



CIRPACK

White Paper

The IMS Odyssey



Edito

Even if the IMS (IP Multimedia Subsystem) history still goes on, we can already see similarities with the Iliad and the Odyssey. In Homer's poems, Odysseus went to war for 10 years, and spent another 10 years fighting the gods to return home. IMS, on its side, started in the early 2000s, when the 3GPP chose the SIP protocol as the foundation for a new core network architecture. Will the story of IMS, whose return to Ithaca would be its common deployment, lasts also 20 years? And what are the remaining paths to success?

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IMS Overview

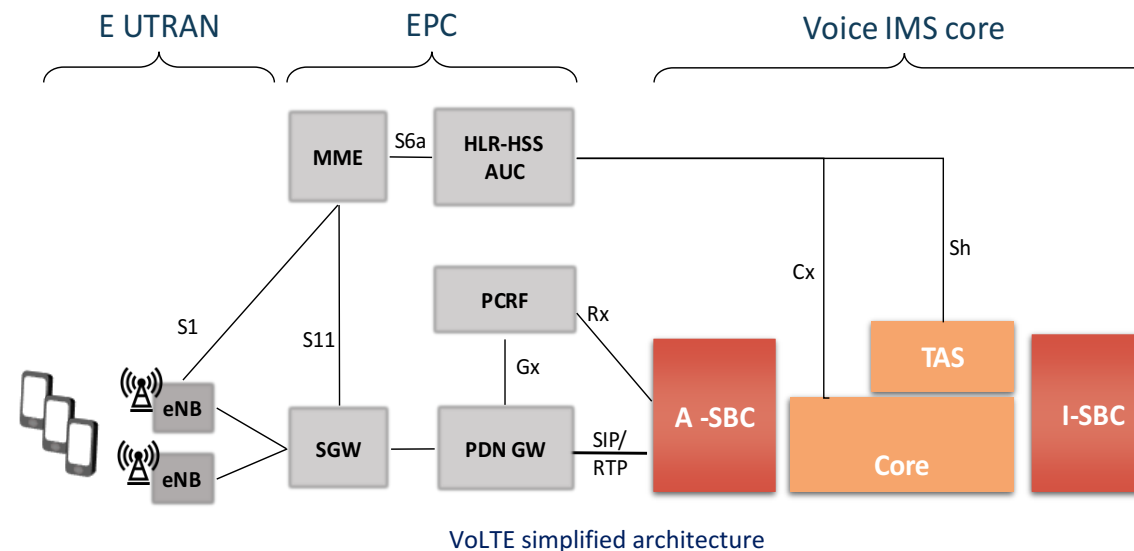
The goal of IMS was to specify a universal, interoperable and evolutive architecture for person to person communications on any IP networks, and replace all current telephony solutions. This new architecture is based mainly on two protocols: SIP, Session Initiation Protocol, widely used now in all VoIP applications as the unified signaling protocol going from terminals to terminals across networks and applications, and Diameter, the AAA (authorization, Authentication and Accounting) protocol used as a general-purpose service protocol in the communication supporting functions. Beyond protocols, IMS also specifies a complete set of modular network functions, defining which ones route the SIP signaling and provide security, service discovery, telephony applications, call routing and interconnection functions. It also defines the way the IP QoS, the end user service profile, the end user location and private data are stored and communicated among these functions. The goal of IMS was to provide an IP communication network architecture that allows roaming, interoperability of networks, products and services and an evolutive service infrastructure.

Seen as the successor of the so-called Next Generation Networks (NGN) where telephony switches are based on call servers and IP-to-circuit network gateways, the IMS has suffered for a long time from a lack of interest from telecommunications operators. This was mainly due to NGN solution adopting the dominant telephony protocol SIP, and consequently bringing enough innovations in telephony. Although NGN networks were less focused on modularity and interoperability, they are “good enough” to prevent a quick migration to IMS. Another reason of the slow penetration of IMS -intrinsic reason in this case- was its inherent complexity, resulting from its ambitious requirements and the complexity of the various specifications from several standardization bodies.

