

Streamed services

An essay by T. Gilling

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Next-generation communications, starting with Fifth-Generation Mobile Communications (5G), are expected to be highly affordable, high bandwidth, low latency, highly reliable, and ubiquitously available.

When creatively combined with a number of other communications-oriented technologies it will allow personal computing (what we do with our personal computing devices) to be designed and operated in ways that are very different to today.

Approaches to personal computing that have, to date, only been possible on the smallest scales, will suddenly become possible on global scales. Personal computing will finally be able to make a long overdue paradigm shift, leaving behind 20th century practicalities, and becoming a true 21st century technology.

Ironically, this 21st century version of personal computing may realise approaches that were originally invented in the 20th century but were just not practical at that time due to the many limitations of our telecommunications technologies, limitations that will soon lie far behind us.

5G is not the only next-generation communications technology that promises to help change personal computing for the better, there are also many others, including:

- Aerial platform networks, which are able to deliver Internet connectivity via high-altitude solar-powered balloons and high-altitude solar-powered drone-aircraft,

- Distributed-input-distributed-output-based wireless communications, which uses the constructive-interference of multiple radio signals to deliver reliable and full signal strength communications into high population density environments,
- G.fast, which is a noise cancellation and channel-bonding technology that allows high-bandwidth communications to be delivered over existing copper wire-based telephony infrastructures,
- Low earth orbit constellations of communications-satellites, which will blanket the whole globe in affordable low-latency Internet connectivity,
- Mesh networking, which can bring wireless Internet connectivity to every corner of the home and office, and can also be used to create cost-effective and highly-durable ad-hoc wide area networks in challenging rural environments,
- Millimetre-wave-based wireless communications, which offers a highly cost-effective alternative to digging up city streets in order to install optical fibre-based communications,
- Single sign-on, which allows a user to log onto one mobile/wireless Internet access service and then seamlessly and automatically gain access to other federated mobile/wireless Internet access services, as and when required,
- Small cells, which can deliver short-range high-bandwidth Internet connectivity exactly where it is needed, and will, eventually, make such connectivity ubiquitous,
- Very-high bandwidth optical fibre-based communications, which are capable of cost-effectively delivering bandwidths of up to 10 gigabits per second to the home, office, and small cell site, and
- Wi-Fi congestion mitigation technologies, which are able to deliver reliable wireless Internet connectivity even in highly-congested unlicensed-communications environments.

All these technologies, and probably many more, will allow a comprehensive technological-shift from our current predominantly download-oriented approach to personal computing to a streaming-oriented one, in which all required personal computing functionalities are provided by remotely-located cloud computing-based data centres using real-time communications protocols that are communicated over the Internet. A shift that is, in many ways, already well under way, as can be seen by the availability of the many streamed services listed below.

The fact that this shift is already under way is not widely known, certainly not by average Internet users, who are currently having intense love affairs with the download-oriented smart-devices in their pockets, but for many businesses this is already their everyday reality. Such businesses have embraced the streaming-oriented approach to personal computing because it offers them significant strategic and commercial

advantages. From the perspective of their employees, this new approach often looks and feels just like business-as-usual. The fact that the technologies that underpin this approach are designed and operated very differently is not even noticed. This is one of the key advantages of the streaming-oriented approach to personal computing, it does not necessarily require everyone to learn a whole new way of working, it can, if required, look and feel exactly like our current download-oriented approach. It is, in this respect, very much a slot-in-replacement for our current personal computing approach, and if implemented well can be adopted with relatively little inconvenience.

The following list is not intended to be definitive or exhaustive, simply representative of the streamed services that are currently available. In simple terms, all the services listed below use Internet-based real-time communications to provide access to remotely-executed functionalities, with only a relatively-basic user-interface being executed locally. Most of the more functionally-rich services, such as hosted applications and hosted desktops, are only available on a commercial basis due to the fact that providing such services requires the use of non-trivial compute and communications resources, which, correspondingly, incur non-trivial costs. So, whilst streamed services may allow many capital costs to be traded for operational costs, a cost always remains somewhere that must be paid by someone.

