Abstract
Smartphone and Internet are seen seamlessly making an users day. Net Neutrality is todays raging concern for internet being open, accessible and unbiased based on the content. Service providers however have an obvious debate regarding their investment in transporting the user data over their network. The equilibrium both in terms of revenue and traffic in the Telecom ecosystem is quoted to be feeble because of Over The Top (OTT) services. This paper provides an overview of Over The Top Services, Net-Neutrality, threats faced by the telecom service provider from the content provider, impact on public and content providers with regulation of internet is described. Being in Information Era it is quite important to have a sustainable Telecom ecosystem which is heart of the Information systems. Possible solutions to address different problems have been depicted; several risks and concerns for implementing these solutions on current system and business models are also briefed.

1. Introduction
Telecom service providers in India let their customers enjoy the greater degree of freedom in internet anytime and anywhere [1]. There is a separation between carriage and the content in the Internet Network this enables OTT content and application service providers to deal with end user directly. TSPs are not included in the context apart from the carrying the content specified with control neither on application not on content. TRAI states that TSPs realize their only revenue from...
the data usage of customer to access these OTT services over internet and TSPs are not involved in planning, selling and enabling these OTT services.

According to Alexa traffic rankings major sources of internet traffic are from the portals of Google, Yahoo, MySpace, YouTube, Facebook, Windows Live, eBay, Wikipedia.org and msn.com these are not owned by the TSPs, social networking websites such as Facebook, LinkedIn, MySpace etc capture millions of user connectivity hours.

We can classify the services which are available on internet into following categories:

- OTT Communications
- OTT multi media
- e-Commerce
- Cloud Storage Services
- Social Media
- Web Content.

The declining smart phone prices and incrementing access to the network facilitated by the TSPs are the greatest contributors to the OTT’s growth cost of conversion, reproduction and distribution costs are reduced greatly due to Digitization of contents being a greater reason for explosive ramp up of online content. It is cited that provisioning of these OTTs would impact telecom players economically and would upheaval the current telecom business model, the consultation paper also say that it’s been observed in the developed countries. TRAI hence issued a regulatory framework to undertake actions to protect the telecom ecosystem. This paper deals with the impacts on end user and OTT services due to the regulation planned.

2. Page Layout

The paper further is divided as follows, part III deals about OTT services and their environments which summarize reader about the OTT services, their requirements and traffic behaviour in the telecom networks. Section IV introduces reader to the problems in the current OTT and TSP framework and issues which needs to be addressed, several concerns of both OTT service providers as well as TSPs. Section V briefs about the Net Neutrality and its effects, customer ethics etc. this section also introduces reader with different scenarios and considerations with net neutrality, Section VI provides a brief of creation of QoS aware frame work for OTT services as which can address the problem of traffic congestion in TSPs network due to OTT services and is followed by revenue flow framework which can bring in sustainability to Telecom eco system.

3. OTT Services ad Environment

OTT services refer to provisioning of multimedia services such as audio, video, messaging, Voice over IP (VoIP) and television services etc. The service provider of OTT services generally has lesser infrastructure in comparison with the Telecom service provider. OTT service providers either rely on TSPs and Internet Service Providers (ISP)s for accessing the end customer and is depicted in Fig 1 where OTT service providers such as Facebook, Viber and Skype reach out end customers through infrastructure of TSPs or ISPs.There are several factors which boosted the OTT service market place capable Smartphones which have easier user interfaces, high data rate connectivity and processing power, reliable data connections, another cause of the growth of OTT paid services is online banking and commerce services which directly pipe customer payments to service providers without intervention of TSPs which make user feel more secure and safe.
There are majorly three basic categories in applications of OTT services

- Messaging and Voice Services generally real time
- Application Eco systems for e-commerce and social networking
- Audio and Video content

![Figure 3.1: OTT Service Map](image)

With growing user demand depending on the type of application of the content provider the TSPs should have to focus on Bit Pipes to cater the specific QoS which would require substantial investments for infrastructure. The voice services such as Skype, Gmail video chat are impacting the revenue of TSPs similarly the use of traditional SMS services are declining with the growing messaging services such WhatsApp, We Chat etc. there by injuring the lucrative business of telecom operators. With the growing cloud services which will demand high speed network access to drive the downloading of large content from the cloud it is pressurizing TSPs to improve their infrastructure to cater the needs of the customer,

OTT growth is considered as threatening by TSPs surprisingly the OTT service providers have to rely on the TSPs for catering their services to end user. There are 5 factors which shall drive OTT service.

**Technology Readiness:** The countries with reliable and fast broadband networks and higher number smartphone users are better suited for OTT services

**Cost Incentive:** Generally OTT service cost lesser or available for free when compared to their counterparts, they generally use advertisements to realize the revenue.

