The IMS Policy Function and PCRF

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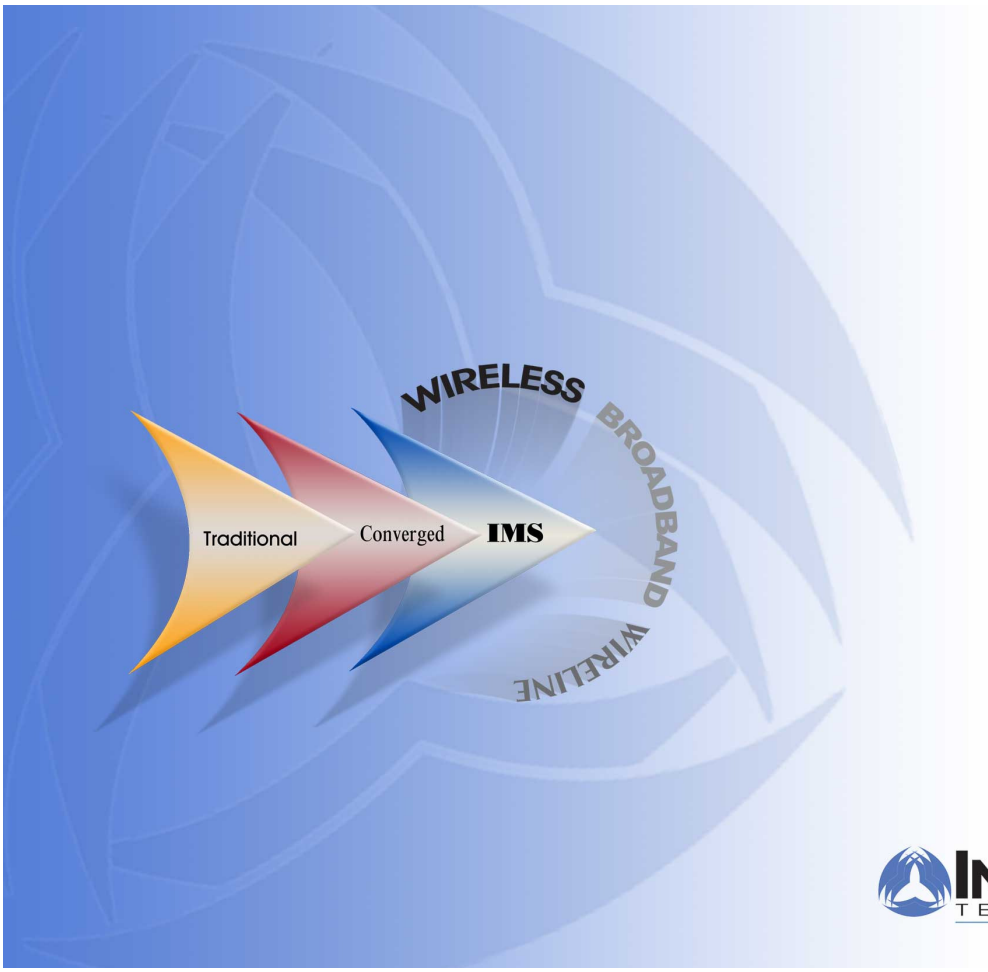
October 2006



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Introduction

IP-Multimedia Subsystem (IMS) networks promise complex user scenarios where one can access multiple applications in a single session from any location and across different access technologies. The policy function is the key to making this functionality possible and is directly responsible for the QoS perceived by the consumer. The policy function has been evolving along with the network architecture. A relatively new term in the network alphabet soup is PCRF. PCRF is variably referred to as Policy Control and Charging Rules Function, Policy and Charging Rules Function or simply Policy Charging Rules Function. The PCRF is included in 3GPP-IMS Release 7. This paper will serve to explain what the policy function does in an IMS network and how it does it. It will also introduce the latest policy evolution, the PCRF.

Background

In next generation networks, the service plane (also called the control plane) and the transport (or bearer plane) are logically independent. The service plane transfers service information and manages service resources, while the transport plane delivers IP packets and manages transport services. By separating these two planes, each plane can be developed separately allowing a plethora of new services, including the blending of those services, which will be available to the consumer through a number of access technologies. The key element in this architecture has a northbound interface to the service plane and a southbound interface to the transport plane and is responsible for policy, charging rules, resource allocation and Quality of Service (QoS).

The Policy Function

The policy function is middleware that coordinates network resources to meet the demands of users that are authorized to use the requested services. This function works on two levels. The policy server first determines what a subscriber may do in terms of the type of content and the particular application that a subscriber may use. This first level provides an entitlement check for content and access authorization. The second level goes deeper and determines the bandwidth and resources that would be required in order to deliver this service. This level controls admission and QoS.