Cloud Desktops Platforms and Providers

Please see Hosted Desktop Platforms and Providers

Cloud Gaming Platforms and Providers

Azure for gaming	https://azure.microsoft.com/en-us/solutions/gaming/
Gaikai	https://www.gaikai.com/
GameFly Streaming	https://www.gamefly.com/#!/streaming
GameNow	http://www.ugamenow.com/#!/landing
GFACE	https://gface.com/
GFORCE Now	https://www2.nvidia.com/en-us/shield/games/#geforcenow
GameTree TV	http://www.transgaming.com/
Leap Computing	https://www.leapcomputing.com/
LiquidSky	https://liquidsky.tv/
LoudPlay	http://www.loud-play.com/
ORBX	https://home.otoy.com/stream/orbx/
PlayGiga	http://www.playgiga.com/
PlayKey	http://playkey.net
PlayStation Now	https://www.playstation.com/en-us/explore/playstationnow/
Polystream	http://polystream.com/
SFR Jeux Vidéo à la	http://www.sfr.fr/sfr-et-moi/vos-services-sfr/game-on-

Demande	demand.html
Ubitus	http://www.ubitus.net/en/index.html
Utomik	https://utomik.com/

Desktop-as-a-Service (DaaS) Platforms and Providers

Please see Hosted Desktop Platforms and Providers

Hosted Application Platforms and Providers

Amazon AppStream 2.0	https://aws.amazon.com/appstream2/
CenturyLink Application Hosting	https://wwwctl.io/solutions/application-hosting/
FRAME	https://fra.me/
Lagoa	http://home.lagoa.com/
Microwire Hosted Applications	http://www.microwire.com.au/solutions/hosted-applications/
OnApps	http://www.onapps.net/hostedapps/tabid/96/default.aspx
RightNetworks Application Hosting	https://www.rightnetworks.com/
rollApp	https://www.rollapp.com/apps
RunThatApp	http://runthatapp.com/
Starcom Hosted Apps	http://starcom.tech/hosted-apps/
Site2 Hosted Applications	http://www.site2.com/services/hosted-applications/
SystemHOST Hosted Applications	http://www.systemhost.co.uk/hosted-applications/
turbo.net	https://turbo.net/
VMware Horizon Air Cloud-Hosted Apps	https://www.vmware.com/cloud-services/desktop/horizon-air-desktop.html
X.IO	https://www.x.io/
YourOfficeAnywhere Terminal Server Application Hosting	http://www.yourofficeanywhere.co.uk/services/terminal-server-hosting/

Hosted Desktop Platforms and Providers

Amazon WorkSpaces	https://aws.amazon.com/workspaces/
Apps4Rent Virtual Desktop	http://cloudproducts.apps4rent.com/virtual-desktop/
Citrix XenApp & XenDesktop	https://www.citrix.com/products/xenapp-xendesktop/desktops-as-a-service.html

ClearPath Solutions Group Cloud Hosted Desktops	http://www.clearpathsg.com/solutions/cloud-computing/cloud-hosted-desktops/
CloudMyOffice Hosted Virtual Desktops	http://www.cloudmyoffice.com/hosted-virtual-desktop-features/
GoCloud Hosted Desktops	http://www.gocloud.co.uk/hosted-desktop/features/
Hyve Cloud Hosted Desktop	https://www.hyve.com/hosted-desktop
Network Alliance Hosted Desktop	http://www.networkalliance.com/cloud-solutions/desktop
OnePlatform OneDesktop	http://www.oneplatform.com/hosted-desktop/
Oosha Hosted Desktop	https://www.oosha.co.uk/hosted-desktop
OnlineVirtualDesktops.info Virtual Desktop	http://www.onlinevirtualdesktops.info/
Optimal Networks OptimalSphere Hosted Desktops	http://www.optimalnetworks.com/cloud-solutions/optimalsphere-hosted-desktop/
OnTheNetOffice Hosted Desktops	http://onthenetoffice.com/hosted-virtual-desktop/how-it-works/
SemTech IT Solutions Hosted Desktops	http://www.semtechit.com/it-services/cloud-computing-services/hosted-desktop.html
SystemHOST Hosted Desktop	http://www.systemhost.co.uk/hosted-desktop/
U2Cloud Hosted Virtual Desktop-as-a-Service	http://www.u2cloud.com/
UCClouds.com Hosted Desktops	http://www.ucclouds.com/
Vesk Virtual Desktops	https://www.vesk.com/
VMware Horizon Air Cloud-Hosted Desktops	https://www.vmware.com/cloud-services/desktop/horizon-air-desktop.html

Hosted Virtual Desktops (HVDs) Platforms and Providers

Please see Hosted Desktop Platforms and Providers

Music Streaming Providers

AccuRadio	http://www accuradio.com/
Anghami	https://www.anghami.com/
Amazon Prime Music	https://www.amazon.com/gp/dmusic/promotions/PrimeMusic
Apple Music	https://www.apple.com/music/
Arena Music	https://arena.com/
AWA.fm	http://awa.fm/