**Inclination of Society towards OTT:** OTT apps are particularly driven by a specific social group, ex: - OTT communication services are popular among teenagers.

**Strength of platform used by OTT:** There is requirement of large population which is using a single OS population for better strength of OTT service.
Service Scalability: OTT players will have an advantage in terms of scalability they can scale up the services with minimum new infrastructure deployment. However OTT service providers on the other hand have cut throat competitions with contemporary service providers changing and updating platforms, providing security to the user content in the application, maintenance of cloud etc. OTT service providers also claim that their application induces higher uploading and downloading frequency from the user thereby increasing their revenue through ramped up user traffic usage patterns of OTT services are summarized in Table 3.1.

Table 3.1: OTT Usage Patterns

<table>
<thead>
<tr>
<th>Category</th>
<th>OTT usage</th>
<th>Frequency</th>
<th>Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Messaging</td>
<td>High</td>
<td>Poor network</td>
</tr>
<tr>
<td></td>
<td>VoIP</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Entertainment</td>
<td>Social N/W</td>
<td>High</td>
<td>Lack of Local Content, Poor network services</td>
</tr>
<tr>
<td></td>
<td>Downloading web content</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gaming</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Live Broadcast</td>
<td>Low</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Watching Videos</td>
<td>Medium</td>
<td></td>
</tr>
<tr>
<td>Online Market</td>
<td>e-Commerce</td>
<td>Medium</td>
<td>Safety and Privacy</td>
</tr>
<tr>
<td>Finance</td>
<td>Booking Tickets</td>
<td>High</td>
<td>Safety and Privacy, Low penetration of Plastic money</td>
</tr>
<tr>
<td></td>
<td>Banking Transactions</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stock and Trading</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Distance Learning</td>
<td>Medium</td>
<td>Lack of design, poor network</td>
</tr>
<tr>
<td>Health</td>
<td>Health information</td>
<td>High</td>
<td>Lack of trust</td>
</tr>
<tr>
<td>Other</td>
<td>Email</td>
<td>High</td>
<td>Lack of apps in local languages, Poor network services</td>
</tr>
<tr>
<td></td>
<td>App Downloads</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maps</td>
<td>Medium</td>
<td></td>
</tr>
</tbody>
</table>

4. Issues With Current Framework

Considering the impacts of OTTs over TSPs either positive or negative TRAI classifies the issues into three categories

- Regulatory Imbalances
- Impact on Economy
- Security Issues

Regulatory Imbalances: Both TSPs and OTTs have greater capabilities to provide similar services to the end user. Most of the part Communication OTT service providers are competing with the traditional TSPs but the TSPs will have to adhere greatly to the regulations and obligations where as the OTT service providers will have minimal impact from these obligations in terms of spectrum, licensing, QoS parameters, Spectrum related charges, obligations under various telegraphic acts etc. OTTs however aren't governed for their Security and QoS provision yet they care much about the Quality rendered to end user to keep up themselves in the market with emerging competition from the business rivals there by not losing the customer therefore they keep themselves up by providing best quality that an user expect.

Impact on Economy: Due to universal presence of internet it is difficult for the brick and mortar shops to compete against emerging e-commerce giants and are losing existence slowly, however the OTT services on other hand are helping small scale and cottage industries grow their business and reach customer worldwide with proper usage of the OTT services. OTT growth can increase
business creation and employment dramatically. It is predicted that these services will also improve efficiency of employee by 2.1%, carbon emissions are expected to reduce from 30-90% based on firms. When cloud services are considered the country where the cloud servers are located shall be benefited the government taxes paid by these data centers. When communication services are considered there is huge impact on existing business models of TSPs since their traditional billing model from voice calls and SMS is being hindered largely by there services like Skype and WhatsApp etc. however these services generally have freemium models and will generate revenue through Advertisements or these services are rendered by the firms which have stronghold market in other sector for example Skype is catered by Microsoft and WhatsApp service is handled by Facebook. due to above stated situations the reduce revenue percentage of TSPs shared with government there by there shall be substantial lower the accumulation of Universal Service Obligation Fund (USOF).

Security Issues: Communication services which make use of internet for the transmission of Voice and Instant messages shall not be imposed with security obligations as much as the TSPs are imposed on their voice and SMS services. There exist security issues such as telephone number management, public safety, national security and emergency number access. In case of prosecuting criminal acts (cyber crime) or terrorist activities Lawful Intercept is a legally approved surveillance which can be brought into action, such provisions are still not under existence for OTT communication services. Most of the service providers shall delete of the content after it being delivered to intent which is considered as threat of regulation and execution of investigation under attack or crime. One more concern with the country like India with cultural sensitive user, the content they host on cloud or communication service provider's space is highly sensitive to emotions and cultures of people.

