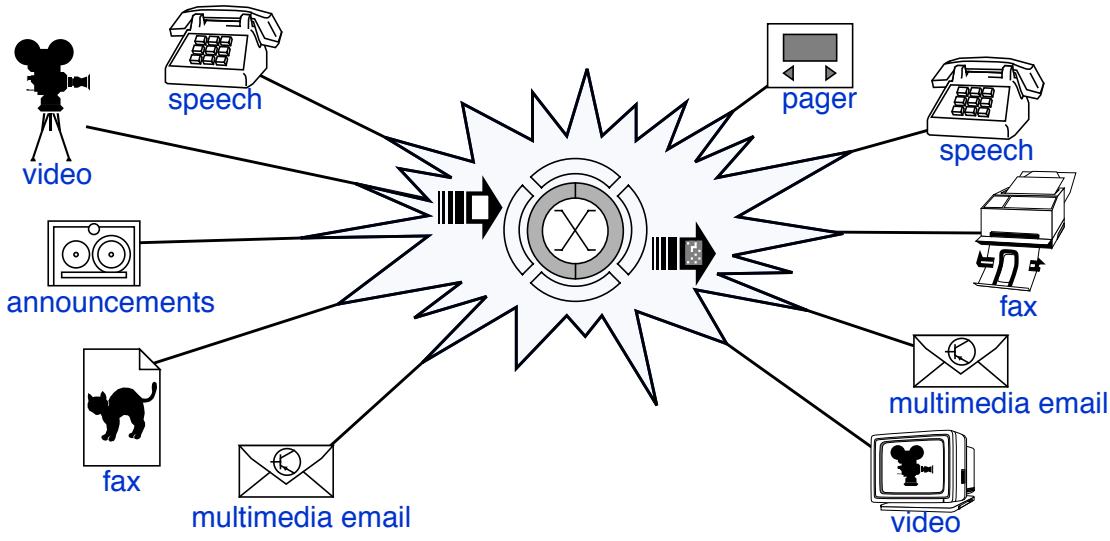


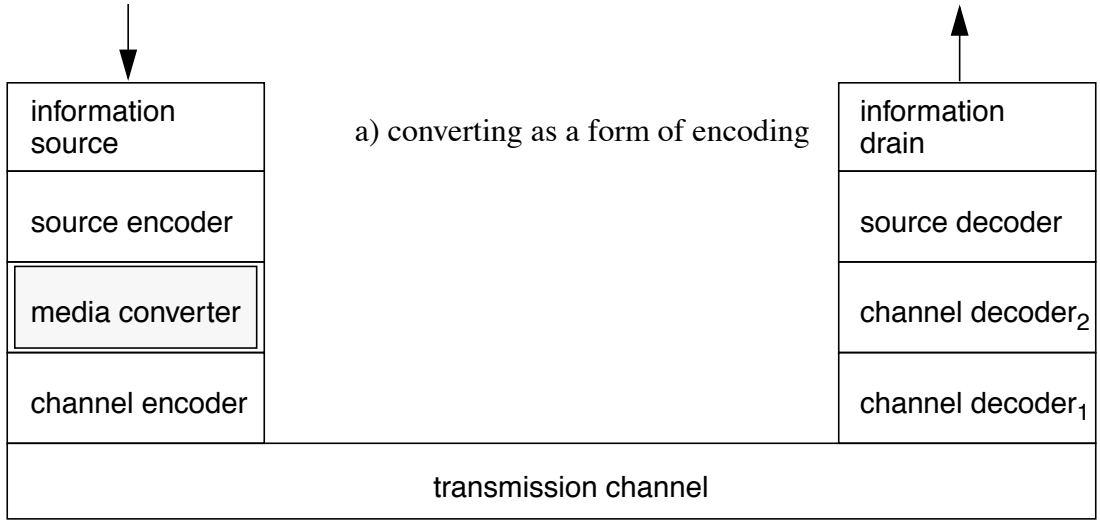
FIGURE 2 Prioritized implementations for media conversion in the PCSS

FIGURE 3 Media converter system

Definition:

Media converter = system entity

- input is information I_1 with the semantic S_1, carried by a specific medium M_1, using a specific form (or format) F_1.
- output information I_2 in another Medium M_2 in format F_2, carrying a semantic S_2