BBC iPlayer Radio	http://www.bbc.co.uk/radio
bRadio	http://www.bradio.com/#!en/
CLIGGO MUSIC	https://music.cliggo.com/
Deezer	https://www.deezer.com/en/
Earbits	http://www.earbits.com/
Google Play Music	https://play.google.com/music/listen
Groovesharks.org	http://groovesharks.org/
Groove Music	http://music.microsoft.com/
iHeartRADIO	https://www.iheart.com/
Internet Radio (curated links to 38,533 radio stations)	https://www.internet-radio.com/
Jango	http://www.jango.com/
Joox	http://www.joox.com
Last.fm	http://www.last.fm/
Line Music	https://music.line.me/
MusixHub	http://www.musixhub.com
Napster	http://www.napster.com/
NetEase Cloud Music	http://music.163.com/
Pandora	https://www.pandora.com
Patari	https://www.patari.pk/
Radical Indie	http://w.radicalindie.com/
Qobuz	http://www.qobuz.com/
Saavn	http://www.saavn.com/
SiriusXM Radio	http://m.siriusxm.com/streaming
Slacker Radio	http://www.slacker.com/
SoundCloud	https://soundcloud.com/
Spotify	https://www.spotify.com
Tidal	http://tidal.com/
TuneIn	http://tunein.com/
Yandex Music	https://music.yandex.ru
Yandex Radio	https://radio.yandex.ru

Video Streaming Providers

56.com	http://www.56.com/
AcFun	http://www.acfun.tv/
AfreecaTV	http://www.afreeca.com/
Aparat	http://www.aparat.com/
Archive.org	https://archive.org/

Bilibili	http://www.bilibili.com/
Break.com	http://www.break.com/
Comedy.com	http://www.comedy.com/
commons.wikimedia.org	http://commons.wikimedia.org/
Crackle	http://www.crackle.com/
Dailymotion	www.dailymotion.com
DaCast	http://www.dacast.com/
Daum	http://www.daum.net/
EngageMedia	https://www.engagemedia.org/
Facebook	https://www.facebook.com/
Flickr	https://www.flickr.com/
Funny Or Die	http://www.funnyordie.com/
Funshion	http://www.fun.tv/
GodTube	http://www.godtube.com/
Hulu	http://www.hulu.com/
Lafango	https://lafango.com/
LeTv	http://www.le.com/
Livekeak	http://www.liveleak.com/
MainStreaming	https://mainstreaming.tv/
Metacafe	http://www.metacafe.com/
Myspace	https://myspace.com/
Naver	http://www.naver.com/
Niconico	http://www.nicovideo.jp/
Ora	http://www.ora.tv/
Playwire	http://www.playwire.com/
rediff iSHARE	http://ishare.rediff.com/
Rutube	https://rutube.ru/
SAPO	http://www.sapo.pt/
SchoolTube	http://www.schooltube.com/
SmugMug	https://www.smugmug.com/
Tencent QQ	http://www.qq.com/
Tout	https://www.tout.com/
Trilililu	http://www.trilulilu.ro/
Tudou	http://www.tudou.com/
TV UOL	http://tvuol.uol.com.br/
VBOX7	https://www.vbox7.com/
Veoh	http://veoh.com/
Viddler	http://www.viddler.com/
Viddsee	http://www.viddsee.com/
VideoJug	http://www.videojug.com/

Vidyard	http://www.vidyard.com/
Vimeo	http://www.vidyard.com/
VK	https://vk.com/
VNG	http://www.vng.com.vn/
vzaar	http://vzaar.com/
Wistia	https://www.wistia.com/
Youku	http://www.youku.com/
YouNow	https://www.younow.com/
YouTube	https://www.youtube.com/

Virtual Desktops Platforms and Providers:

Please see Hosted Desktop Platforms and Providers

Web and Video Conferencing Platforms and Providers

Adobe Connect	http://www.adobe.com/products/adobeconnect.html
AnyMeeting	http://anymeeting.com/
AT&T Connect	https://www.business.att.com/enterprise/Family/collaboration/connect/
BigBlueButton	http://bigbluebutton.org/
BigMarker	http://www.bigmarker.com/
Blackboard Collaborate	http://anz.blackboard.com/online-collaborative-learning/collaborate.aspx
BlueJeans Network	http://bluejeans.com/
BrightTALK	https://www.brighttalk.com/
Calliflower	http://www.calliflower.com/
Epiphan Video	https://www.epiphan.com/
Fuze	http://www.fuze.com/
Glance	http://www.glance.net/
GoToMeeting	http://www.gotomeeting.com/
IBM SameTime	http://www.ibm.com/sametime/
iMeet	http://imeet.com/
Intercall	http://www.intercall.com/
LogMeIn	https://www.logmeininc.com/
MegaMeeting	http://www.megameeting.com/
Mikogo	http://www.mikogo.com/
Nefsis	http://www.nefsis.com/
ON24	http://www.on24.com/