5. Net Neutrality

There is exponential consumption of channels for data traffic this has given rise to new set of issues in accessing internet. Over the years there is a demand of possessing strategies by TSPs for dealing the traffic generated by OTT services. The situation has raised a conflicting debate on whether to keep internet open or regulate it.

TSPs are concerned that the excessive use of internet would result in high congestions and bandwidth difficulties. It is quoted that 10% of mobile users actually consume 90% of operators bandwidth. Applications which stream videos and other multimedia will generate huge traffic on the operators network because of this skewed condition TSPs are trying to device their business models and technologies to address the current situation in consideration.

“Net neutrality” (NN) is generally construed to mean that TSPs must treat all internet traffic on an equal basis, no matter its origin or type of content or means used to transmit packets. All points in a network should be able to connect to all other points in the network and service providers should be able to deliver traffic from one point to another seamlessly, without any differentiation on speed, access or price. The principle simply means that all internet traffic should be treated equally”. Currently net neutrality is the hottest debate topic and is linked to freedom of expression and right to information.

Traffic management is core of net neutrality concept and there are 2 board forms of internet traffic management.

- TSPs attempt to convey all traffic on more or less equal terms this is called ‘Best-efforts’ internet access, This results in an ‘open internet’ with no specific services being
hindered or blocked, although some may need to be managed during times of congestion.

- TSPs in will prioritize traffic according to the value they ascribe it this is called Managed Services. This results to a form of discrimination, but this method is normally efficiency enhancing.
- Network discrimination is the process where the TSPs will discriminate the traffic in several ways.
- Reducing or “throttling” internet speeds: Some TSPs can slow down or control specific services and applications, or demand users to pay an extra fee to have access to such internet services.
- Blocking Service or Applications: In order to increase revenue and profits, some TSPs offer their proprietary services and block similar online services
- Blocking websites: Service Providers can block websites for a number of reasons – either to secure their network, or to avoid competition, and sometimes for social, public relations or political reasons depending on the sensitivity.
- Preferential treatment of services and platforms: Service providers can control or regulate data caps on internet access and grant data allowance exceptions to certain services which TSPs want to process.

6. Possible Solutions to Situation

It is very much demanding to keep internet open and accessible irrespective of the content, the same reason of being open and unbiased made internet so popular among the crowds, however based on the current situation and imbalance in the revenue in eco system which is major concern has to be answered. It all starts with what level of neutrality is to be maintained in the network, Figure 6.1 is the conduct of traffic management device by Ofcom a telecom regulating body in UK. Towards left is with Best effort where there is no regulation on the traffic and is transparent and towards right is increasing level of regulation over the traffic being host.

![Traffic Management Conduct](image)

**Figure 6.1: Traffic Management Conduct**

In case of wireless networks it is difficult process to manage traffic because the users are highly mobile. To accommodate voice calls TSPs reserve capacity for each call/ connection or total traffic on network. Texting and Internet access are key applications being used TSPs are required to migrate their architecture more look like internet. Instead of changing the financial network it is
important to modify the architecture accordingly to adapt to the changes in the trend of service usage.

Introduction of QoS over IP networks turn to be an inevitable condition in future. Having a flow aware network would assure better quality of service in packet networks, flow identification process instead having a goal of dividing the packets into different classes it creates instances of which service differentiation if performed. The packets which belong to Protected Flow List are forwarded unconditionally and the new flows are subject to admission control which is measured based on MBAC which implies accept and reject based on current link congestion status. MBAC uses congestion measurements that are performed within scheduler. Two indicators fair rate and priority load are constantly monitored where fair rate gives estimation of rate currently realized by backlogged flows and the priority load gives the sum of lengths of priority packets transmitted in a certain interval divided by the duration of interval this can be used for assigning the priority and processing based on the predefined number. Queue management is essential in FAN system and fair queuing ensures that bandwidth is shared equally. This could provide a better solution for the TSPs to manage the traffic flow and avoid congestions in the network and would help in managing the resources to adapt to the OTT service growth.

Another major breakthrough innovation is the concept of visualization which involves sharing TSP infrastructure, instead of having a fixed infrastructure. Network functions virtualization (NFV) is the helping hand for TSPs, here network functionalities can be imposed on the Commercial off the shelf (COTS) hardware, this provides a “liquid pool” resources which are consumed dynamically on requirement. Once Virtualization is done the TSPs may have to move to cloud services, this gives an added advantage of automation of several processes. However the virtualization also involves understanding the usage patterns from the user point of view where the TSPs must gather and process enough information from the traffic patterns before deployment of cloud services. Virtualization can go even better by deploying “Thinking Networks”, these networks are self-organizing, self-healing responses to unpredictable and unavoidable circumstances, thinking networks is based on Diameter networks which would need high level intelligence and control assets to enable the service providers cater needs of their customers irrespective of underlying technology. In short virtualization will restructure current TSP architecture by removing redundant control elements or infrastructure.