First IMS adoption - the Trojan war's end

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However, IMS has slowly gained interest, firstly due to some fixed network modernizations-from NGN to IMS-, and secondly due to 4G mobile network deployments. Indeed, 4G, also called LTE (Long term evolution) was the new generation of mobile network technology where all communications, including voice, are based on IP. In such networks, the classical NGN architecture shows its limits and the 3GPP proposed IMS as the voice core network technology. Voice over LTE (VoLTE), IMS for 4G telephony was adopted by mobile standard bodies. This milestone could be considered as the middle of the IMS story, the end of the Trojan War. But we all remember the Odyssey has been long and difficult for the king of Ithaca, and the analogy still applies for IMS.



First IMS adoption - the Trojan war's end

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IMS was officially set as the standard for VoLTE. However, reality - or Greek gods? - reserved some more challenges for IMS to be implemented and deployed. Despite the assessment of the standards, VoLTE deployments indeed have been facing operational difficulties, and slowdowns.

To place or receive a call, the 4G phones can downgrade the network connection to 3G, and then benefit from a more mature, wider, and amortized 3G network coverage. This is still the dominant situation for almost every 4G operators. Sticking to 4G to make real VoLTE calls powered by IMS increases the Quality of Experience. The VoLTE mobile phone preserves the preexisting 4G data communications, does not waste time to disconnect and reconnect on 3G, and finally benefits from the latest high-quality voice encodings: Wide Band AMR and EVS. But this nominal scenario, that seems to be the way to go once 4G is deployed, requires a strong and large 4G coverage and VoLTE capable terminals. It also implies a migration from NGN architecture to IMS, impacting the operator information system. Contrary to 4G only operators launching VoLTE with 4G from day one, the vast majority of traditional MNO with 2G and 3G infrastructures had to take some time, for network planning, interoperability tests, terminal and application modernization. In consequence, in 2018, only the first tier of mobile network operators had launched VoLTE. The IMS journey is still on going in public mobile networks.

In parallel, fixed networks, where no gap in access technology clearly triggers a change of telephony architecture, are also migrating to IMS, but at a slower although steady pace.

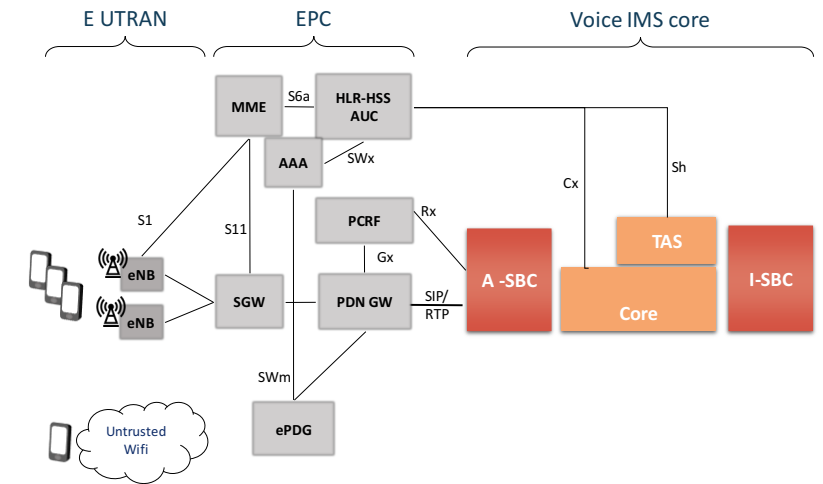
The Odyssey of IMS

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Because of the credibility gained with the first deployments in fixed and especially 4G networks, IMS is now considered as a viable architecture, and the state of the art of modern mobile core network. But there is still a long way for its universal adoption. Now, we can consider VoWifi as the next step.