This allows the application layer to be access technology agnostic, allowing a given application to operate seamlessly across the various access technologies shown in figure 1 on the next page. The policy function also enables multiple applications in a converged multi-service infrastructure. The operator creates policy rules to track resource usage and set priorities across all applications. Policy rules are a set of conditions that, once met, allow certain defined actions. The rules can be based on static information, like the subscriber's profile, or can be based on dynamic information, such

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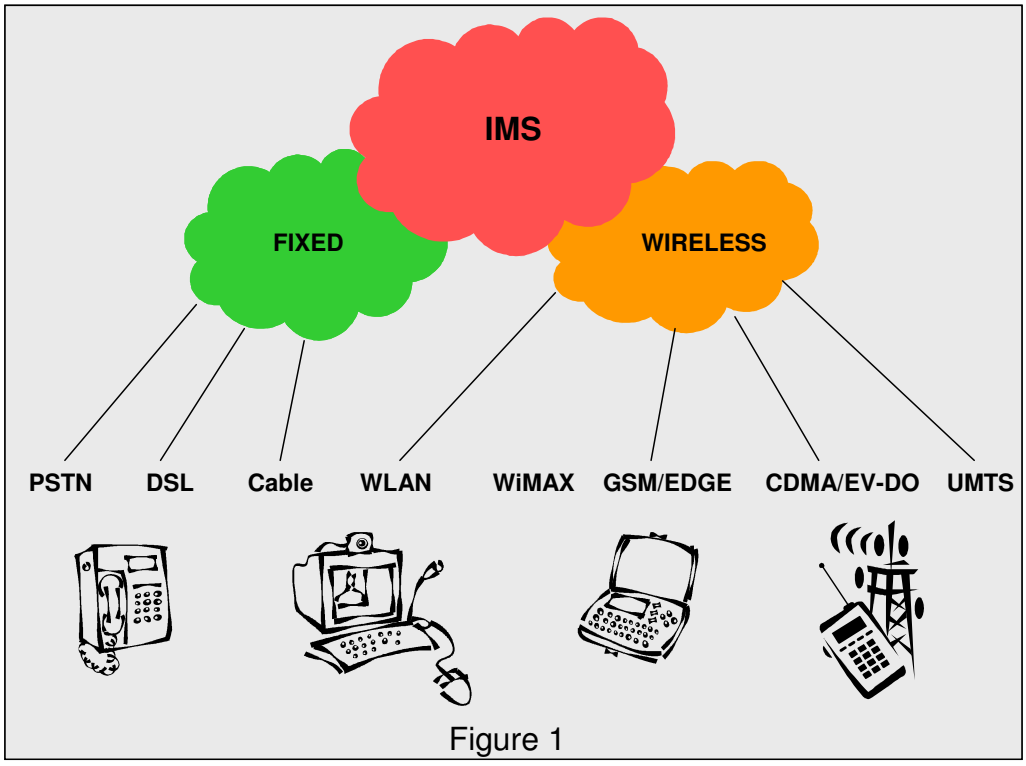

Figure 1

as the available bandwidth on a requested network path. The network operator develops policy rules that enable optimum use of the network resources across all applications as well as an optimum user experience. These rules and permissions reside in the P-CSCF (Proxy Call Session Control Function) as well as other functions in the network such as the HSS (Home Subscriber Server), where subscription details are stored. Policy enforcement itself is distributed across the layers in order to achieve the desired results.

The Policy Control and Charging Rules Function

In 3GPP Release 5 these functions were carried out by the Policy Decision Function (PDF). However, the PDF specification was limited to static charging rules, basically allowing post-paid applications. But many of the applications envisioned for IMS, such as IP-TV and on-line gaming, would benefit from pre-paid charging. Release 7 will address this by incorporating dynamic ruling in addition to rules-based charging in a function designated as the PCRF. Access permission can be verified and the credit balance can be checked and debited – all in real time. Also, by adding the charging function, rules can be created and enforced that determine how a subscriber is billed, not only for a particular activity, but also for the modes of that activity - such as when roaming, when engaged in peer-to-peer data sessions, inside or outside of a carrier's walled-garden and so forth. The dynamic ruling function is achieved through real-time interaction with the 3GPP Release 7 PCEF (Policy Charging Enforcement Function), which handles the IP-flow in the transport plane.

