# Networking Approach in 2030

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Presentation Date, Location & Time: ……

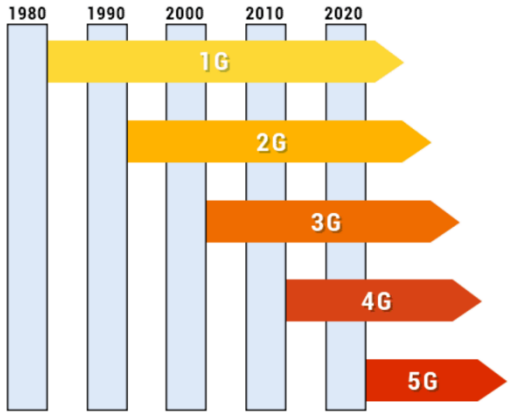
# Summary

- Network 2030 is such an initiative that looks at network capabilities to support what lies ahead of the 5G vision.
- It provides an even tighter integration between communications and human life and identifies key future scenarios that should appear in the period 2030-2035.
- Network 2030 questions how to deliver strict guarantees with the IP, which has been the incumbent in its original form since the beginning of the Internet.
- More importantly it explores on-the-wire communication mechanisms from many broader perspectives not restricted by pre-existing notions of layers etc. to any particular form of technology.

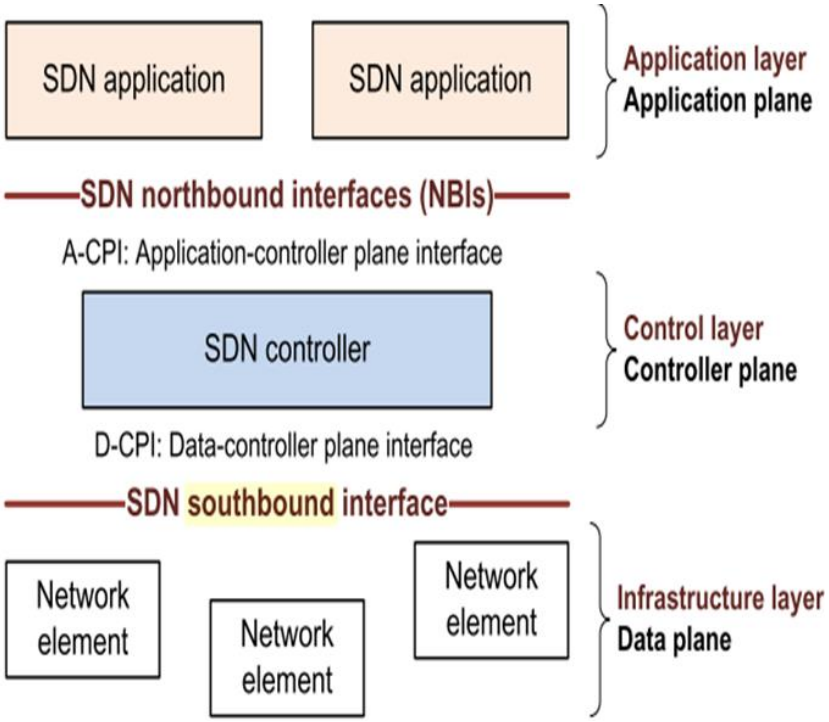
- IMT-2020 introduced integrated requirements related to both fixed and wireless elements in consideration to the growth of mobile networks to support enhanced broadband, with ultra-reliable and low latency services requirements in an agile and reusable manner by softwarization means of technologies such as SDN and NFV.
- While IMT-2020 created a framework for new connected services and applications, it does not effectively address the role ofthe Internet Protocols (IP) which is the fundamental carrier of information in modern networks.
- The next-generation of applications will be designed with strict resource requirements; therefore, networks will need to perform carefully close to application requirements

# What's in store for the future

- Evolution of network infrastructure and increasing spectrum costs has led to via Software Defined Networking (SDN) to play a crucial role in respect to 5G commercialization.
- SDN is defined by "the decoupling of control and packet forwarding planes in the network".
- It enables networks to directly connect to applications through application programming interfaces (APIs),
- SDN decouples the network configuration and traffic engineering, separating them from their fundamental hardware infrastructure.
- This parting allows the use of OpenFlow and other open protocols. These open protocols can access network switches and routers that often use proprietary and otherwise closed firmware by applying globally aware software control at the network's edge.



