Project Seminar on

Analysis of Recovery Time Objective (RTO) of Disaster Recovery System for Microservice Enterprise Architecture

in partial fulfillment of

VII Semester Bachelor of Engineering (B.E.)
Electronics Engineering

PROJECT PHASE- I (ENP 455)

Name of Students (Roll No.)

1. Tanmay Sahare (06)
2. Sankalp Kitey (14)
3. Kirti Laad (49)
4. Yash Kumbhare(62)

Guided by

D.M.KOTAMBKAR (Guide)

S.S.BOKARE (Joint Director **C-DAC**)(CO-Guide)

Department of Electronics Engineering
Shri Ramdeobaba College of Engineering and Management,
Ramdeo Tekadi, Gittikhadan, Katol Road, Nagpur 440013, India.

Session 2023-24

Table of Contents

1. Introduction
2. Literature Review
3. Motivation
4. Objective
5. Methodology
6. Data Visualisation
7. Dependency matrix and equations
8. References

Understanding What is Microservice.

Reading and Analysing Several Research Papers

Visualization and Relation of RTO

What is a Disaster for these Microservices.

Choosing One Microservice as a Case Study

WHAT IS

DISASTER

RECOVERY

GifImages.pics

LITERATURE REVIEW

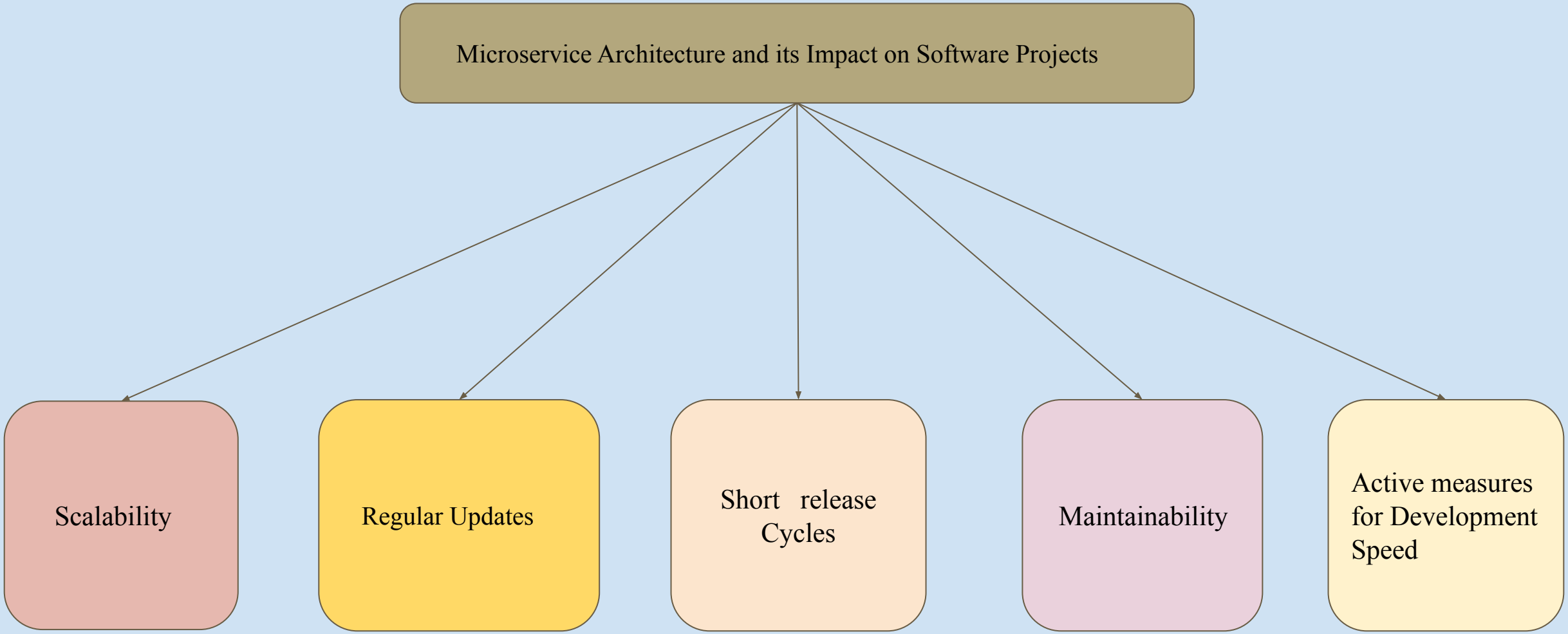
Ref. No	Author	Title	Architecture	Year of Publication
[1]	Mario Villamizar, Oscar Garcés, Harold Castro, Mauricio Verano, Lorena Salamanca, Rubby Casallas	Evaluating the Monolithic and the Microservice Architecture Pattern to Deploy Web Applications in the Cloud.	Monolith and Microservices	2015
[2]	Antonio Bucchiarone, Fondazione Bruno Kessler Nicola Dragoni,	From Monolithic to Microservices An Experience Report from the Banking Domain	Monolith and Microservices	2018
[3]	Arne Koschel, Irina Astrova, Jeremias Dötterl	Making the move to microservice architecture	Microservices	2017
[4]	Saulo S. de Toledo, Antonio Martini,	Architectural Technical Debt in Microservices	Microservices	2019
[5]	Alexander A. Dontsov1 Igor A. Sutorikhin1,2	Development of a geographic information system for data collection and analysis based on microservice Architecture.	Microservices	2021

