Future safe networks: The DNA2 uncertainty

By Haim Melamed

Triple play, Fixed Mobile Convergence (FMC), and IP Multimedia Subsystems (IMS) are the three main drivers of the telecom world today. Quadruple play, which is actually the first two (triple play and FMC) bundled together, is the direction in which carriers are moving forward, providing multiple, optionally bundled services to customers. The third – IMS – is the unified future network, based on Internet Protocol, required to seamlessly support various services of the quadruple play, or any subset of the quadruple play.

Any telecom expert that you encounter will agree that voice, video, and data in the fixed and mobile environments will eventually ride over IP. Convergence is apparent, allowing additional services to run on a single IP network.

Are we close to a point where one solution will fit all? Surprisingly, the answer is negative. Any carrier that is currently building a Next Generation Network (NGN) is facing multidimensional uncertainty.

The networks' Devices, Network, Access, and Applications (DNA2) future is actually diversifying rather than consolidating. Stronger and feature-rich handheld devices and Customer Premises Equipment (CPE) products have been created. New network-based protocols and codecs emerge each day. Different types of broadband access technologies exist including xDSL, Cable, Fiber to the X (FTTx), Broadband over Power Line (BPL), and Broadband Wireless Access (BWA). Many new applications and services need to be deployed rapidly to increase Average Revenue Per User (ARPU) and reduce churn.

Any carrier that is trying to build a *future safe network* under this multidimensional uncertainty is facing a great challenge. Selecting a single vendor as an infrastructure provider will possibly lock the carrier to specific devices, network, access, and service creation environments. Moving towards the best-of-breed direction as derived from the IMS architecture has proven to be the correct course forward.

Devices

The IT and telcom worlds exhibit similar behaviors over time, with the telecom world lagging behind the IT world. The IT world has moved forward from a dumb terminal based world, connected via a fixed connection over a slow network to a centralized mainframe computer. This new world encompasses high-performance personal computers communicating peer-to-peer via a wireless, fast network.

Similarly, the telecom world has moved from the old POTS telephone, connected via a fixed line, voice-only TDM connection, to a world where mobile devices, supporting voice, data, and video communicate with each other over high-speed, 3G networks. See Figure 1.

Current telecom devices are hybrid devices, supporting multiple applications in a compact form. The CPU power in today's mobile telecom devices equals the power we had 5 years ago in a home personal computer. In parallel, the speed of today's cellular 3G networks equal the speed of local area PC networks that existed 10 years ago. Today there is storage space in mobile devices that is equivalent to storage we had in home PCs 5 years ago.

The combination of powerful edge devices on one hand, and a very fast network on the other hand, enables the creation of many applications. Distributed computing, file sharing, video conferencing and streaming, and additional applications are available today in our home PC over broadband Internet connection. These applications are becoming available on the mobile telecom devices, too. The life cycle of telecom devices today is between 9 and 30 months, depending on the geographical and cultural elements. However the replacement of the user's mobile device will create new revenue for the service provider, while the substitution of a network infrastructure supporting new device applications leads to expenses being incurred. Therefore, service providers must become vigilant while building an infrastructure correctly as this will support robust, faster, and application-rich devices.

Network

Building a network to support new applications and devices is not an easy task. Although some levels of uncertainty have