# SDN Architecture




Infrastructure layer: consists of both physical and virtual network devices such as switches and routers.

- **Control layer:** This layer consists of a centralized control plane. It provides centralized global view to entire network.
- **Application layer: I**t consists of network services, application and orchestration tools that are used to interact with control layer.
- The infrastructure layer comprises network elements, which expose their capabilities toward the control layer (controller plane) via interfaces southbound from the controller.
- The SDN applications exist in the application layer (plane), and communicate their network requirements toward the controller plane via northbound interfaces, often called NBIs

# Market Driving Factors

- High density data movement
- Holographic avatars
- Striving for even more realistic personal communications
- Security through trustworthy systems
- Self-governing independent network systems

# High Density Data Movement

| Massive Amount of Data | |
|---|---|
| Self-driving cars | 1000 CPUs, 100 sensors, 10 GB per mile[1] |
| Lytro (Light field) camera | 300 GB per second |
| Formula 1 car | 200 sensors, 200 GB of data[2] |
| Twin Jet engine-based airplanes | 5000 sensors, 10 terabytes per 30 minutes per plane. 5000 planes in US[3] |

# Holographic Avatars

| | Dimensions | Bandwidth | 100:1 compression |
|---|---|---|---|
| Tile | 4 x 4 inches | 30 Gbps | 37.5 Mbps |
| Human | 77 x 20 inch | 4.62 Tbps | 5.7 Gbps |

| Number of human holograms Flows | Approx. Bandwidth Requirement |
|---|---|
| 1000 | 5.7 Tbps |
| 10000 | 57 Tbps |
| 100000 | 570 Tbps |

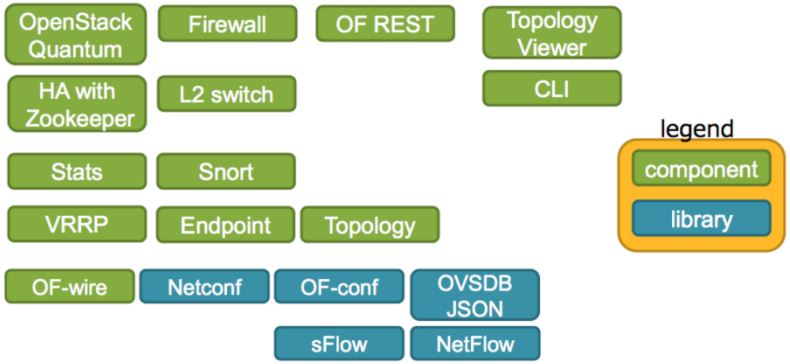
# Near-Real Personal Communications and Experiences

- AR/VR simulates a remote environment in order to make visual conversation look more natural, as if the both sides people are at same place.

# RYU: Component based framework

- Openflow protoocol
  - OF-wire: 1.0,1.2, 1.3, Nicira extension
  - OF-config 1.1
- Non-openflow protocols
  - Netconf, OVSDB, netflow, sflow, VRRP, SNMP
    - Snmp: Enterprise OID: 41786
  - Ryu can configure Open vSwitch directly without ovs-vsctl, ovsdb-client

- RyuApp, library
  - Packet library
  - STP, LACP
  - Sample apps, etc...
  - Conversion from/to JSON representation from/to OF
  - RPC to communicate/control Ryu
- Integration with other project
  - OpenStack
  - HA with Zookeeper
  - IDS(Intrusion Detection System) with snort




**Components, libraries, features and protocols supported and included in RYU**

# The Evolution of Network Capabilitites

- We often describe fixed communication network generations (ATM, IP, MPLS, etc.) separately from 3GPP generations (3G, 4G, 5G etc.).
- The 3GPP generation are far more structured in describing their bounded capabilities via network parameters like bandwidth, latencies, reliability along with frequency spectrum mostly because they do not overlap like the fixed systems.
- During the IMT-2020 initiative, for the first time, the combined impacts of both cellular and wireline network was studied jointly.
- Thus, in the quest for the next generation of integrated networks IMT-2020 is a first.
- To put this achievement in perspective, we discuss below how capabilities are evolving from the present to the near future and use this information to extrapolate into the long-term future.

