A critical survey of protocols proposed by the IETF as enablers for customer interaction in an electronic customer relationship management system -- Part I - eCRM metrics

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Abstract

A modern enterprise needs to interact with customers anytime, anyhow and anywhere to be successful in the global marketplace. This level of customer interaction has become possible due to the advancements in network infrastructure and the simultaneous development of voice and multimedia protocols for seamless transport of information. Instant and unified messaging extends this capability to enable customer touch point integration. This paper provides a critical analysis of the metrics of an effective electronic customer relationship management (eCRM) customer interaction system from customer, business and technology viewpoints. Based on this analysis, Part II of this paper will review the features and the services offered by some of the protocols as proposed by the Internet Engineering Task Force (IETF) with respect to their effectiveness in enabling customer interaction, and derive an IETF based protocol suite that may be used in an eCRM system.

Sommaire

Une entreprise moderne doit interagir avec les clients à tout moment et à tout endroit afin de réussir dans le marché global. Ce niveau d'interaction avec les clients est rendu possible grâce aux avancées dans les infrastructures des réseaux et dans le développement simultané de protocoles pour la voix et le multimédia afin de transporter sans soucis l'information. La messagerie instantanée et unifiée étend cette capacité à rejoindre le client. Cet article présente une analyse critique des éléments d'un système efficace de gestion des relations avec les clients (eCRM) sous l'angle de vue client, affaire et technologique. Basée sur cette analyse, la seconde partie de cet article va revoir les caractéristiques et les services offerts par certains des protocoles offerts par l'Internet Engineering Task Force (IETF) et particulièrement les caractéristiques qui sont en rapport avec l'efficacité et déterminer une suite de protocoles basée sur un protocole de l'IETF et qui pourrait être utilisée pour un système de type eCRM.

1.0 Introduction

Today most e-businesses implement eCRM by using human-computer interaction and thereby reduce the need for human intermediaries [1]. CRM entails four phases:

- Customer interaction,
- Data analysis and mining,
- Knowledge discovery, and
- Market planning [2].

Electronic customer interaction involves encouraging the customer to spend time electronically in order to obtain sufficient information regarding the customers needs, preferences and requirements. This information is analyzed using a process such as data mining to extract knowledge about customer values. Customer values are, in turn, used as the guiding principle in the market-planning phase to customize and personalize the services/goods/sales offered by the enterprise. An integrated approach to eCRM is important because it can be effectively used to analyze information for continuous, online and real-time learning of customer values. This paper focuses primarily on key technology issues and, to a lesser extent, on business and customer centric issues. We first identify what factors (metrics) are valuable in an eCRM system from the point of view of the various stakeholders and associate a priority level (critical, important, and desirable) with each metric. As shown in Figure 1, the three stakeholders typically identified in an eCRM framework are the customer, the business enterprise and the provider of technology [2].

Section 2 of this paper, discusses customer interaction requirements in an eCRM system. Section 3 identifies the metrics first from a customer centric perspective that may be used to evaluate what a customer expects when interacting with a voice/multimedia enabled eCRM system. Section 3.2 identifies the key metrics an enterprise may wish to evaluate before adopting or integrating a given protocol or technology with existing legacy eCRM systems. This will help an enterprise decide what technology is relevant to it and how much of it? It will also help an enterprise understand what is the potential of a particular technology or protocol. Section 3.3 identifies a series of requirements (metrics) from a technology perspective that would enable eCRM and how each requirement may influence its adoption by an enterprise for effective interaction with the customer. Section 4 has a critical analysis of the metrics from the three stakeholders perspective and categorizes them into mutually exhaustive, mutually exclusive and non-overlapping requirements. Based on these metrics, Part II of this paper will review