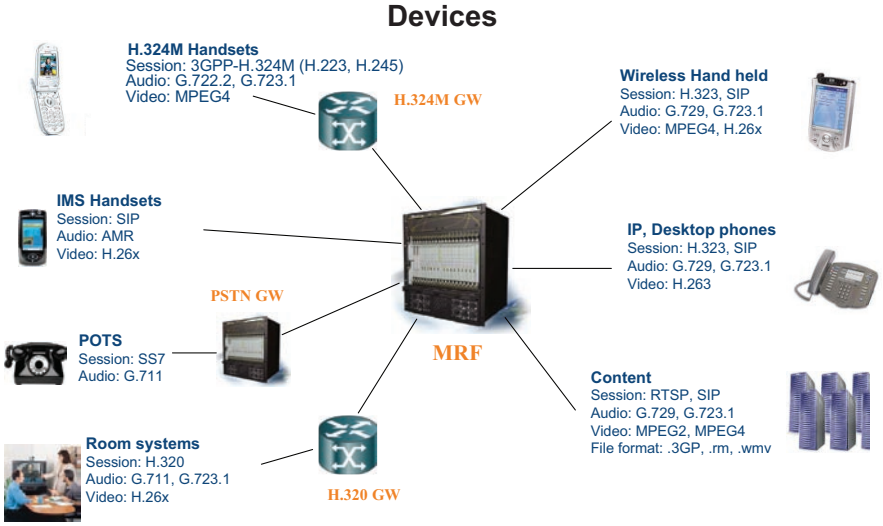

Figure 1

been eliminated, we are left with many unanswered questions.

IP is the chosen protocol for all future networks. Naturally, voice is carried on these networks using VoIP protocols. The architecture of IMS as the core solution for NGN networks enables the interoperability and integration of different network elements among themselves and various network services and applications.

The interaction between new world devices and the NGN IMS network creates many new media types, formats, and protocols. On top of the core IP-based network we see:

- Multiple control protocols
  - SIP
  - H.248
- Multiple media types
  - Voice
  - Video
  - Data
  - Audio
  - Images
  - Animations
- Numerous media formats (G.711, G.722, G.723, G.726, G.728, G.729, G.729e, EFR, AMR, WB-AMR, EVRC, QCELP, 4GV, iLBC, ISAC, H.263, H.264, MPEG4, and many more to come)

Building a network to allow the transparent move of all of these and many others to come involves many open questions. A service provider must select the right equipment for the IMS infrastructure to support all of these and myriad unknown others in the future, without a forklift upgrade.

Access

The advantage (and disadvantage) of IMS is that it does not define the access technology. The greatest variety in the telecom world today is of access technologies. In the wireline space, other than the TDM telephony network, the dominating technology is broadband. Among the different broadband technologies we can find dozens of variations of xDSL, cable, fiber, and broadband over power line. In the wireless space, we can find many variations of cellular broadband wireless technologies, wireless LAN technologies, and Fixed Wireless Access technologies. A partial list of these technologies includes:

- UMTS
- CDMA2000
- 3.5G
- 4G
- TTD
- Wi-Fi
- MetroFi
- WiMAX (2004/16e)
- Flash-OFDM and many future additions

Although all of the technologies mentioned earlier are the transport technologies for voice, video, and data packets riding over IP, each one of them requires the infrastructure to support different network characteristics (such as bandwidth, delay, jitter, and packet loss) and different media codecs.

In addition, the use of all of these access technologies and protocols in parallel requires massive resources of transcoding and protocol translation in the access and in the network. A solidly built, future safe NGN network must take into account these requirements, and the uncertainty of the future winning access technologies.

Three application waves

Customer applications drive the multidimensional uncertainty of NGN networks. Introducing new applications is the only way to address telecom operators' chief concerns: increasing ARPU and reducing churn.

Telecom applications come in waves. Globally, we can see different waves of applications occurring at different times.

The first wave starts from voice, followed by text, data, video, and multimedia (Figure 2). Our parents used the telecom infrastructure for voice calls only. We are using it today extensively for text messaging, too (mainly SMS). Our children are now using it to browse the Internet and download music and games, while some of us are already using it for video calls and video streaming.

The second wave begins from real-time use of the network and adds the support for store-and-forward applications. For each type of telecom media we have the real-time and the store-and-forward versions (Table 1).

The third wave starts from 1:1 applications and adds the support of group applications. Once again, all types of media have both versions, for example, a phone call or a conference call, a personal chat or a group chat, a personal SMS or a group SMS and a video call or a video conference call.

All of the above services must be supported on the future NGN concurrently.