ooVoo	http://oovoo.com/
OpenMeetings	http://openmeetings.apache.org/
Oracle Beehive	http://www.oracle.com/technetwork/middleware/beehive/overview/index.html
PGi	https://www.pgi.com/
Skype	http://www.skype.com/
Skype for Business	https://products.office.com/skype-for-business/
TeamViewer	http://www.teamviewer.com/
VIA3	http://www.via3.com/
Voxeet	http://www.voxeet.com/
VSee	http://www.vsee.com/
WebEx	http://www.webex.com/
Webinato	http://www.omnovia.com/
Yuuguu	http://www.yuuguu.com/home
Zoom	https://zoom.us/

Web Desktop Platforms and Providers

Ancyra Desktop	https://www.ancyradesktop.com/
AstraNOS	https://astranos.org/
eyeOS	http://www.eyeos.com/en
OnlineStor Desktop	https://onlinestor.net/products/desktop
WebTop	http://webtop.inovamatic.com/index-en.html
ZeroPC	https://www.zeropc.com/

On the whole, streamed services have been quite successful, given that our current approach to personal computing is still very much download-oriented, but there is one particular exception, cloud gaming, which has, so far, failed to really live up to its tremendous potential, and establish itself as a truly viable alternative to 'traditional' computer gaming on dedicated consoles, desktop PCs, and smart-phones, even though it has had the support of quite a few influential technology heavyweights over the years.

Cloud gaming pioneers like Big Fish Unlimited, Core Online, G-Cluster, OnLive, and Shinra Technologies have all 'bitten the dust' over recent years, and it is rumoured that many of the remaining players in this space are still struggling.

Described in terms of Gartner's Hype Cycle for Emerging Technologies, cloud gaming went rapidly from Innovation Trigger to the Peak of Inflated Expectations, and then just as quickly onto the Trough of Disillusionment, where it is now, in my opinion, more or less stuck. With the Slope of Enlightenment and Plateau of Productivity still to be attained.

It is, in many ways, surprising that cloud gaming got itself into such an unfortunate

situation, because it is really just another type of Software as a Service (SaaS), a generic technology class that 'passed' through the Hype Cycle, and reached its Plateau of Productivity, several years ago.

The most likely reason that cloud gaming got stuck is that, unlike most other types of SaaS, cloud gaming is highly-dependent on the quality of the Internet connection that is used to access it. In simple terms, cloud gaming needs Internet access that can consistently support highly-responsive real-time interactivity, combined with 'effectively' unlimited (unmetered) data downloads. A type of Internet access that is not commonly available.

Cloud gaming's lack of success may also have been partly due to the fact that it has a subscription-based business model, and whilst most gamers are more than happy to make a one-off payment to own a physical copy of a computer game, they are much less happy about making periodically-repeating payments to access a virtualised computer game. Particularly when the cumulative cost of such access can quickly exceed that of a physical purchase, and has no future resale value whatsoever, unlike a physical computer game.

As regards the quality of Internet access, cloud gaming needs moderate bandwidths, consistent bandwidths, and consistently-low communications-latencies in order to work well. Unfortunately, whilst the Internet is very good at handling communications with very high bandwidths, allowing it to support cloud gaming's moderate bandwidth requirements with relative ease, it is very bad at handling communications that need consistently-low latencies and consistent bandwidths. In fact one of the mechanisms that was previously put in place to allow the Internet to support very high bandwidths, namely very large data buffers within the Internet's networking equipment, is actually responsible for much of the high communications-latencies that we now experience. Solving such problems is not going to be quick nor easy, certainly not on the globe-spanning scale of the whole Internet. However, over smaller distances, such as over the last-mile, between an ISP's on-ramp to the Internet and your home or office, it should be largely possible. Cloud gaming will also need 'effectively' unlimited data in order to allow its data streams to 'run' for as long as they are required, something that is rarely available on mobile Internet connections, which are often constrained by the imposition of pitifully small data-download limits, known as data-caps.

So, because of all these problems, cloud gaming was unable to become 'the next big thing' in computer gaming. Consequently, the world's gamers, who had, on the whole, always been rather suspicious of cloud gaming's 'revolutionary' promises, simply turned their collective attention towards the latest generation of traditional computer gaming solutions based on dedicated consoles, desktop PCs, and smart-phones, where it is likely to firmly remain for a good few years yet. Nevertheless, regardless of its initial failure and the apparently unassailable success of traditional computer gaming, cloud gaming still has tremendous potential, and, whether it seems believable or not today, remains computer gaming's inescapable destiny.