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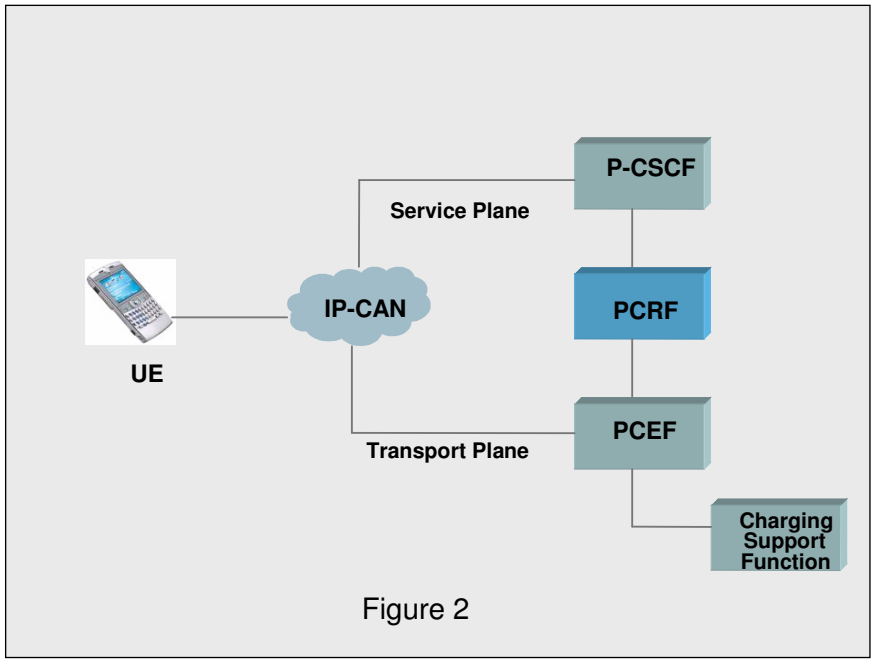

Figure 2

Figure 2 depicts these functions at a high level. The PCRF puts these dynamic policy rules at the edge of the network, binding the service plane and the bearer plane. It stores and acts on policy rules originated by the P-CSCF (Proxy Call Session Control Function) in the service plane. It directs and applies these policy and charging rules to the Access Gateway of the IP-CAN (IP Connectivity Access Network) where the rules are enforced.

IP-CAN is what the specifications define as the access network connecting to the IMS core. IP-CAN access technologies can include UMTS or GSM (3GPP), CDMA 1x or EV-DO (3GPP2), cable-based Internet (Packet Cable 2.0), DSL, Wi-Fi, WiMAX as well as future technologies. Each of these technologies and their respective standards body has a unique specification and nomenclature for the policy enforcement function as well as for the interfaces or reference points between the PCRF and both the P-CSCF and the PCEF. The following chart attempts to sort these out.

Please note that all acronyms are defined at the end of this paper. Also note that these specifications continue to evolve and that the terminology may change as well.

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	3GPP Release 7	3GPP2	ETSI TISPAN	CableLabs
Technology	UMTS, GSM	CDMA 1X, EV-DO	Multiple	Cable
Policy Decision Function	PCRF	PCRF	RACS (SPDF & A-RACF)	PAM
Policy Enforcement Function	GGSN	PDSN	Technology Dependent	CMTS
Interfaces to The PCRF	Go & COPS	Tx, Ty	Gq', E4, Ia	SOAP & XML

In the simplest case a service provider operates a single access technology so the PCRF would be connected to a single IP-CAN. An example would be a wireless operator that only owns a cellular network. A level of complexity is added if that operator should add roaming to Wi-Fi hotspots or if that operator is owned by a fixed line service provider with sharing of services across both technologies. In this case you could either opt to have two PCRF's, one for each IP-CAN, or a single PCRF that services both technologies. The picture becomes more complex as you move up to triple-play and quadruple play scenarios. It is clear that the best solution is a single PCRF that has visibility to all of the available resources so that handoffs can be seamless and QoS can be maintained. Policy Management is ideally centralized, while policy enforcement should be distributed across network access types and layers. These cases are depicted in Figures 3 and 4.