VoWifi

As detailed in the previous chapter, IMS is mandatory for VoLTE, and is also proposed for VoWifi (Voice over Wifi). VoWifi specifies how public Wifi hotspots can be used as an alternative to the MNO radio networks. Compared to VoLTE, in VoWifi, the Radio Access Network composed of 4G eNodeB is replaced by regular Wifi networks, and the Evolved Packet Core that traditionally handles the 4G mobility and connection management, is augmented with specific IPsec servers. These IPsec servers provide the encryption of the communications between the terminals and the MNO infrastructure, preventing interception of communications in the visited Wifi networks. Then, the IPsec servers called ePDG (evolved packet data gateway) are connected to the regular LTE core's Packet Data Gateway (PDN GW) where the dataflows from and to the mobile handsets are sent to external IP networks. The beauty of this architecture is that PDN GW processes VoWifi traffic as regular VoLTE calls, and sends them to the IMS infrastructure, resulting in the same execution of call handling features: authorization, accounting, supplementary services and routing, to name a few, as with any other 4G call.



VoLTE & VoWifi simplified architecture

RCS

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The Rich Communication Suite (RCS), also rebranded by GSMA as Universal Profile, and by Google as 'Chat' is another mobile technology relying on IMS. Universal Profile is about 1 to 1 messaging, group chat, file transfer, enriched voice calling and consequently connection to chatbot whose interactivity exploits the richness of this new messaging.

Universal Profile is meant to replace SMS and MMS in the long term, bringing a universal messaging technology that bridges all terminals, networks, and applications, including interworking with legacy SMS/MMS. With this goal, RCS or Universal Profile, is naturally based on IMS. Indeed, SIP signaling used for routing calls and interconnecting network can also be used for routing messages of various sizes and formats, such as presence, geographical information, etc. In addition, RCS reuses the authentication and authorization mechanism, and the access to network application servers from IMS. Technically, RCS application are implemented as IMS Application Server sitting on top of an IMS core network.

RCS

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In order to provide a universal messaging solution for Android users, Google backs this initiative, and delivers within its SMS/MMS application “Messages” the support for Universal Profile. As this is embedded in the regular SMS application, the migration efforts and change of habits perceived by the mobile end users are highly reduced. The new RCS hero, Google, benefits on its side of an existing market of billions of SMS users as natural captured market share.

Concerning the deployment of RCS, two scenarios are possible. First RCS/Universal Profile is the natural evolution for new VoLTE network, as the IMS foundation is brought by the 4G voice, and RCS becomes then the opportunity to enrich this VoLTE. The second scenario that has been already started with mixed success several years ago now, is based on RCS launch for any type of end users, i.e. not necessarily 4G/VoLTE users. The Google Android Messages application might accelerate RCS adoption, compared to previous initiatives which were based on dedicated applications to be installed manually on mobile handsets.

To conclude on rich messaging, it is remarkable to notice that RCS, similarly to IMS, has been published a long time ago in its first standard version, and has been launched too early by tech savvy MNOs. RCS is still in the Disillusionment phase of the hype cycle, waiting for the slope of enlightenment.

Private LTE and mission critical 4G

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A new challenge for IMS appeared recently. 4G is a mobile radio technology, and as such is an obvious candidate for the new generation of private and professional mobile radio networks. The currently deployed technologies of these networks, for instance TETRA or Wimax, are based mainly on 2G technologies, and have reach maturity, if not obsolescence. The advantages offered by LTE are higher capacity and QoS customization, longer range and better spectral efficiency, industry grade reliability, security, power consumption. These improvements could bring at least additional features and for sure better efficiency to numerous private and professional networks: first historical actors in Private mobile radio, such as public safety, law enforcement and disaster relief, transports from public railways to airlines, and now new stakeholders such as manufacturing plants and industry 4.0, primary industries and venue services.

Several initiatives have been launched, to organize these modernizations or new initiatives, and distribute rights to use radio spectrum. To name a few, in the United States, the Citizens Broadband Radio Services (CBRS) has set up a mechanism to distribute licensed and shared spectrum. In Europe, France and German regulators have launched consultations and distribution processes to allocate licensed spectrum.