# The Evolution of Network Capabilities

- Capabilities of Today (pre-5G)
- IMT-2020 capabilities
- Leapfrogging into 2030 (post 5G era)

# Capabilitites of Today

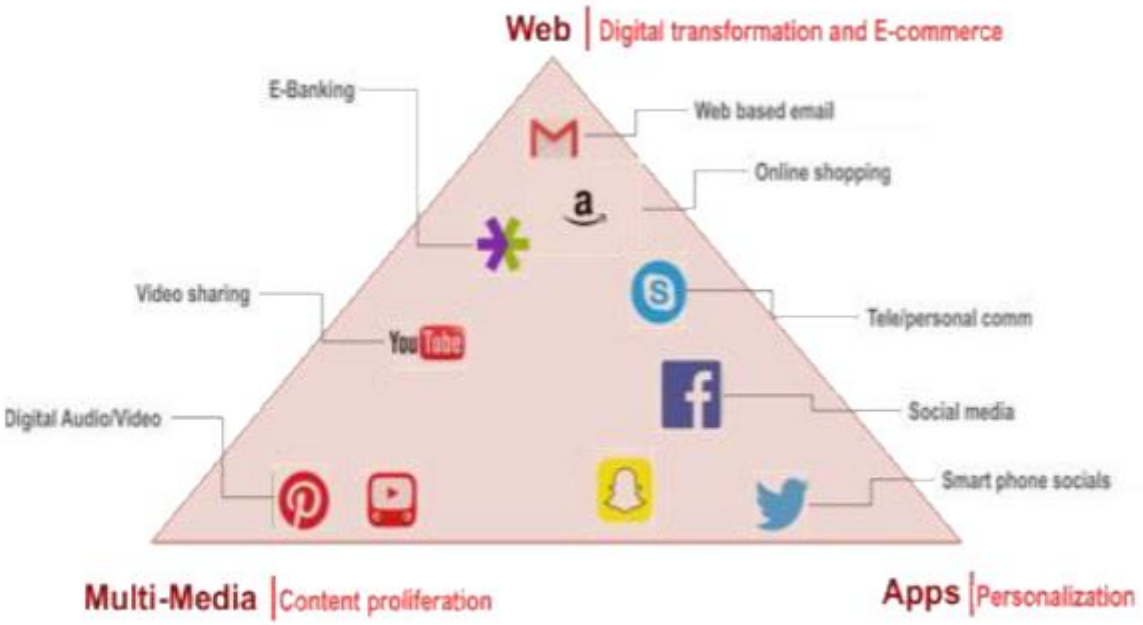
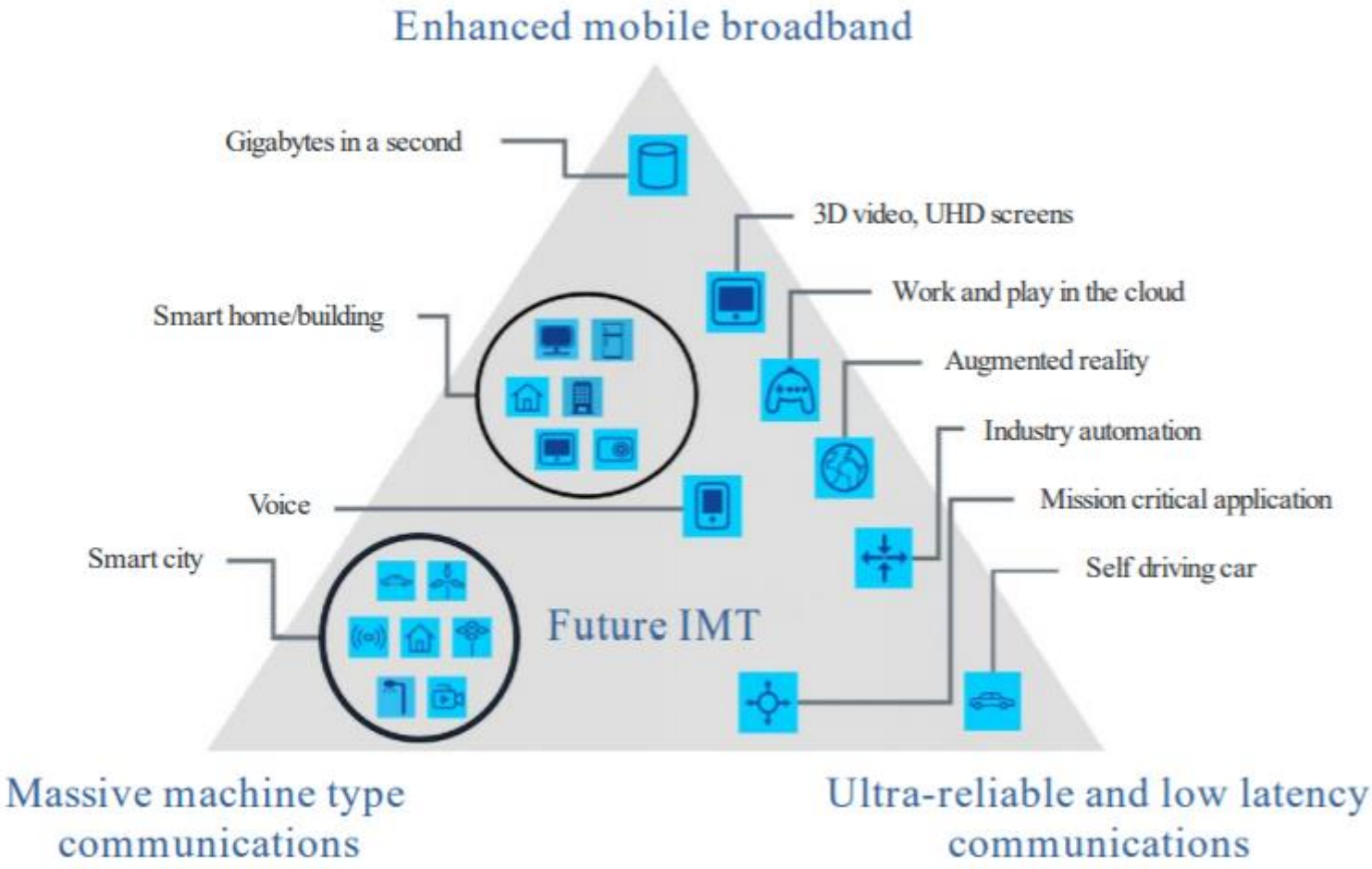
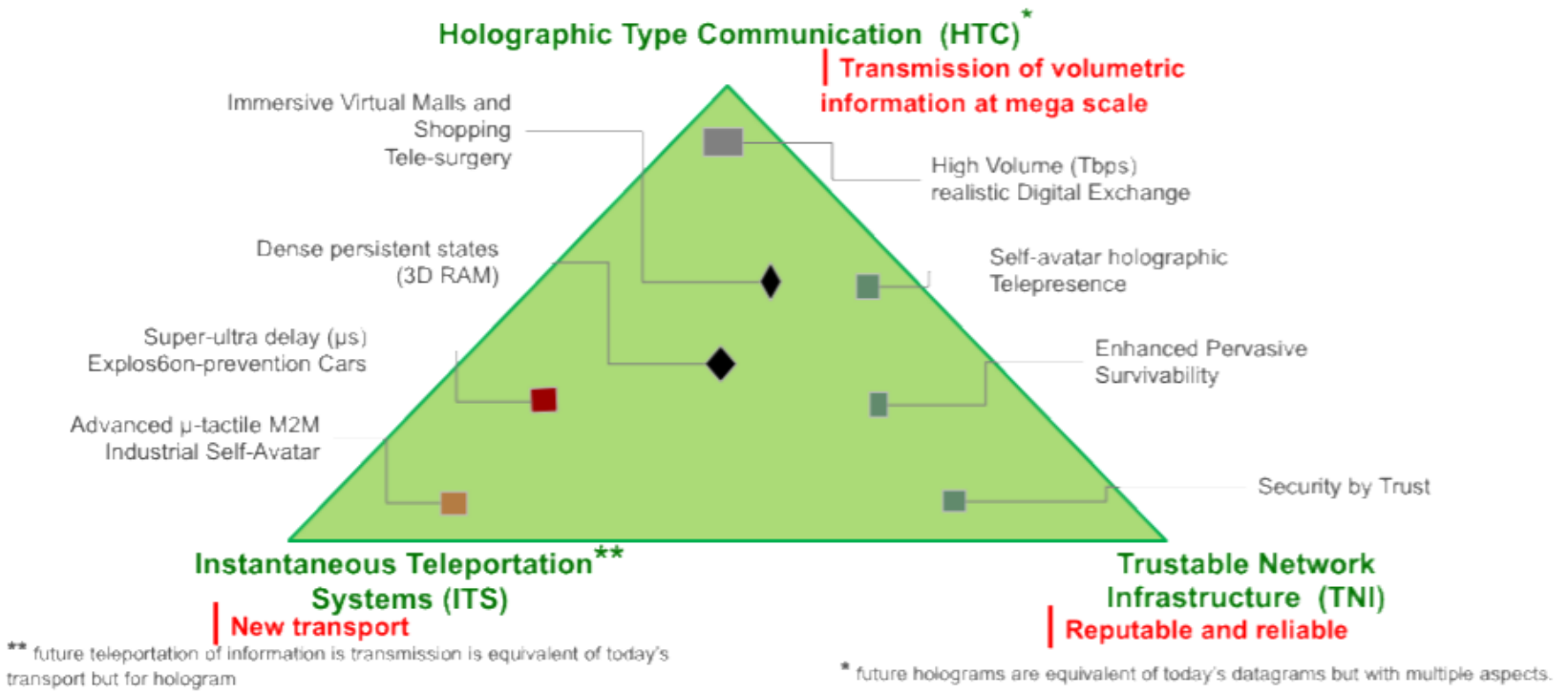