The reason that any emerging technology gets 'stuck' in the Trough of Disillusionment is because it has, quite obviously, failed to meet initial expectations, which are often unrealistic and over inflated, and its early adopters have, consequently, become

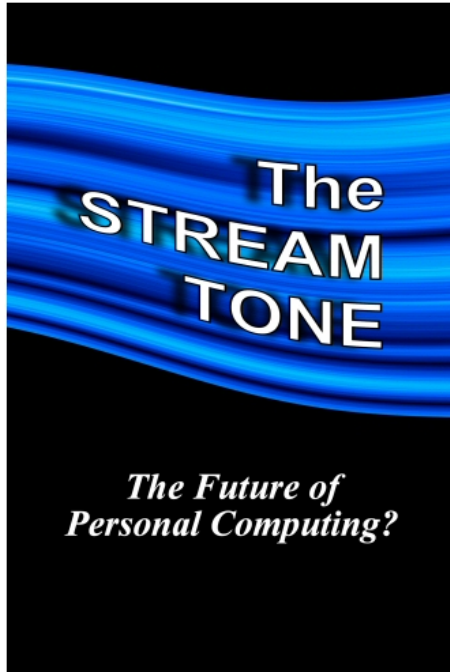
disillusioned, disappointed, or just plain annoyed. The process of trying to understand why an emerging technology has failed (got stuck) is how that technology is then able to move onto the Slope of Enlightenment, where its failings can start to be addressed. Once its failings have been fixed, such that it is now able to make a useful and valued contribution to the world, it will then be able to move onto the final stage of Gartner's Hype Cycle, the Plateau of Productivity.

If cloud gaming is ever going to reach its Plateau of Productivity it will probably need a wholly new type of Internet access, one that provides quality of service (QoS) guarantees for bandwidth and latency, and 'effectively' unlimited data-download allowances. Only then will cloud gaming services be able to reliably deliver the high-quality experiences that gamers have come to expect, and, by so doing, prove, once and for all, that a streaming-oriented approach to computer gaming can finally be trusted, and is genuinely worth the on-going cost of a subscription. Internet access with such characteristics may seem impossible today, but next-generation communications will definitely make such access possible in the future. A future that may, in fact, be only a few short years away, given that 5G is expected to launch in 2020. So, in many ways, it is no longer a question of whether cloud gaming can provide a viable alternative to traditional computer gaming, because it can, its underlying technologies have already been proven, but simply a question of when.

By something like 2025, the computer gaming landscape could look very different to today, transformed as part of personal computing's comprehensive shift from a download-oriented approach to a streaming-oriented one, and we will look back on our current dedicated consoles, desktop PCs, and smart-phones as unfathomable anachronisms of a time probably best forgotten. Of course, people have been making such predictions for years, generally with little success, but on this particular occasion I feel that this is one prediction that is far more likely than not. *Why not check back in nine years and see if I'm right.*

The STREAM TONE: *The Future of Personal Computing?*

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Imagine... a world where your next personal computing device is the last one that you would ever need to buy. Where you would never need to worry about operating systems, software patches, or viruses. Where you always had enough processing power, memory, storage, and top-of-the-line graphics. Where you could access all of the very best software applications, regardless of their platform. Where you had a constant connection to all your favourite digital services, and your battery lasted for days, perhaps even weeks, of full-on use. Sounds good, doesn't it? Well, this is the world of the Stream Tone. A world that does not exist in some far off future; this could be, figuratively speaking, our world a mere five minutes from now. All that is needed to make it a reality is the creative convergence of certain technologies that are already available and in use today.

The STREAM TONE: *The Future of Personal Computing?*

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Personal computing is changing from an old world of local services, provided by local devices, to a new world of remote Web-based services, provided by cloud computing-based data centres. **The STREAM TONE: *The Future of Personal Computing?*** is a 408-page academically-oriented non-fiction book that explores, in considerable technical detail, what might be required to make a comprehensive move to this exciting new world, and the many benefits that move could bring. This book not only attempts to make a thorough evaluation of the technology ecosystem that will be required to create this future but also considers many of the implications of such a move. Along the way, it also discusses a wide range of currently-available technologies and how they could possibly be used to enable this future.

Supporting materials (errata, hyperlink-extract, etc.) now available

For further information please visit: www.TheStreamTone.com