MONOLITH

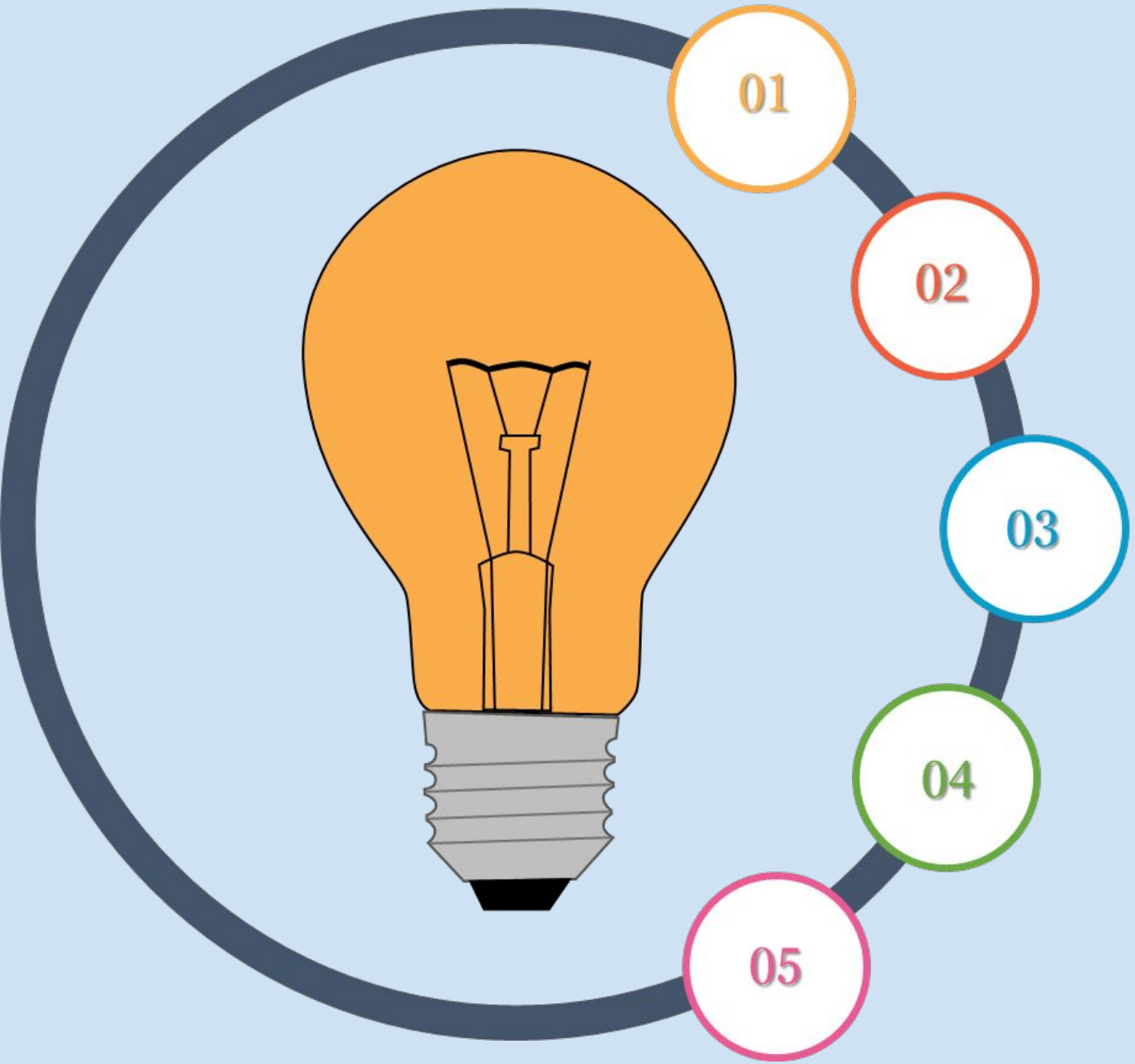
VS

MICROSERVICES

Making the Move to Microservice Architecture



MOTIVATION



01 Growing Adoption of Microservice Architecture.

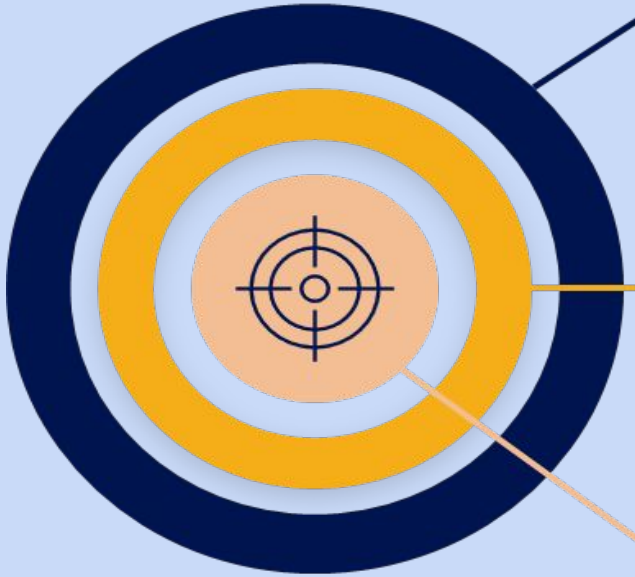
02 Ensuring Business Continuity.