**Figure 2: Current Internet Capabilities**

# IMT-2020 capabilities



# Leapfrogging into 2030 (post 5G era)



# New Paradigms of Internetworking

- Holographic Type Communication
- Instantaneous Teleportation System
- Intrinsic Trustable Security

# Instantaneous Teleportation System

| Today's Concept | | Future Concept | |
|---|---|---|---|
| Datagram | A self-contained routable entity with destination address in packet switched networks | Hologram | A representation of routable entity and its attributes (latency, b/w, metadata, behavior etc.), chained to previous and next hologram |
| Transport | A one-dimensional information carrier over network. Behavior captured E2E. | Teleport | Different dimensions of information containers carrier over networks<br>Transmits at extremely near-real-time (sub ms) |

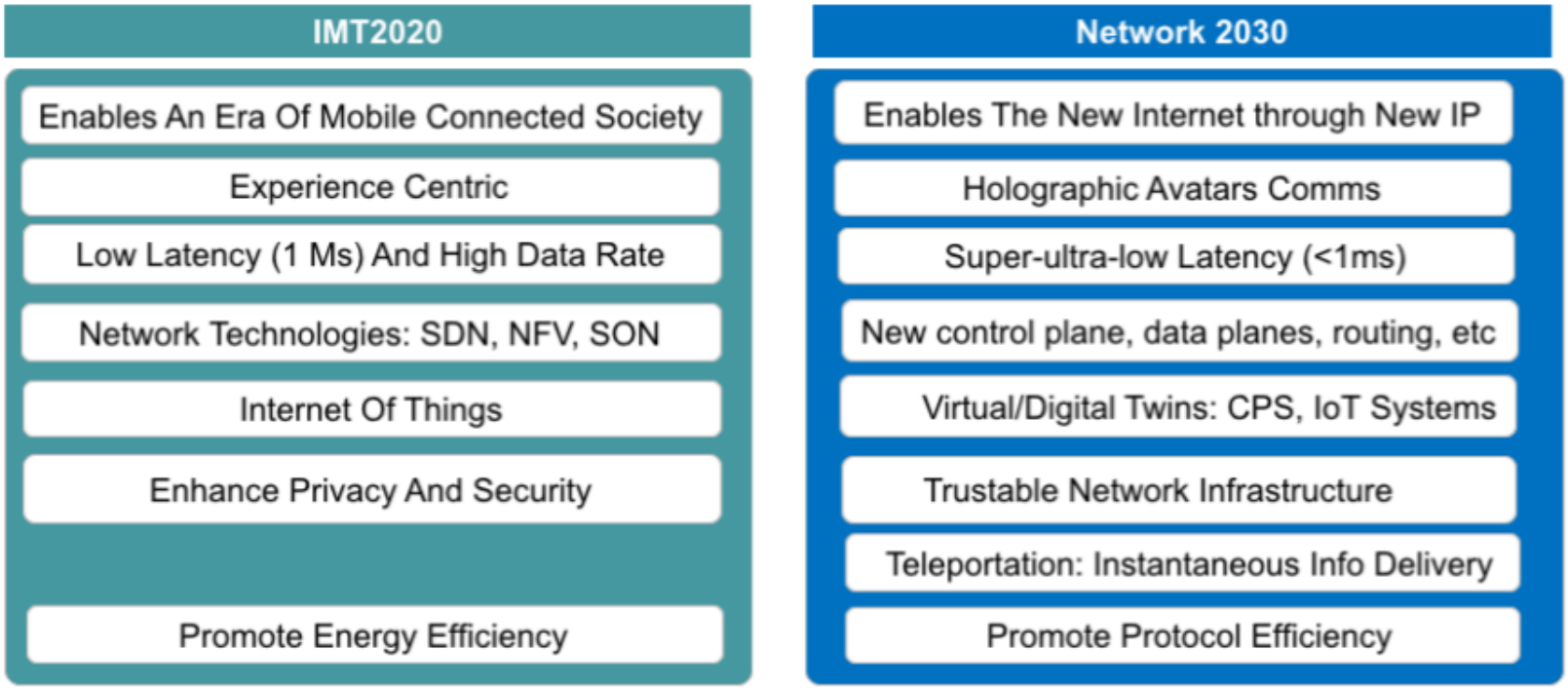
# Intrinsic Trustable Security

- Decentralization is one of the emerging technologies that implements proof of trust using blockchains but applying it to overall holistic network security is yet to be studied thoroughly

# Requirements for Network 2030

- The New IP
- Relevance of Tighter service requirements
- Protocol Efficiency
- Federated Networks
- Achieving Network 2030

# From IMT2020 to IMT2030



# Q&A and Discussion

## Thanks for Your KIND Attention


DISCUSSION