![Figure 6.2: Flow of Revenue](image)
To address the revenue generation to TSPs from the OTT Service providers, previous discussion on Virtualization and cloudification shall answer the TSPs revenue issues to certain extent by reduction of redundant infrastructure which would require greater investments, however TSPs unlike Internet Service Providers who are generally wired networks to homes will have to invest a lot in buying spectrum. Thus there is discussion to have a model specified based on the content providers revenue model. However TSPs have easy access to the customer than the Content provider. There is a realizable scheme in which the service provider can charge the content provider and it is often referred to as side payments. However we need to keenly device method to charge content service provider based on whether they offer services free of cost or charge them. In reality each service provider either content provider or the service provider will aim in maximizing their own profits.

Figure 6.2 depicts the flow of revenue from the customer to content service providers $V_F$ indicates the revenues which are generated from the advertisements to the Free Content Providers(F) and $V_p$ indicates the revenue generated to paid Content provider(P) from external sources, $P_S$ and $P_F$ indicate Customer(C) payment to TSP(T) and paid CSP respectively, $T_F$ and $T_P$ indicate the flow of revenue from Content providers to the TSPs for management of infrastructure, however there must be strategic decision on the transport prices that is $P_F$ and content services i.e. $P_S$ since customers are most unlikely to pay both the ends, there must be a proper memorandum of understanding between TSPs and CSPs regarding the pricing to maintain equilibrium, however free content service providers such as youtube and facebook shall not make money directly from the customer instead they gain substantial money from the advertisements and for hosting content from others, such firms must ensure to maintain equilibrium in the ecosystem by rendering their help to TSPs in transportation of data. However the demand to the app or OTT service is also to be taken into consideration while billing the content provider. Equations explained shall show mathematical movement of revenue and considerable factors.

Any Business firm works for profit and shall have a margin of expectation and growth. we shall assume that the above situation is realized and TSPs are being paid by content providers Both F and P are said to have a fair and profitable business if and only if $V_F>T_F$ and $(P_S+V_F) > T_P$. The total revenue generated by each of the can be realized with the equation 1 and 2 for F and P respectively are $R_F$ and $R_P$.

\[
R_F = DF(V_F - T_F). \\
R_P = DP(V_P + P_S - T_F).
\]

$DF$ and $DP$ represent the demand factor for each of the service, if the demand is less then 1 indicates that the revenue generation shall reduce drastically there are however several factors which indicate the revenue. Along with these there is need to answer several other questions.

\[
DF = DF^*(1-T_F/V_F)(1-\alpha(P_S/P_S^*))\left(1-P_F/PF^*\right). \\
DP = DP^*(1-\beta(T_F/V_F))(1-(P_S/P_S^*))\left(1-P_F/PF^*\right).
\]

In the equations 3 and 4 $DF^*$ and $DP^*$ are the maximum demand values for F and P, $P_S^*$ and $PF^*$ are willingness of customer to pay. To exercise this model there are lot of considerations, several issues and risks which directly relate to very much sensitive and classified financial information of Content service providing firms, it is most unlikely that every firm would reveal such information to external bodies. In country like India charging customers directly would be even difficult for TSPs to realize since most of the customers prefer using the packet data services on TSP networks for OTT services, charging them over would not encourage user to access these services over TSP catered internet, rather customer would more incline using these services over WiFi networks.
provided by Internet Service Providers at even low costs per MB. There is a greater need of proper revenue flow architecture reformation and division amongst different players in OTT services. Security and privacy go together tapping user data and eyeing it is privacy breach and intolerable, however there is a requirement of governing body for regulating the security and safety of the OTT services, proper checks for security and privacy of these services can be done at Application market places like Google Store in case of android, AppStore in case of iOS etc. These firms shall could globally take care of licensing, approving and deciding the level of permission to collect user data, moving the user data across their severs. Local government doing regulation on OTT service providers would affect the economy due to un willingness of OTT Service providers to start their business in the countries with stringent regulations and they are more likely to move out to the places where the regulations are lenient, thus to host their application or service they will have to rely on App market place every OTT service provider is imposed with the check specified.

7. Conclusion

We have introduced reader with the problem and debate between OTT service providers and the Telecom Service Providers which is raging issue. Different OTT services and their architecture is being discussed, problems with the current service model and business model has been outlined, importance of net neutrality and its existence has been briefed, we summarise that net neutrality has direct impact on customers right to information and is quite sensitive matter to take decisions on, restructuring current model and architecture is best solution for addressing the traffic management, Virtualising the network components, use of cloud technology and Thinking networks can address the problem of investment of TSPs on network infrastructure thereby saving lot of their revenue, TSPs must consider next generation monetisation and design their networks which shall cater the user based on the demand then rather than imposing the user to stick to legacy services.

References

[2]. alexa.com “Alexa’s traffic estimates”.