03 Unique Challenges of Microservice Disaster Recovery.

04 Optimization for Cost and Efficiency.

05 Real-World Impact and Industry Relevance.

OBJECTIVES

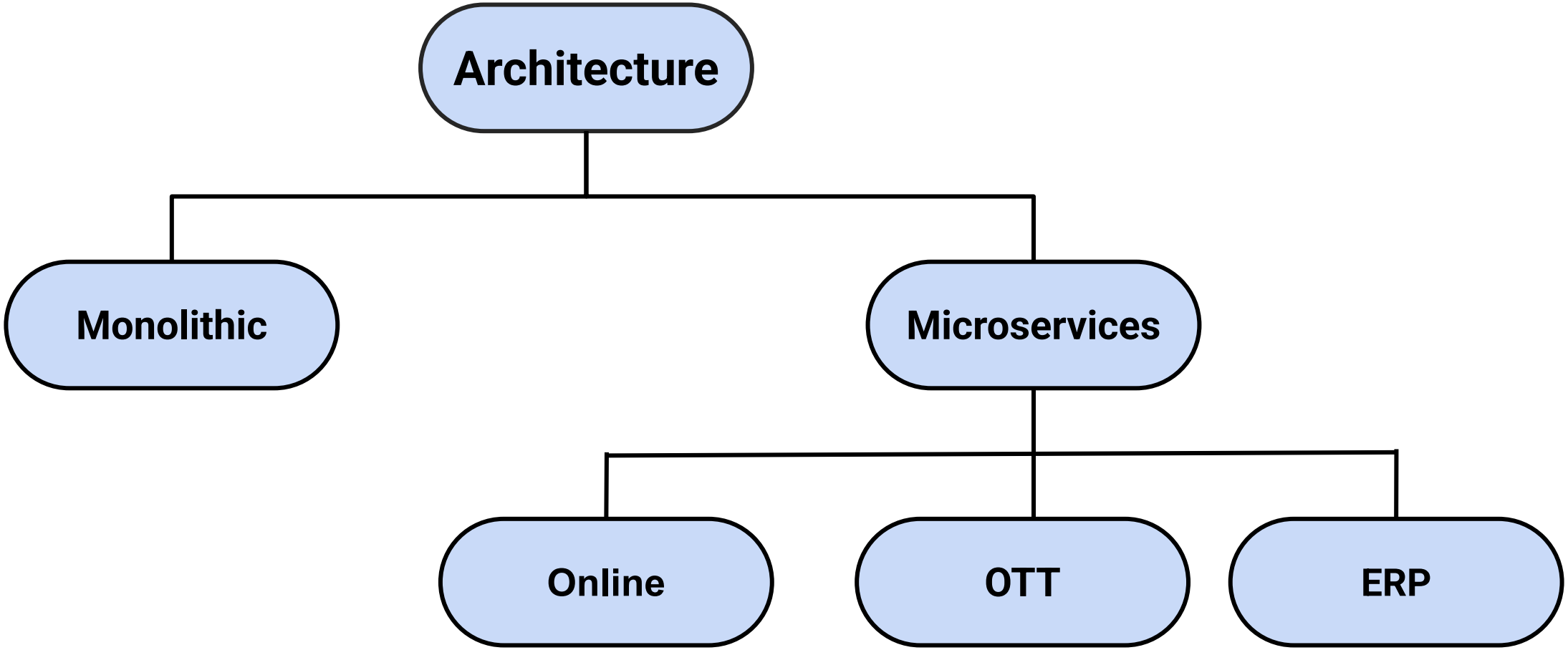


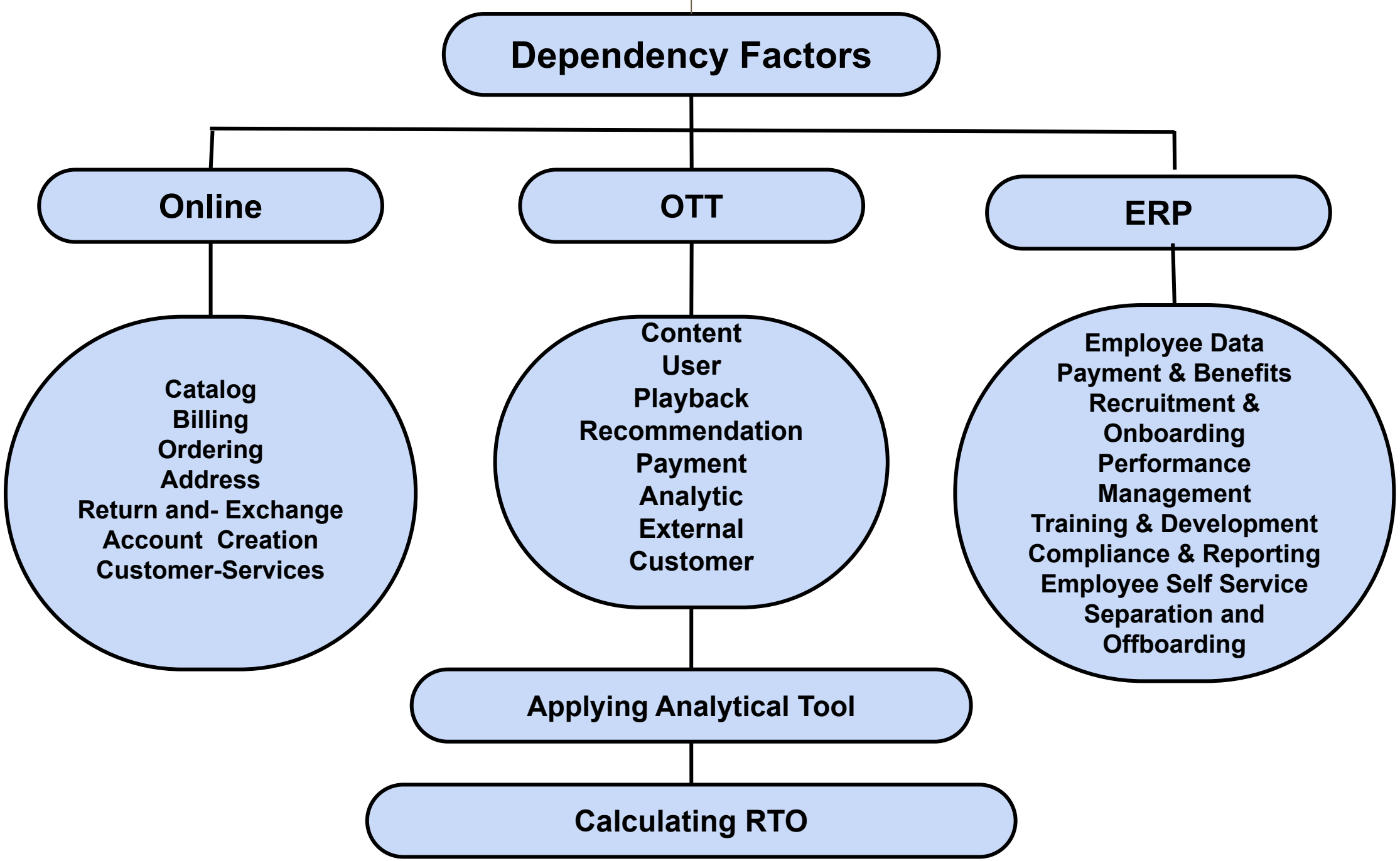
01 Understand Microservice Enterprise Architecture.

