If one were to pose the question “What is middleware?” to someone closely associated with Set Top Box deployment, there is a likelihood that the answer would be left somewhere in the middle……….i.e. in the middle of the air! Why should that be the case? Is it rocket science? No it is not and the answer is simple that middleware does not form a visible or directly accessible part of a STB software stack. Secondly Middleware is not discussed in the industry as frequently as the all -important but invisible Conditional Access software or the most visible EPG application software. Middleware is relegated way below in scheme of things in the STB just as hardware device driver software or the operating system. The same is the case with the system software in a PC as compared to the various application software that run on the PC. This by no way implies that Middleware is not important.

Well, in trying to define middleware we have added some more “wares” to the cooking pot and so now let’s briefly elaborate on those before delving deeper into the middle of middleware!

**APPLICATION SOFTWARE**

Application software is a type of software on a computerized device such as PC, Set Top Box (STB), Mobile phone etc. that the user directly utilizes and manipulates. Most of us have since long been familiar with applications software from the world of computers such as Microsoft Word, Outlook Express, Firefox browser, Windows Media player etc. and more recently with application software on mobile phone such as Google Maps, BlackBerry Messenger etc. In the

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**Notes**:

1. It is been presumed that the STBs are to be used for pay platforms and hence the presence of a Conditional Access system has been taken for granted.
2. Though the article is on middleware for STBs, continuous reference has been made to the Personal Computer (PC) and mobile phones for sake of analogy.

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STB World, the Electronic Program Guide (EPG) is the most accessed application which the user interacts with directly in order to navigate.

Application software should be contrasted with system software and middleware, which are involved in integrating a computing device’s various capabilities, but typically do not directly apply them in the performance of tasks that benefit the user.

**SYSTEM SOFTWARE**

System software deals with the infrastructure and is involved in making the computing device’s various functions work together. It is designed to operate the device hardware and to provide and maintain a platform on which various applications software can run. Without the system software, the application software has no meaning. System software includes the BIOS, device firmware, Operating Systems, software diagnostic tools, compilers, data communication programs, data management programs etc.

**MIDDLEWARE**

Middleware is a general term for software programming that serves to “glue together” or mediate i.e. communicate between 2 or more separate software programs and/or manufacturer’s hardware. Just as a person knowing Hindi and talking to another person knowing only Hebrew would need a translator to be able to communicate,
applications running different types of software or operating on different computer platforms need help communicating with each other. In case of STBs, the latter would be boxes running on different manufacturer’s hardware which would need help communicating with the various applications. So middleware is software that connects 2 or more software applications so they can exchange data.

Middleware typically includes an application manager, the virtual machine, the interactive engine, the libraries and databases etc.

It is very important to note that there is nothing like “The middleware”. The term middleware is like an interface and hence can be executed in many different ways. It can be a very thin layer or can be a thick and complex layer and include a multitude of features. Thus each software provider has his or her own version of where to draw the line of how much to handle in middleware vs the application based on their basic architectural philosophy.

Figure 1 should make it clear as to why middleware is so called. The fact that it sits in “middle” of Hardware driver layer and the application software (e.g. the EPG) gives it this name.
HOW TO INSTALL MIDDLEWARE?

In a PC or laptop, the system software is pre-loaded when we purchase a PC and typically some minimum applications software is always provided. The user then keeps adding new applications (till the system slows down and then we call the IT guy!) or rarely deleting un-used ones as per his or her requirements. An IT savvy user can also delete all software on a computer and start afresh with a new combination if required!

In a STB, the software is a composite stack and the user cannot typically add / delete any software component like we do in a PC!

In contrast in case of STBs, for various reasons, the software is generally a composite stack and the user has absolutely no access to adding or removing any software component. As we saw in figure 1, a typical STB software stack would consist of:

- Hardware Drivers: From the STB manufacturer
- Middleware (If applicable): From a Middleware provider or Conditional Access provider
- Conditional Access drivers: From Conditional Access provider
- Application software: From a single vendor or multiple vendors, depending on the platform’s STB management philosophy

So one cannot simply buy a middleware and “load” it onto the STB, it has to be properly integrated into the software stack.

It is obvious from the above that since multiple software suppliers are involved, the integration of the various components is the most important part since all the components have a complex relation, directly proportional to the STB features and after compilation have to work as “one” software in real time. And this can make the all important difference between a stable STB and a “run-away” STB!

Also during a software upgrade, the entire software stack is downloaded to the STB and not only the component that has undergone a change.
Middleware Is Simply Un-Avoidable For Platforms That Deploy STBs From Multiple Hardware Vendors And Are Application Rich. Otherwise It Is A Level Of Complexity One Can Safely And Happily Live Without!