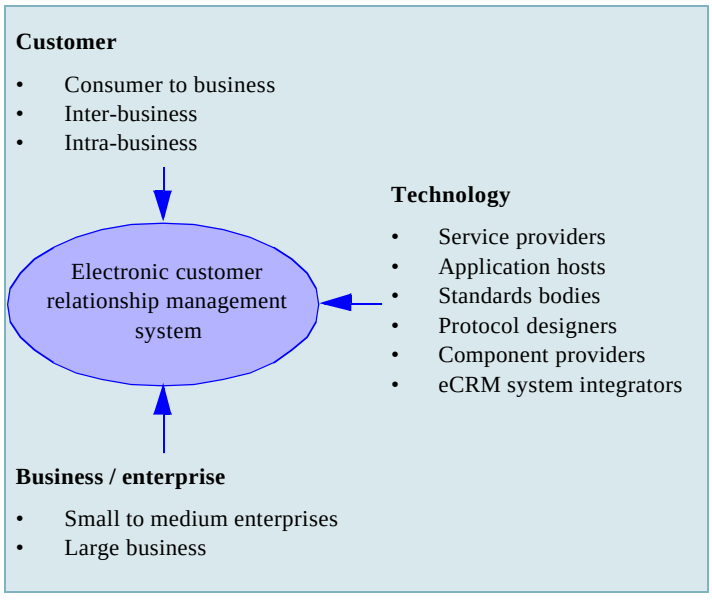

Figure 1: Stakeholders in an electronic CRM system

the features and the services offered by some of the protocols as proposed by the Internet Engineering Task Force (IETF) with respect to their effectiveness in enabling customer interaction, and derives an IETF based protocol suite that may be used in an eCRM system [8].

2.0 Customer interaction requirements in an eCRM system

Good CRM must begin with effective, real-time, reliable and secure customer interaction. All other steps in the eCRM process rely on this most important first customer interaction phase. Customer interaction is said to be successful if it is two-way, integrated, recorded and managed [2]. Customer interaction is integrated when it is coordinated across all customer touch points which include email, voice mail, public switched telephone network (PSTN), website and fax. This may be implemented using an integrated communications system and needs to be in real-time to be effective. Call centres with automatic call routing capabilities are an additional asset in routing a call from a customer to an appropriate representative within the least possible time [3]. Management of the two-way interaction involves customizing and personalizing of the interaction and the associated communication channel. Tailoring the response to the requirement of various customer segments can customize the interaction. The interaction can be personalized further by tailoring the system response to the needs of a particular customer, thereby enabling one-one relationships. The communication channel can be personalized by specifying caller preferences and by ascertaining callee capabilities. Doing this would have benefits in terms of assuring quality of service (QoS) or alternately, on a best effort basis, in allocating network resources for the call and ensuring real (near real) time delivery (receipt) of information to (from) the customer.

3.0 Analysis through metrics

With the e-business eCRM requirements for ensuring successful customer interaction in mind, proposed in the following sections are a number of metrics that a customer may use to evaluate the responsiveness of an eCRM system. The enterprise or business may use the customer centric metrics to measure the effectiveness of the system for first time customer interaction and to encourage repeat interaction with the system. The customer centric metrics for evaluating the responsiveness of an eCRM system form the basis for deriving the business centric metrics for adopting a particular protocol or technology. The technology centric metrics can be broadly classified into protocol and architecture, infrastructure, engineering and service metrics.

3.1 Customer centric metrics for measuring the performance of an eCRM system

The most important measure that a customer will use for repeat interaction with an eCRM system of an enterprise is the ease of using such a system. Customers are also concerned with privacy issues when they are asked to reveal information, sensitive or otherwise. Reassuring a customer about the nature of the information being collected, why it is being collected and how it may be used is very important. It is also advisable to assure the customer regarding the security measures such as, authentication, encryption, authorization and other measures that are in place to ensure the customer's right to privacy. It is important that the communication channel characteristics, protocol and technology are designed for real time applications. Whatever may be the nature of technology and protocols used in the eCRM system, they must be transparent to the customer i.e., the customer need not have any knowledge regarding the capabilities and technical characteristics of the various components of the system. Also, the eCRM system must be capable of integrating multiple customer touch points such as email, fax, or telephone. If the customer cannot obtain a satisfactory response from the eCRM system, it must be possible for the customer to locate automatically an appropriate customer service representative in a reasonable period of time. Given below are the customer centric metrics that can be used in designing an eCRM system and their associated priority level to the customer.

- **Ease, convenience and availability**
  - Contact the enterprise at anytime - critical
  - Ease of use - critical
  - Speed of transaction and real-time/near real-time perception – important
  - Customer touch point integration – important
  - Accessibility through wireless communication devices - important
  - Ease in locating a customer representative – desirable
  - Customer friendly technology - desirable
- **Guaranteed privacy - Critical**
  - Secure communication - critical
  - Prevention of security threats - critical
- **Other features**
  - Customizing the communication channel - Desirable
    - Capability in specifying user/caller preferences
    - Interrogating the system to obtain callee capabilities
  - Collating information - Desirable
- **Annoyance factors that need to be eliminated/reduced**
  - Non-real time perception in voice communication

Table 1: Impact of customer centric metrics on business centric objectives.