02 Introducing Disaster Recovery and Recovery Time Objective (RTO).

03 Strategies for Achieving Aggressive RTOs in Microservice Environment.

METHODOLOGY




Dependency Factors
Online
OTT
ERP
Catalog
Billing
Ordering
Address
Return and- Exchange
Account Creation
Customer-Services
Content
User
Playback
Recommendation
Payment
Analytic
External
Customer
Employee Data
Payment & Benefits
Recruitment &
Onboarding
Performance
Management
Training & Development
Compliance & Reporting
Employee Self Service
Separation and
Offboarding
Applying Analytical Tool
Calculating RTO

Data Visualization

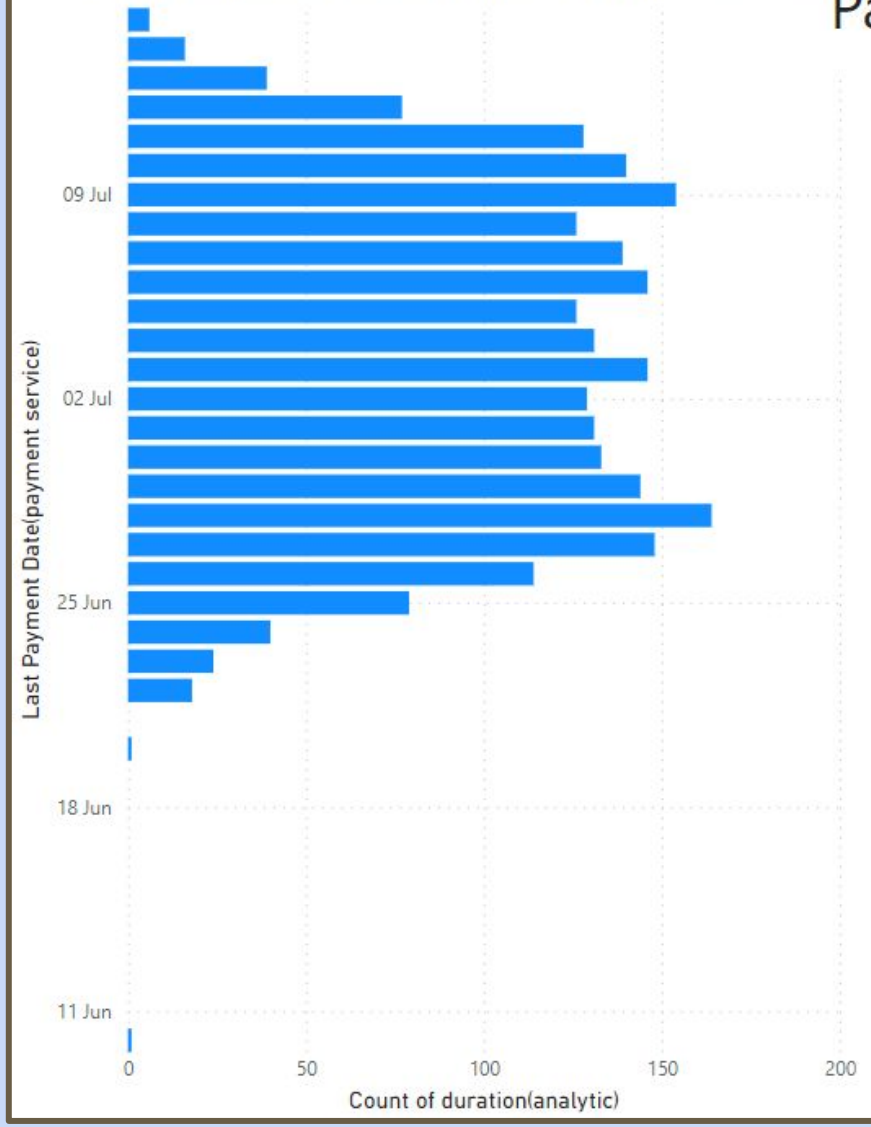
Services

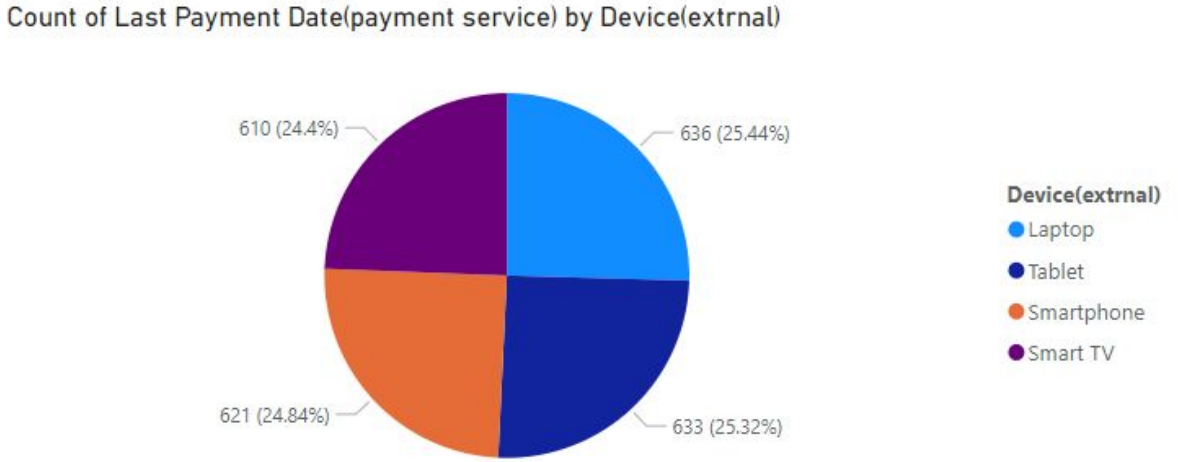
1) Payment Service
2) Content Service
3) Customer Service
4) External Service
5) Analytic Service