TO USE OR NOT USE MIDDLEWARE?
In order to answer this question, let us see what a middleware typically does.

❖ HARDWARE ABSTRACTION
The most important function of middleware is that it isolates the application software from the STB hardware by using the Hardware Abstraction Layer (HAL). Hence a single version of an application e.g. EPG can be ported on totally different STB hardware platforms from different manufacturers where each STB would have a different set of drivers based on different main chip, tuner, demodulator, type of memory, Input / Output interfaces etc. This freedom to have multiple hardware vendors is very important since it allows the platform to buy STB hardware from more than one supplier and yet have single application software running on all STBs. Some mature platforms in the West have at a single given time STBs deployed from more than 10 suppliers (not counting the various models from each) and without middleware the platform would have to test and verify software from each of the 10 suppliers. In such cases middleware is no longer an option but a clear compulsion!

Needless to say, 2 different hardware platforms with different chipsets say ST 5107 vs the Connexant (Now NXP) Brazos would have a much greater variances in hardware drivers compared to 2 hardware platforms with same chips say ST 5197, but different HW designs i.e. tuner, demodulator, memory etc. Or to drive the point home, even if 2 hardware vendors are using a reference design from the chipset manufacturer, even then it is quite unlikely that an application
would work seamlessly on 2 different manufacturer’s hardware without substantial tweaking. In case the platform operator has only 1 hardware vendor, the above point is not relevant.

✤ CHOICE OF VENDORS FOR ITV APPLICATIONS

As we saw above, if a platform has say 3 STB manufacturers then in absence of a middleware all application software will have to be made separately for each of the 3 STBs. However if a middleware is present, an application such as the EPG would be insulated from the hardware variances. In case of Interactive TV (iTV) applications, the importance of middleware is multi-fold where-in any third party can develop the applications using a middleware Software Development Kit (SDK) which would work on the given STB. Thus the platform is not “stuck” with only one iTV application supplier.

To take an example, the MediaHighway Development Kit (MHDK) enables a third party to develop HTML and Java applications quickly and cost-effectively using standard authoring tools such as JBuilder, NetBeans, Eclipse, and Dreamweaver. It also simplifies development by simulating, debugging, and pre-integrating the completed application on a PC or STB before deployment. This allows the developer to do substantial testing at his end and provide a bug-free application to the platform.

This same principle has allowed the mobile phone industry to develop a plethora of applications in a very short period of time for the multitude of phone models available worldwide.

✤ ABILITY TO RUN MULTI-MEDIA APPLICATIONS

iTV engines such as Flash, HTML etc. along with inclusion of high end graphics in the middleware allows rich multi-media applications to run on the STB. *(Please refer figure 1 of Tweeps and figure 2 of IMDb).* The introduction of Java has raised the bar of what the STB can do compared to the earlier days. This does not mean that without middleware a multimedia application cannot be run on a STB and the above statement is purely from a real life deployment point of view. A word
of caution on multi-media applications is that a STB cannot be expected to match multi-media applications on a PC given the PC's processing resources and associated cost. So one cannot expect any STB to match a PlayStation for games!

**EPG IN MULTIPLE LANGUAGES**

By including a font rendering engine in the middleware, multiple languages can be handled by a single EPG thereby not only giving the user a choice to select the EPG language but also reduces the STB memory requirement and thereby the STB cost.

**EPG CHANGES**

Use of middleware allows the platform to change themes, text, graphical elements, screen positions and insert advertisement on-the-fly without having to touch the underlying code. This means the EPG look and feel can be changed to a degree by the platform on a periodic basis without having to do a software download!

**ADVERTISING ON PROGRAMME BANNER OR ANY EPG SCREEN**

Use of middleware allows the platform to insert advertisement on-the-fly without having to touch the underlying software stack. The advertisements can be updated as often as required vide the head end and can be targeted to a single user of a group of users or all subscribers. This feature can give the platform a much needed revenue stream! *(Please refer figure 3 & figure 4)*

**PVR**

The PVR which has taken the West by storm is yet to be recognized by the Indian subscriber is another good example of what the middleware can do. All the trick modes and various PVR functionality are handled in the middleware by the "PVR component" once the initialization is done by the EPG.

From the above it should be clear that Middleware is not mandatory for a STB and the decision of whether to have Middleware or not depends on various factors. Middleware becomes particularly handy if there are a number of different programs, platforms and software in use. Otherwise it is a complication that one can live without!
HOW TO SELECT A MIDDLEWARE?

The choice of middleware is driven by multiple factors such as:

- Preference of the system Integrator – Remember the systems integrator is finally responsible for making things work in the agreed time frame and hence his recommendations based on experience can play a big role in selection of the middleware.