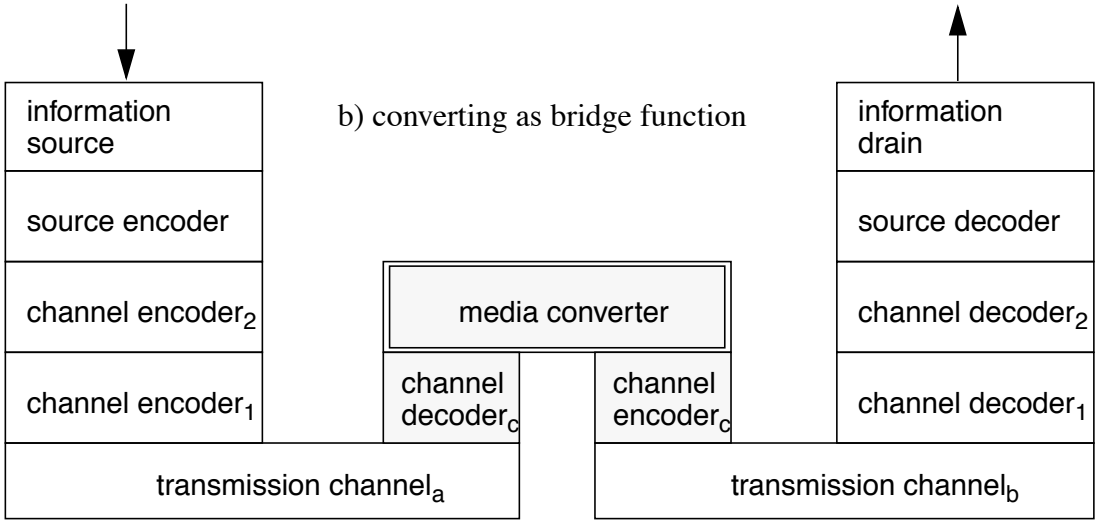


FIGURE 4 Modelling information transmission and media conversion

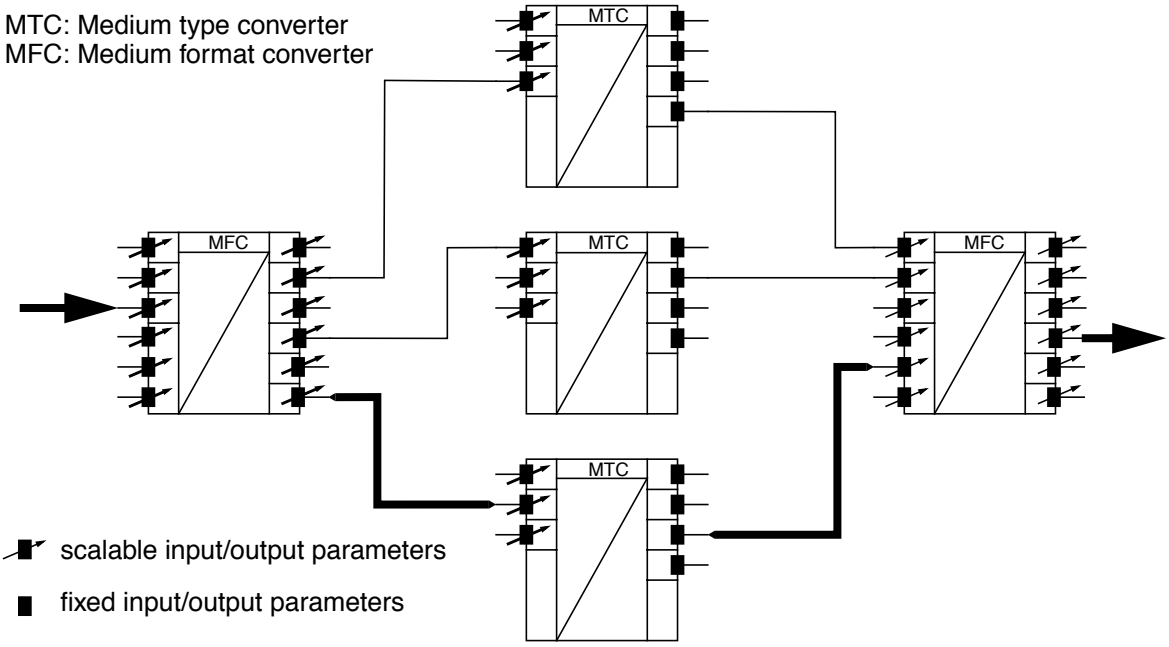


FIGURE 5 Medium type conversion with format adaptation

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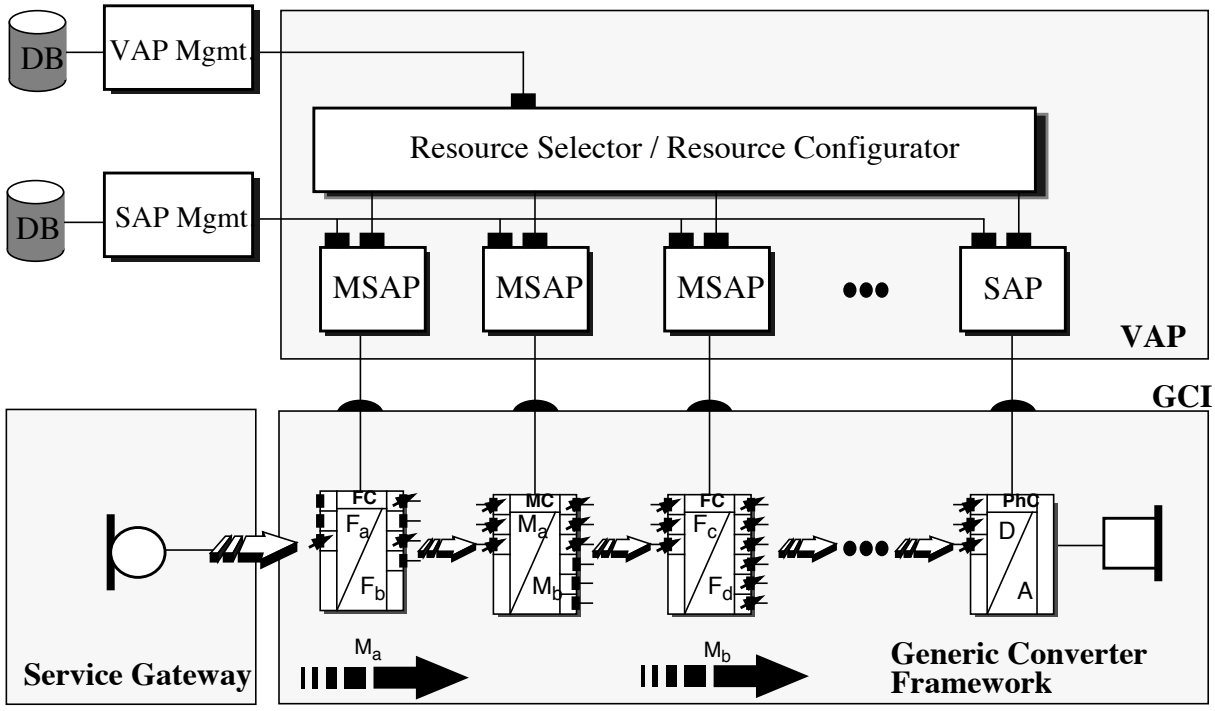

FC Format converter F_i Format i VAP Virtual Access Point
MC Medium converter M_i Medium i SAP Service Access Point
GCI Generic Converter Interface MSAP Mediator SAP

FIGURE 6 Dynamic Interworking of Converter Elements

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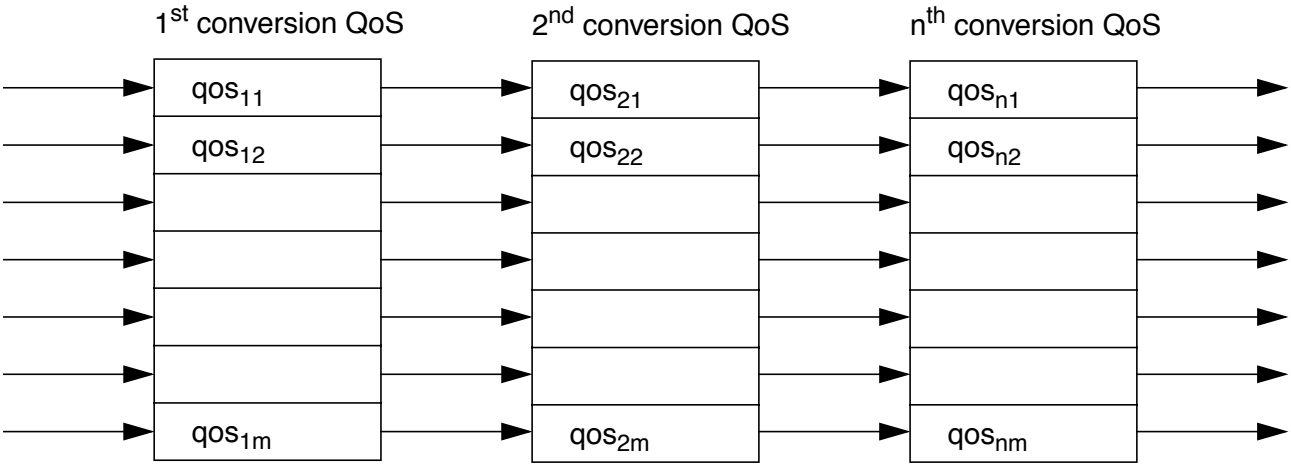

FIGURE 7 Propagation of QoS-parameters in concatenated conversions

Quality-of-Service definition

- Delay
- data volume and data rate
- Intelligibility
- Error probability
- Computational resources
- Cost (respecting tariffs)
- Quality degradation due to lossy compression/decompression
- Quality degradation due to entropy reduction (colour reduction, quantification)

--> Media dependence of QoS parameters
--> different combinations of parameters for different situations

Quality-of-Service evaluation

- dedicated model for concatenation of each class of parameters
- adding of delays
- more sophisticated calculation for quality and intellegibility degradation
- e.g.: evaluation of the sum of squared differences

Strategies

- algorithmic approach --> problem: complexity of different parameters
- hard limits for specific parameters (e.g. cost, delay)
- fuzzy logic evaluation