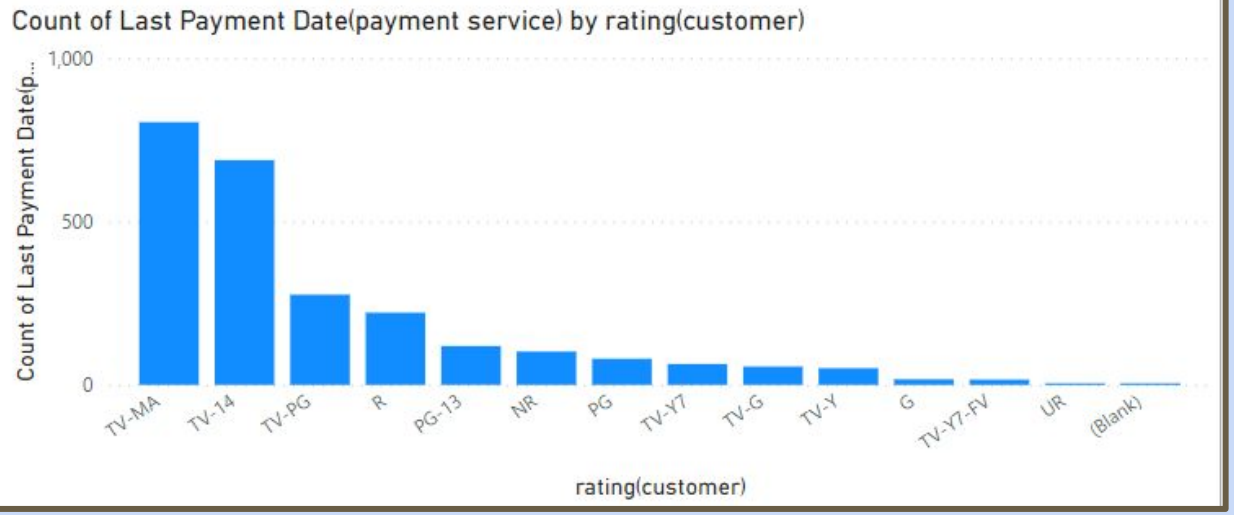
Power BI

+ableau