Private LTE and mission critical 4G

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Technically, these new networks could be considered most of the time as micro 4G only mobile network operators, using lightweight and simplified version of regular 4G radio access network. And naturally voice services on these networks could be performed by an IMS core. However, an “application” or use case, inherent to professional mobile networks, was needed in the 4G network: mission critical communications. Indeed, PMR has been created to provide to teams such as fire brigades, emergency, law enforcement or military teams and even car fleets, the mean to communicate in group. This refers to talkie walkie type of communication, also known as “push to talk”. These group communications should be controlled, with group policies, specific user affiliations and rights such as floor control and call preemption.

3GPP launched MCPTT, Mission Critical Push To Talk, as part of Release 13 in 2016. 3GPP also defined soon after Mission Critical Data service and Mission Critical Video services as complementary services, and integrated Multimedia Broadcast Multimedia Service, a bandwidth optimization for group communication as a refinement for MCPTT.

Starting from a monolithic architecture, both in standards and in implementations, the MCPTT service was rendered by a standalone Group Call Server, connected directly to the 4G evolved packet core. However, in the latest version of the 3GPP standards, a unification of MCPTT with IMS shows the Group Call server becoming an IMS Application Server, reusing the IMS core infrastructure. Now, the corresponding products are appearing in the market, and the industry is starting the first trials. IMS is entering a new phase where implementations are validated in critical communication environment.

Vo5G

Looking further, the next big thing in mobile networks is undoubtedly 5G. 3GPP published in 2018 the 5G new radio specifications, launching a new phase of development for MNO and their technology suppliers. 5G standards define a new radio technology, with the following goals: enhancing the speed and bandwidth, support of license and unlicensed spectrum, tailored network capacity with “slices” dedicated to groups of customers or applications, and support of massive IoT deployments. These recent 5G specifications also reuse the IMS and VoLTE architecture for person to person communication, under the name Vo5G (Voice over 5G).

Vo5G still follows the same IMS architecture, and its implementation will integrate new features and service capabilities: for instance, the audio codec EVS becomes mandatory in Vo5G, and video is now based on H.265 for better encoding performances and resilience. The next video codec H.266 is expected for updates of the Vo5G technical specifications. On the list of new use cases, we can find immersive voice and audio services due to bandwidth and terminal’s improvements.

A new IMS opportunity

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All the opportunities and challenges listed above, from VoWifi, RCS, private LTE to Vo5G, require, to say the least, evolutions in terminals and/or network. They are enabled by new servers, new terminal applications, and finally a new access technology. These pre-requisites are all risks to be overcome. Some of these pre-requisites, for instance new 5G access networks, will certainly be deployed because of other reasons than IMS based telephony. On the other hand, RCS deployments are based on dedicated RCS servers and terminals applications, so RCS and IMS, must prove their intrinsic advantages to meet a real success.

However, there is a domain where IMS can be deployed today, where no additional network access nor terminal capability is needed: Mobile Virtual Network Operators (MVNO).

MVNO as of today

An MVNO operates a mobile service, without operating its own radio access network. MVNOs usually associate with MNOs to deliver their services. MVNOs can be classified in several types, based on the technology or tasks they operate. From one side, a brand reseller MVNO relies almost on all facilities of the MNO and focus on customer care, marketing and sales; while on the other side, a full MVNO operates a core network infrastructure connected to the MNO radio network. Up to 3G networks, telephony has been based on circuit calls, and MVNO could manipulate calls, i.e. offer their telephony services such as call routing and specific tariff plans through call control interfaces such as Camel, and more recently SIP. In this latter case, SIP messages are not originated by the terminals, but generated from the call control applications running in the MNO domain. This architecture, where calls are presented in the form of SIP to the MVNO, is called SIP forced routing, and corresponds to the best current practice.

A new IMS opportunity

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Full 4G MVNO

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In the case of 4G, VoLTE implies that mobile phones use the SIP protocol. Furthermore, in 4G deployments, we see two new architectures allowing Full MVNO to control their subscriber VoLTE communications.

In the first architecture, MNOs provide a direct access inside their 4G Evolved Packet Core to Full 4G MVNOs. On their side, the full MVNO should implement their own Packet Data Network Gateway (PDN GW), the component responsible to interface the mobile core network to IMS for voice and internet for data services. The PDN GW provides policy enforcement, QoS control, and data charging, it constitutes the best control point for all data communications of the mobile subscriber, including voice. This type of MVNO-MNO interfacing, called S8HR, is also the industry preferred way to establish 4G roaming between MNOs. We can recognize in this model the MVNO as a “home” mobile network, using systematically the radio network of the MNO, acting here as the “visited” network.