- Platform’s long term plan of applications and services to be deployed including the iTV applications – As long as one has planned the applications and hence the hardware, one can always start without a middleware and integrate the same later.

- Time to launch - This is very relevant for a new platform since a new integration can take many months to be available for testing and few more to stabilize

- Middleware’s deployment history for the STB hardware – A new chip can add many months of integration to the project

- Middleware’s deployment history for the Conditional Access software used by the platform

- Availability of local support

- Etc.

Besides the above, all important cost factor can sway things since the most common commercial model for middleware is payment on per STB deployed basis. If the platform plans to have a handful of simple games only as iTV applications on a single hardware platform, that would not be the driving factor to go a middleware. The STB manufacturer’s native SW would be sufficient to handle this requirement and maybe much more!
Though Middleware Is Available In Proprietary As Well As Open Standards, Almost All Major Platforms In India Are Using Proprietary Middleware!

THE WHO’S WHO OF MIDDLEWARE

Middleware is available as proprietary solution as well as open solution. Some examples of proprietary middleware solutions are those from Microsoft, NDS, OpenTv (in spite of the name!), PowerTV etc. Such deployments are seen in case of vertical markets where-in the entire SW stack is generally though not always controlled by a single vendor, with the associated pros & cons.

Hence as part of on-going endeavor to create horizontal markets, several open standards have been developed of which the DVB Multimedia Home Platform (MHP) is probably the most deployed. MHP is also agnostic of the transmission technology and can be used for DVB-C, DVB-S as well as DVB-T.

Let us look at the history in brief for open standard middleware. MHP was first deployed for DVB – T in Finland in 2002 but was not the first open standard the credit for which goes to the ISO Multimedia and Hypermedia Experts Group MHEG-1 standard published in 1997. MHEG-1 never became popular and was quickly followed by higher versions of which MHEG-5 released in April 1997 was adopted by U.K Digital Terrestrial Group (DTG) for digital teletext and other information based services and hence got good visibility. In 1998 MHEG-6 was released and though never deployed, but by adding set of new Java APIs became the basis for DAVIC (Digital Audio Video Council) standard for iTV.

It was a good thing from standardization point of view that many of the companies that worked on DAVIC were also working in the DVB and hence when DVB selected Java as the basis for MHP it was natural to reuse many of the DAVIC APIs. Thus MHP became the first open middleware standard based purely on Java implying that STBs did not have to implement another technology such as MHEG to use it.

For the USA, the American body CableLabs has developed the OpenCable Application Platform
in the near future on any National platforms. It seems unlikely that we would see open middleware given the path taken by extant broadcast platforms, deployment of any open middleware as of date. And author’s knowledge there has been no mass scale open middleware, mainly MHEG, to the best of the Sky New Zealand etc.

Some examples of proprietary middleware in the Indian industry are Bharti, DEN Networks, Hathway, and Tata Sky who all use the NDS MediaHighway Core middleware. This is the entry level middleware from NDS with a low memory footprint and NDS has 2 other middleware viz. MediaHighway Advanced and Fusion, none of which have been till date deployed in India.

Dish TV and BIG TV use OpenTV (which is since 2007 part of the Swedish group Kudelski who also own Nagravision CA) middleware whereas the latest DTH entrant Videocon is on IDway – J middleware (which is since 2007 part of the Irdeto group). It may be noted that while there are certain pros and cons in taking the entire software stack from one vendor, from a technical perspective it is not necessary to do so. In the sense a platform can use say NDS EPG and CA but use middleware of say OpenTv e.g. Foxtel in Australia or NDS EPG and CA but use middleware of say OpenTV e.g. Foxtel in Australia or Sky New Zealand etc.

While some work has been done in India on open middleware, mainly MHEG, to the best of the author’s knowledge there has been no mass scale deployment of any open middleware as of date. And given the path taken by extant broadcast platforms, it seems unlikely that we would see open middleware in the near future on any National platforms.

ABOUT THE AUTHOR

NAVROZ BEHRAMFRAM has a long association with Cable TV. Starting in 1984 with NELCO undertaking SMATV installations, he moved as Product Manager promoting Scientific Atlanta’s CATV equipment through their distributors Blue Star and Punwire. He then joined Hathway in 1999 to launch Internet services over Cable on the DOCSIS platform. During his stint at Hathway, he was also responsible for launching India’s first Digital platform in 2004 during the CAS mandate. In 2006 he moved to the DTH industry and was looking after Set Top Box business of Tata Sky at launch of the platform. Navroz is currently the CTO of DEN Networks, the New Delhi based MSO.

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