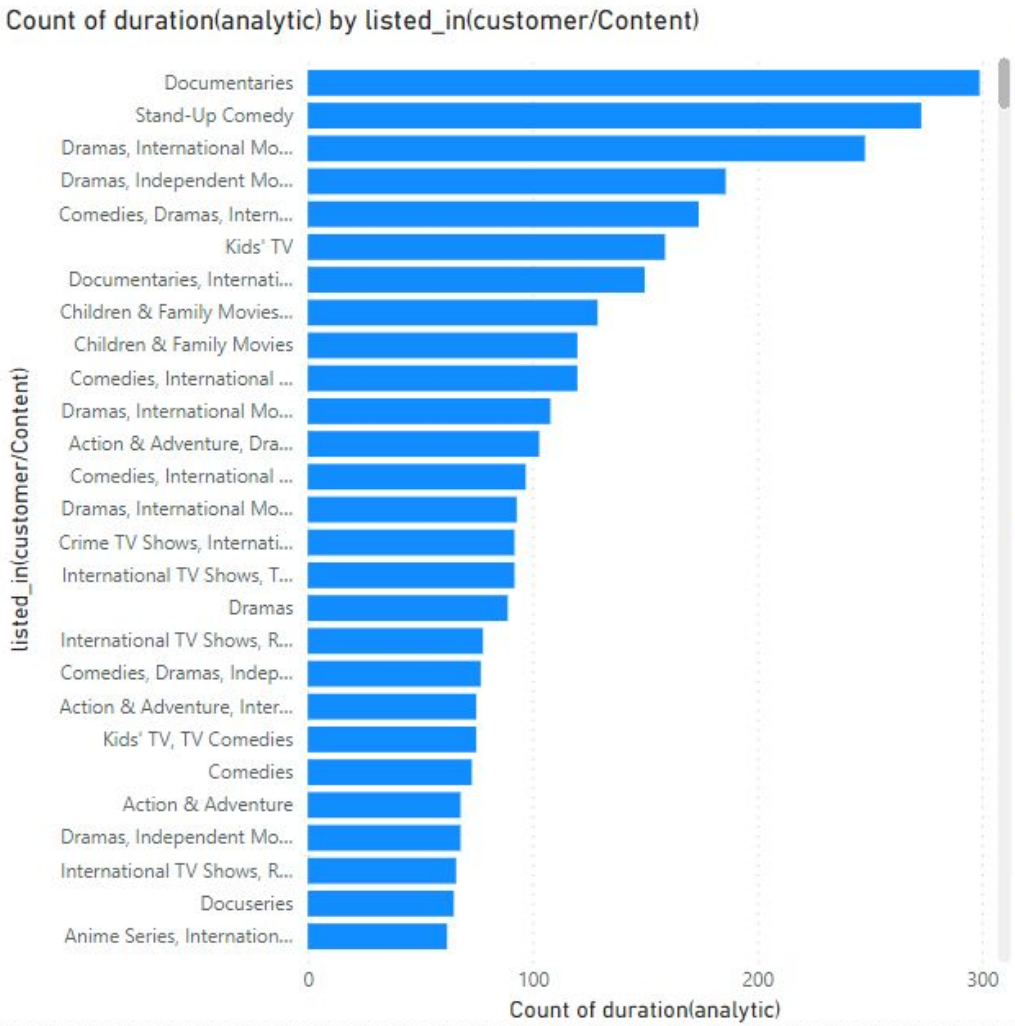
Payment Service