Customer Centric Metric	Interaction	Gather information (I) and formulate knowledge (K)	Customizing responses	Personalized responses
Convenience	Critical			
Ease of use	Critical			
Privacy and security	Critical	Critical (I)	Critical	
Real time perception	Important	Critical (I)	Critical	Critical
Customer touch point integration	Important	Critical (I)		Critical
Integrated communication	Important		Critical	
Automatic call routing	Desirable			Critical
Friendly technology	Desirable			Critical
Customize communication channel	Desirable		Critical	
Collate information	Desirable	Critical (K)		Critical

- Intrusiveness
- Repetition of information gathered from the customer by the system
- Lack of human interaction
- Excessive hold times – especially excessive delays in obtaining information from the system

This approach will be used in deriving the business centric metrics used for adopting an effective eCRM system.

3.2 Business centric metrics for adopting a performance effective eCRM system

Figure 2 shows the key business centric objectives required to attract, retain and increase customers.

Table 1 summarizes the relative importance of customer centric metrics in relation to business. From the customer viewpoint, convenience of communicating with the enterprise is critical and must be available all the time. The ease in using an eCRM system is a function of system design and is determined by several factors such as its accessibility, reliability of system, help available on line, whether it implements integrating customer touch points, the number of simultaneous users that the system can support, the responsiveness of the system and the appropriateness of system response to queries. Secure communication i.e., prevention of security threats such as stalking, spoofing and spamming is essential to addressing the security and privacy concerns of the customer. In addition, the communication itself may be encrypted to ensure secrecy. Real-time perception on the part of the customer is directly related to the bandwidth of the communication channel, system latency, delays related with Internet traffic, packetization, and access [4]. System latency is associated with the various technologies employed such as codecs (coder/decoder), echo canceller (in voice transmission), transforming voice, fax, and video at both customer and enterprise ends. Delays are related to packetization before transmission and buffer, modem processing at the customer end. In addition, there is internet delay associated with the internetwork infrastructure such as ISPs or PSTN that is used in communications with the customer. Access delay is encountered at various servers, gateways and access points in the enterprise, and the PC processor and OS architectures employed at the enterprise and customer ends.

Customer touch point integration involves integrating communication across service providers (PSTN, ISP), across devices (computer, fax, phone) and across services (email, voice mail, instant messaging). Towards integrated communication, mobile commerce is an issue most enterprises will have to address in their evolution from purely click and mortar enterprises to ones that also support interaction with mobile customers. An issue to be addressed in the adoption of a protocol or technology is whether the same protocol/ technology can be adopted/ adapted in a mobile scenario. Thus, from a business perspective, an enterprise needs to balance the conflicting metric of finding a cost effective eCRM solution with customer satisfaction. Availability of off-the-shelf components is a prerequisite to lowering the cost of the eCRM system, as the enterprise need not bear the expenses of development. Also, a protocol or technology must be developed with backward compatibility in mind i.e., it is operable with existing legacy systems such as existing fax, voice, phone and email systems. Customer service representatives must have an understanding of the various components of the

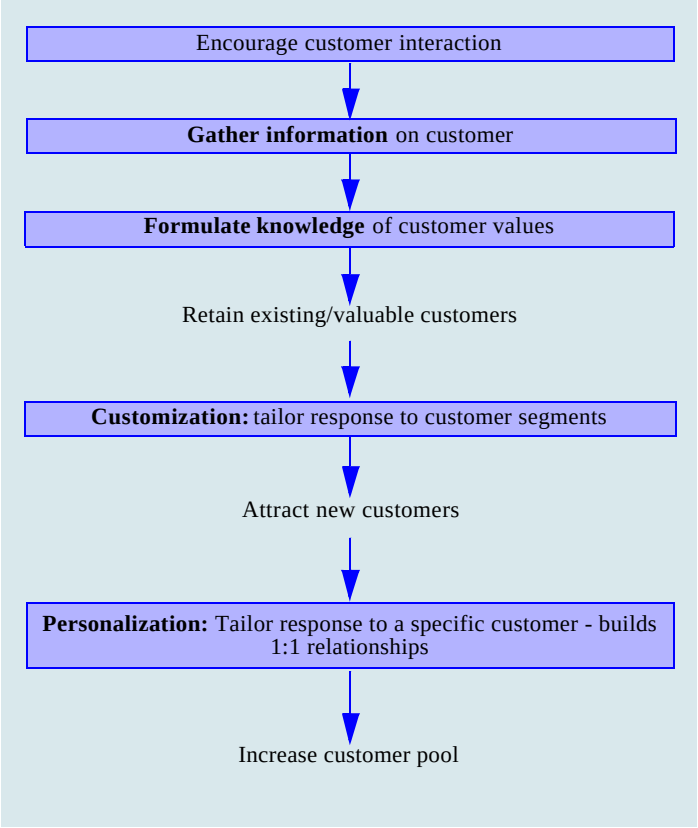

Figure 2: Business centric-objectives in attracting, retaining and increasing customers