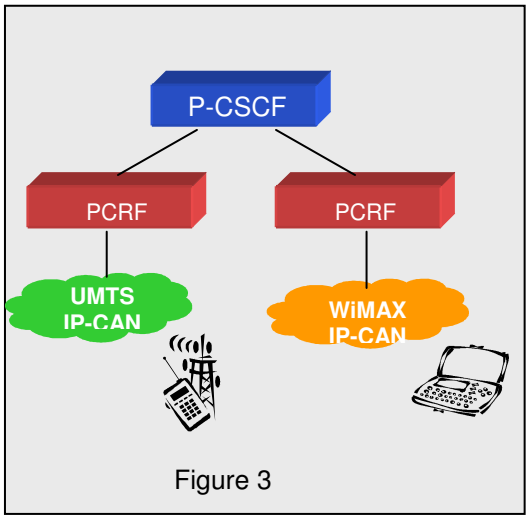

Figure 3

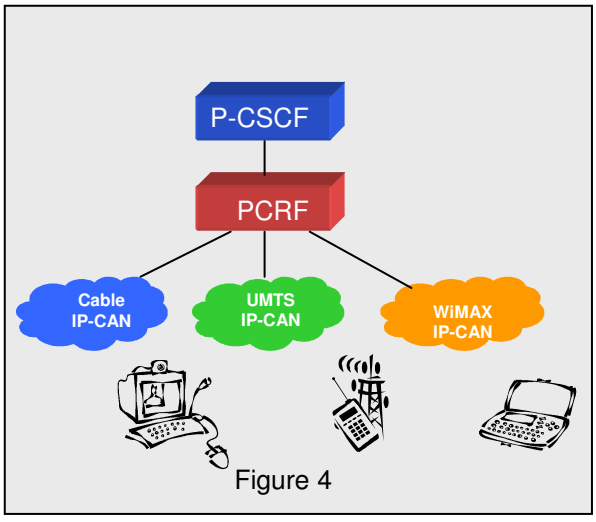

Figure 4

As you can imagine, the PCRF can be very complex. The following are the key attributes for a carrier class PCRF implementation:

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High Performance – Because of the large number of transactions that may be required to set up and maintain a real-time application session across multiple networks, the set up time and latency must be kept to a minimum.

Statefulness – Unlike a simple Internet data session, the PCRF must track multiple states simultaneously. As an example the PCRF first authorizes the bandwidth and QoS, and then reserves the resources before finally committing the resources.

Scalability – As more applications, subscribers and network permutations are added, the PCRF must be able to scale seamlessly. One of the promises of IMS is that operators can trial a service on a small scale, then ramp up very quickly if the market for it takes off.

Reliability – Unlike static policy provisioning, the PCRF is operating dynamically and must be in continuous operation, even when code is being upgraded. Redundancy is mandatory. If the PCRF is broken the whole network goes down.

IntelliNet and PCRF

IntelliNet Technologies is an ideal partner for your PCRF requirements. IntelliNet is in the process of becoming the market leader for the Diameter protocol, which is the key protocol for this critical function. Not only does IntelliNet have a high performance base protocol stack, but it already has the interfaces required to connect the PCRF to the various access technologies. IntelliNet starts with its Accelero™ High Availability development platform that assures that all of the key attributes described above are covered. It combines its portfolio of intellectual property with many years of middleware experience enabling applications for mobility, presence, and charging. You can request more information about IntelliNet's PCRF capabilities by sending an e-mail to info@intellinet-tech.com.

About IntelliNet Technologies

IntelliNet Technologies supplies IP Multimedia Subsystem (IMS) technology and next-generation network convergence solutions to network equipment providers, application developers, systems integrators and service bureaus. IntelliNet products and services are used by leading suppliers in the deployment of carrier grade solutions in wireless, fixed, cable and next-generation networks worldwide. Headquartered in Melbourne, Florida with development offices in Bangalore, India, IntelliNet solutions leverage technical excellence and intellectual property across legacy and next generation applications to shorten time-to-market, reduce costs, increase flexibility and minimize risk. To learn more about how IntelliNet can help you, please visit: http://www.intellinet-tech.com.

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Glossary

3GPP	3rd Generation Partnership Project
3GPP2	3rd Generation Partnership Project 2 (CDMA)
AF	Application Function
AGW	Access Gateway
A-RACF	Access-Resource Admission Control Function
CMTS	Cable Modem Termination System
COPS	Common Open policy System
ETSI	European Telecommunications Standards Institute
GGSN	Gateway GPRS Support Node
HSS	Home Subscriber Server
IMS	IP Multimedia Subsystem
IP-CAN	IP Connectivity Access Network
MMD	Multi-Media Domain
PAM	PacketCable Application Manager
P-CSCF	Proxy Call Session Control Function
PCEF	Policy Charging Enforcement Function
PCRF	Policy Control and Charging Rules Function
PDF	Policy Decision Function
PDSN	Packet Data Serving Node
PEF	Policy Enforcement Function
QoS	Quality of Service
RACS	Resource and Admission Control System
SOAP	Simple Object Application Protocol
SPDF	Service Policy Decision Function
TISPAN	Telecoms & Internet converged Services & Protocols for Advanced Networks
UMTS	Universal Mobile Transport System
XML	Extended Markup Language

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