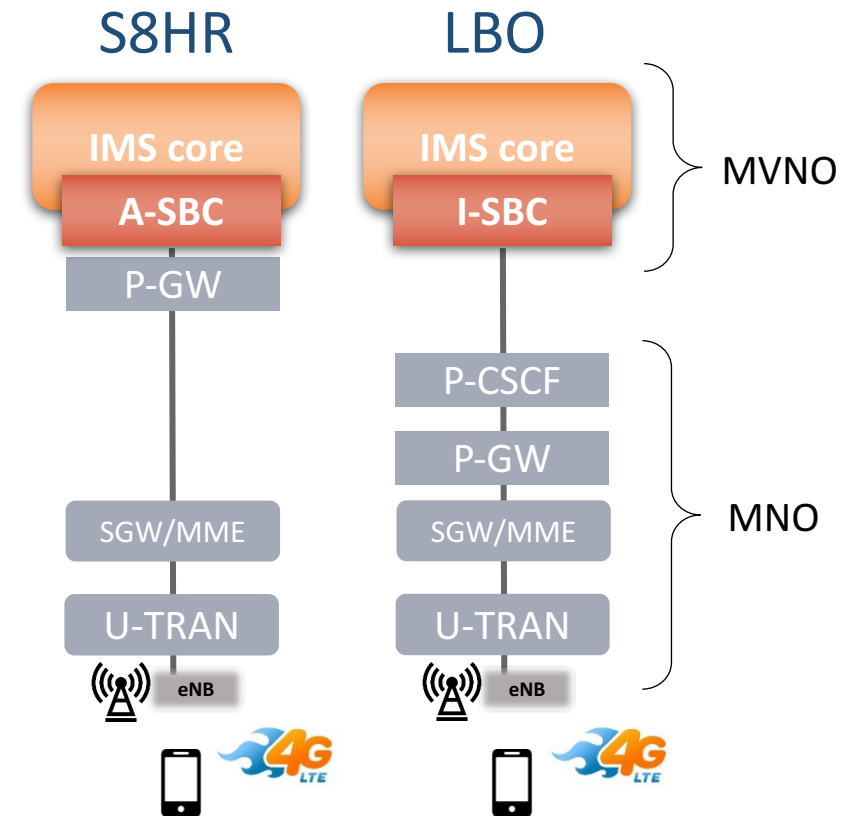
A new IMS opportunity

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Full 4G MVNO

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The second architecture, called LBO for Local Breakout Out, follows even more the IMS architectural concept. With LBO, the MNO handles VoLTE calls from MVNO subscribers as regular calls in its ePC, PGW, and Access SBC. In these components, general call handling, security and Quality of Service mechanisms are implemented, and when the end user specific services must be processed, starting from authentication, the signaling is routed to the MVNO IMS core.