Table 2: Mutually exhaustive eCRM metrics from the stakeholders perspective

Customer centric	Business centric	Technology centric
Contact enterprise at any time, and easy to use	High accessibility, reliable operation and support for multiple users	Protocols that initiate and maintain multi-media communication over IP or over legacy PSTN. The communication may be in real-time or may be non-real time integrated (PSTN or internet based) messaging.
Real time perception - Speed of transaction	eCRM system responsiveness: • delay and latency • QoS, bandwidth	Protocols must address packetization delay. eCRM architecture (servers, gateways, access points) introduce processing delay. System latency is associated with technology employed (e.g., A-D converters). Enterprise network architecture and protocols used must support QoS.
Can reach enterprise through • any service • any device	Customer touch point integration Integrate wireline and wireless devices	Integrate legacy PSTN services with Internet based services, ensure interoperability of heterogeneous mail and messaging systems (such as voice mail, email, video), Integrated instant messaging. Extensibility of wireline protocols and service models to wireless protocols/services.
Privacy • Sensitive • Non sensitive	Security – prevent security threats Encryption of communication and protect customers privacy	Prevent stalking, spamming and spoofing, Support authentication, authorization, non-repudiation and encryption standards.
Ease in locating customer service representative	Automatic call routing	Integrate web based and phone based access systems.

Table 3: Mutually exclusive eCRM metrics from the stakeholders perspective

Customer centric	Business centric	Technology centric
	Low cost of broadband infrastructure	High bandwidth
Fast, appropriate response	Low overall processing time for eCRM system	

eCRM system, their capabilities and deficiencies for a better appreciation of the role of the eCRM system in the enterprise. This will help towards achieving better employee acceptance of the new technology.

Summarized below are the various business centric metrics in order of importance in assessing the effectiveness of an eCRM system.

- **eCRM system design metrics**
  - High accessibility - Critical
  - Reliable operation - Critical
  - Mobility issues - i.e., adoptability/adaptability of the protocols/technology in a mobile scenario. - Desirable
  - Tutoring customers to technology requirements of the eCRM system with appropriate help menus - Important
  - Simultaneous servicing of multiple customers - Critical
- **Responsiveness of the system**
  - Delay and latency issues - Critical
  - Quality of service - Important
  - Bandwidth requirement - Important
- **Security and privacy**
  - Encryption of communication - Critical
  - Prevention of security threats i.e., stalking, spoofing, and spamming - Critical
- **Cost reduction - Critical**
  - Availability of off the shelf equipment/components/protocols that can interoperate and work together - Important
  - Interoperability with existing legacy systems - Important
- **Employee acceptance - Important**

3.3 Technology centric metrics that enable an effective eCRM system

Technology centric requirements can be broadly classified into the following classes, protocol and architecture, infrastructure, engineering and service [5,6]. The protocols deal with the rules for the implementation of orderly multi-media communication within the eCRM system. The architectural viewpoint describes the functions needed of the various logical modules that together implement the features of each protocol, communication channel and interactions between the various modules. The infrastructure or technology deals with the hardware/firmware components with which the eCRM system is designed, including protocol stacks, implementation languages, operation systems and physical equipment. Service requirements deal with the functional requirements expected or offered by the various logical modules in the eCRM system.

3.3.1. Protocol and architecture metrics:

Protocol and architecture metrics encompass interoperability, latency, wireline vs. wireless, security features, QoS provisioning, and packet delay. The standards bodies such as ITU and the IETF workgroups propose their own versions of protocols for achieving similar goals. For example, signalling and managing multimedia communication sessions can be achieved either by adopting the H.323 protocol as proposed by the ITU or SIP proposed by the IETF [4]. A key issue is then, whether equipment that conforms to one standard can interoperate with equipment conforming to the other standard. In addition, the latency associated with a protocol is implementation-dependent i.e., various implementations by different vendors of the same protocol may have varying latency associated with them. Typically, protocols are designed either for use on wired media or wireless media. This is an issue when an enterprise may wish to migrate from supporting wired eCRM to an integrated system supporting both wired and wireless communication. Various protocols address security issues to varying extents. Security issues include whether authentication and non-repudiation is required, when to use authorization, and what encryption standard is used. Protocol extensibility is an important issue in that a client (enterprise or service provider) may propose extensions to the protocol for provisioning custom services.