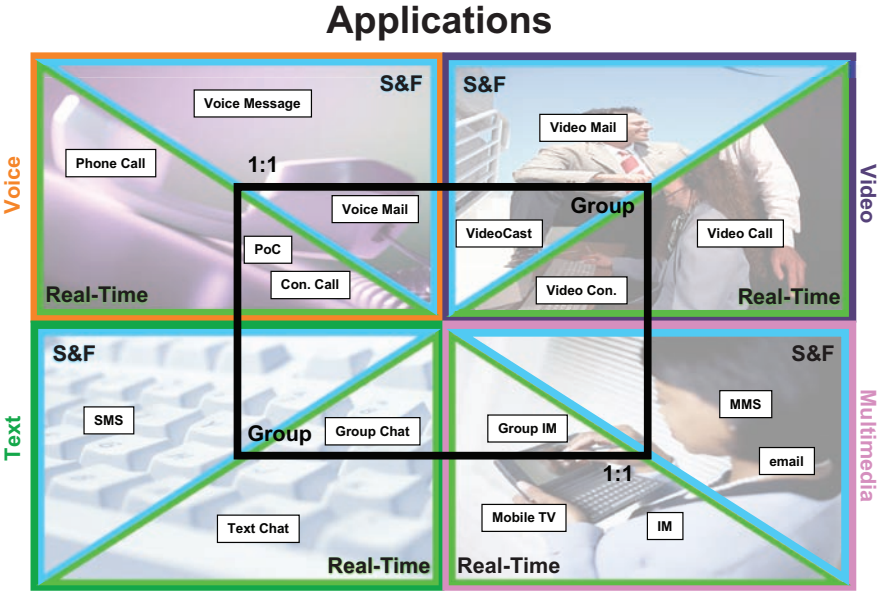

Figure 2

Real-time use	Store-and-forward service
Phone call	Voice mail
Chat	SMS or e-mail
Video call	Video mail
Live video broadcasting	Video On Demand (VOD)

Table 1

Each of them requires different device capabilities, different network services and protocols, and has different characteristics on top of different access networks. Again, a service provider planning a NGN must take into account the evolving new applications and plan a NGN to support all of those in the future.

End-to-end versus best-of-breed

Understanding the multidimensional uncertainty in building an NGN, a service provider can take one of two approaches: The easier approach is to work with one solution provider for most (if not all) of his network components. Another approach is to adopt the best-of-breed architecture, and build an open, standards-based network, to allow future flexibility in devices, network, access, and applications.

In the short-term, working with a single solution provider is an easier and safer approach. No integration hassle, no interoperability problems, and short time to market. On the other hand, the essence of the NGN architecture is the openness, and the ability to introduce future, unknown applications and technologies quickly and easily. Working with a single vendor will possibly lock the service provider into some proprietary architectures and protocols. It will make it harder, and in some cases impossible, to integrate other vendors' solutions into the network. Most important, it will not leave the freedom of choice in the hands of the service provider.

Choosing the best-of-breed approach is not an easy choice. It does involve more integration efforts in the short term, and introduces the overhead of system integration challenges. On the other hand, implementing a standards-based, best-of-breed NGN will allow the choice of the best available network elements, services, and applications, and the future introduction of any device, access network, or application supporting standard protocols and services. IP, VoIP, and IMS make this option easier.

Combining these two approaches yields an interesting situation whereby a service provider makes a hard requirement from his solution vendor to become an integrator and use best-of-breed elements for important parts of the solution network elements such as application servers, media gateways, softswitches, and media servers.

Two crucial components

In the world of best-of-breed IMS telecom networks, two of the most important components of the carrier networks are the media gateways and media servers. These devices are the only devices in the network that:

- Mediate between the different access protocols and technologies
- Mediate between the different media types' codecs
- Connect the TDM and the IP world

The media server function is the hardware resource for many NGN applications.

Selecting the right media gateway and media server for an NGN today captures every aspect of the multidimensional uncertainty. A future safe media gateway and media server must support existing and future control protocols, media types, codecs, and PSTN protocols, in order to be able to support the evolving NGN technologies into the future.

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