# Weekly Activities Log

| Week No. | List of Tasks (Planned) | Log of Achievements, Errors, and Learning |
|---|---|---|
| 03 | Assigned with project topics | Understood the topics |
| 04 | Decided on the topic | Started research on the topic |

# Weekly Activities Log

| Week No. | List of Tasks (Planned) | Log of Achievements, Errors, and Learning |
|---|---|---|
| 05 | Found paper on Towards a New Internet for the Year 2030 and Beyond | Got insights on hologram and 6G |
| 06 | Researched on various controllers | Still researched on the controllers |

# Weekly Activities Log

| Week No. | List of Tasks (Planned) | Log of Achievements, Errors, and Learning |
|---|---|---|
| 07 | Found out about ODL controller | Did a detailed research on the ODL controller |
| 08 | Finally decided on Ryu controller | Researched on its implementations |

# Weekly Activities Log

| Week No. | List of Tasks (Planned) | Log of Achievements, Errors, and Learning |
|---|---|---|
| 09 | Started with the ppt | Started with the initial summary |
| 10 | Continued with the ppt | Added more information |

# Weekly Activities Log

| Week No. | List of Tasks (Planned) | Log of Achievements, Errors, and Learning |
|---|---|---|
| 11 | Continued with the ppt | Added few more information |
| 12 | Completed with the ppt | Understood and gave the detailed analysis of the project |