Architecture metrics deal with the functionality of the various components of the eCRM system, and modularity. The architecture must address the issue whether different components can be added in a modular fashion to achieve a new functionality. A protocol is typically associated with its own architecture. The architecture is typically implemented as a set of logical modules or entities, with a specific functionality associated with each module. The protocol can then be implemented by combining the functions of one or more logical entities into the same box. This approach has advantages in that additional functionality can be added by incorporating new logical entities where the functionality of each entity is clearly defined. Features such as security and QoS provisioning can now be addressed in a modular framework with an entity assigned the task of ensuring security levels and provisioning QoS before communication is established [7].

3.3.2. Infrastructure metrics – enterprise:

The infrastructure metrics that an enterprise must concern itself with when implementing an eCRM system include core network technology, the QoS model, and the interoperability of the eCRM infrastructure with existing legacy systems. The choice of core network technology and its architecture impacts bandwidth utilization, and hence, the latency and delay experienced by the customer. The IETF QoS framework may be broadly classified into two classes, an integrated service (*intserv*) model

Table 4: Non-overlapping metrics from the stakeholders perspective

Customer centric	Business centric	Technology centric
Transparency – the customer is (may) not (be) interested in the details of the technology/ protocols	Tutor customers on how to use the eCRM system effectively	
	Employee acceptance of eCRM system	Ease in incorporating additional functionality
		Provision to tailor services to the needs of the enterprise

and a differentiated (*diffserv*) model [7]. The *intserv* model is based on the premise that resources such as bandwidth and buffer allocation are managed for each real time application. It also provides a guaranteed service, a best effort service or an enhanced best-effort service end-to-end. On the other hand, the *diffserv* service is based on requesting a specific performance level for each packet on a per hop basis. The *diffserv* model can be either quantitative, in which the performance of parameters such as throughput, delay, jitter and packet loss is specified in deterministic or statistically quantitative, or priority based, in which the each packet has a priority assigned to it in accessing a given service.

3.3.3.System Integration metrics:

eCRM system integration must meet metrics such as, the interoperability of various subsystems from different vendors, and the conversion of heterogeneous messages such as video, voice, text, email etc. into standard formats to support unified messaging. Also, the eCRM system must be implemented with minimal duplication and must support number portability specifically, service and service provider portability.

3.3.4.Engineering and Service metrics:

Engineering metrics include the use of codecs (coder/decoder) and echo cancellers for voice conversion before transmission and may include speech to text conversion for storing customer interaction data to be used for data mining and possible knowledge discovery purposes. The issue of backward compatibility, i.e., the question whether devices designed for the current environment can inter-operate consistently with legacy systems must be addressed. Service providers that support an eCRM system are concerned with issues such as: extensibility of service model to provide custom (tailored) services to the enterprise. In addition, when an enterprise makes use of an Internet service provider to reach a customer, service level agreements must be set up between the ISP and the enterprise to ensure QoS.

4.0 Analysis of eCRM metrics

We can view the metrics from the customer-centric, business centric and technology-centric viewpoints as belonging to one of the following categories: mutually exhaustive, mutually exclusive and non-overlapping. Mutually exhaustive metrics reinforce each other across stakeholders in the eCRM system, while mutually exclusive metrics are critical for some stakeholders and are non-beneficial or annoying to other stakeholders. Non-overlapping metrics are essential for some stakeholders and do not impose any restrictions on the other stakeholders. Tables 2, 3 and 4 list the mutually exhaustive, mutually exclusive and non-overlapping metrics for the three stakeholders of an eCRM system. An effective customer interaction eCRM system design should be aimed at maximizing the mutually exhaustive metrics, minimizing the effects of mutually exclusive metrics and optimizing the overlapping metrics within cost objectives.

5.0 Conclusion

This paper analysed the requirements for customer interaction in an eCRM system and has proposed a set of metrics from the customer, business and technology perspective. It is seen that eCRM customer interaction metrics from these three stakeholder viewpoints can be categorized as mutually exhaustive, mutually exclusive and non-overlapping requirements. An eCRM system design should aim at maximizing the mutually exhaustive requirements, minimizing the effects of mutually exclusive requirements and optimizing the non-overlapping requirement within cost objectives to enable effective electronic customer interaction. Part II of this paper reviews the features and the services offered by some of the protocols as proposed by the Internet Engineering Task Force (IETF) with respect to their effectiveness in enabling customer interaction, and derives an IETF based protocol suite that may be used in an eCRM system [8].

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7.0 List of abbreviations used in the paper

eCRM	- electronic Customer Relationship Management
IETF	- Internet Engineering Task Force
ISP	- Internet Service Provider
ITU	- International Telecommunication Union
PSTN	- Public Switched Telephone Network
QoS	- Quality of Service
SIP	- Session Initiation Protocol
TINA	- Telecommunications Information Networking Architecture Consortium

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