A new IMS opportunity

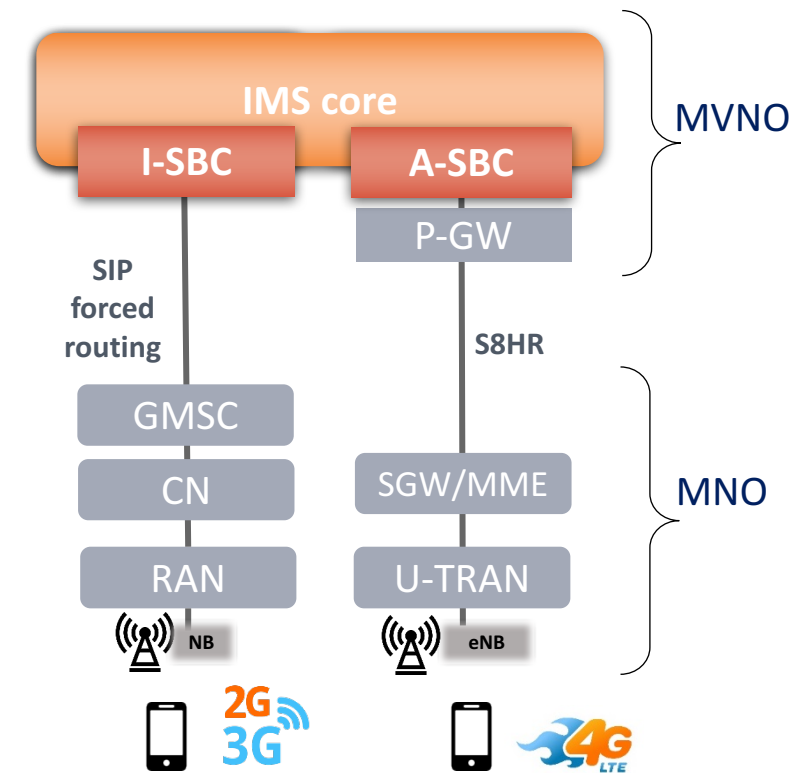
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IMS for MVNO

In all cases, Full MVNO implementing either S8HR or LBO, and the traditional case (2G, 3G) with SIP forced routing, the MNO-MVNO interface is SIP. However, the SIP call controls are not quite the same for these 3 scenarios. In S8HR/LBO, the authentication is handled by the MVNO itself, while it is not in SIP forced routing. Then, some small differences might appear although the supplementary services, specific call routings and billing follow generally the same logic.

As the MVNO subscribers as well as the MNO coverage are going to migrate smoothly to VoLTE and IMS, the MVNO will have to manage a difficult transition, with a progressive migration from a SIP forced routing application server to an regular IMS core network.

An efficient solution should be an MVNO IMS platform, smart enough to be interfaced on one side with classical SIP forced routing, and on the 4G side with S8HR or LBO.



Converged SIP forced routing and S8HR MVNO

A new IMS opportunity

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IMS as a convergent solution for network evolution

This smart IMS MVNO implementation would guarantee a smooth transition from a regular MVNO service in 2G/3G, to a MVNO service in 4G/VoLTE or even to a VoWifi service. Having the same call control application powered by this IMS core, for hybrid scenarios such as:

- SIP forced routing and VoWifi,
- SIP forced routing and VoLTE,
- or even mission critical private LTE with MVNO support outside the private network,

represents a significant operational simplification and efficient design that can be launched today.

Conclusion

The IMS architecture specification started at the beginning of the 21st century, and since then gained in completeness to address new features and new situations, such as ubiquitous broadband like 4G, Wifi and 5G. The initial promises of underlying network independence have been kept, and we are experiencing today fixed and mobile IMS deployments.

As a 20 years cycle is coming to its end, the IMS, as Odysseus in his time, is approaching its target. With a new generation of implementations, lightweight and versatile, the IMS architecture can address today the forthcoming IMS markets: VoWifi, RCS, Private LTE network, evolution to full MVNO and Vo5G.



CEO's words – Patrick Bergounou

Cirpack has been founded twenty years ago to help alternative Telcos grow their business by using this new and very disruptive Voice Over IP technology. They became the world leaders. It's now time, twenty years later, to move to the next step. This is the main reason that led me, when taking over the company four years ago, to set up the next step of this strategy by going to « Full IP » & « Full Software ».

Here we are! Right now! Ready to efficiently serve our customers and prospects on their way to the next twenty years ultimate « communication over IP » technology. With this IMS technology they will better serve their customers by developing new multimedia services based on mobile and online convergent communication tools.

Cirpack has been present alongside its customers for the past twenty years. We carefully listened to them. We better understood them. Using this deep knowledge we developed the best adequate technology to continue to accompany them for the next twenty years.

Entrepreneur and Business Developer, Patrick Bergounou led and developed several companies and business units in various environments in France and abroad, in the areas of consulting, software editing, equipment manufacturing, system integration and IT services. Patrick Bergounou is a graduated Telecom Engineer from Telecom SudParis, graduated MBA from ISG Paris and HEC Executive.