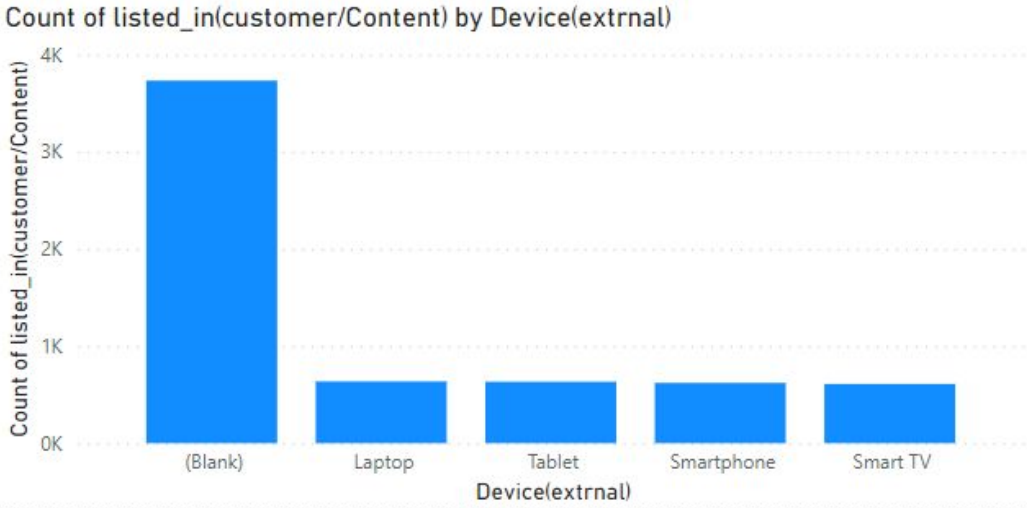




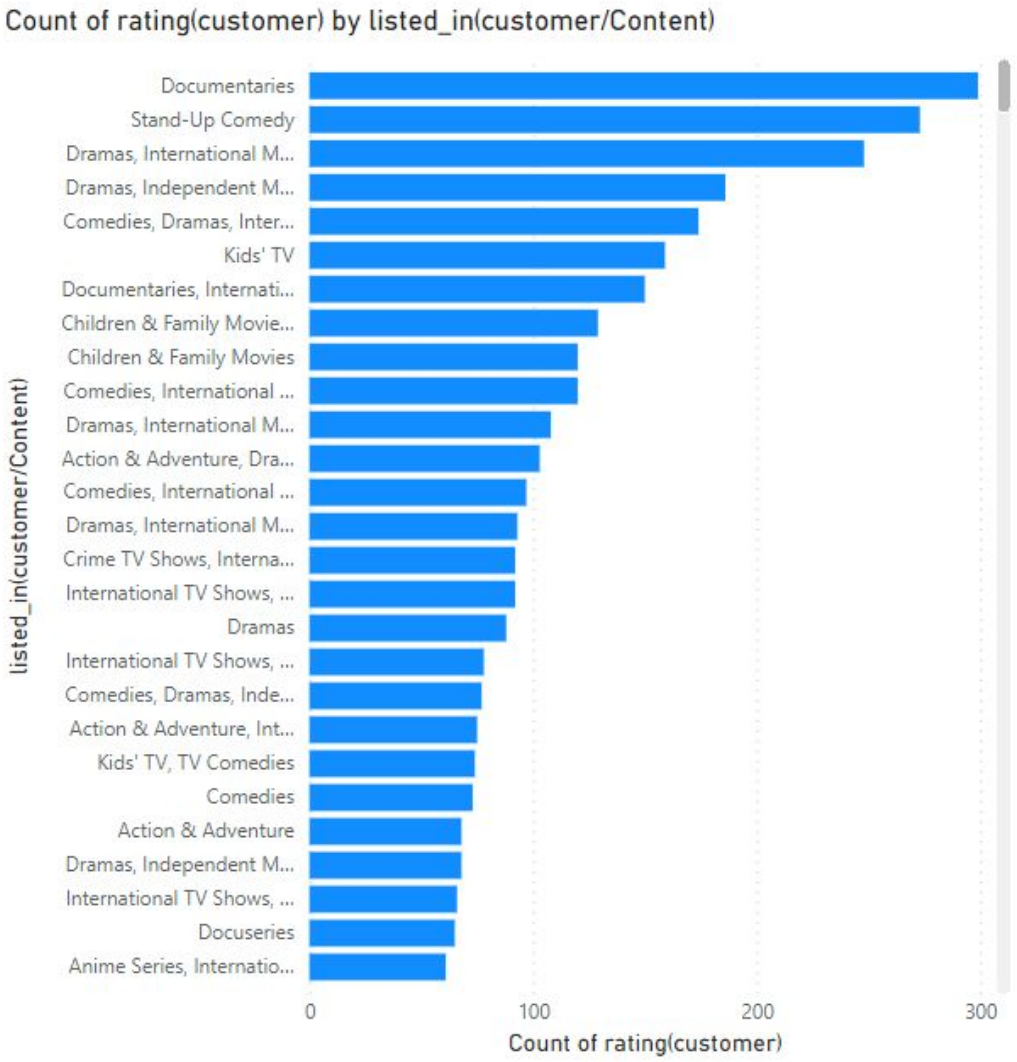


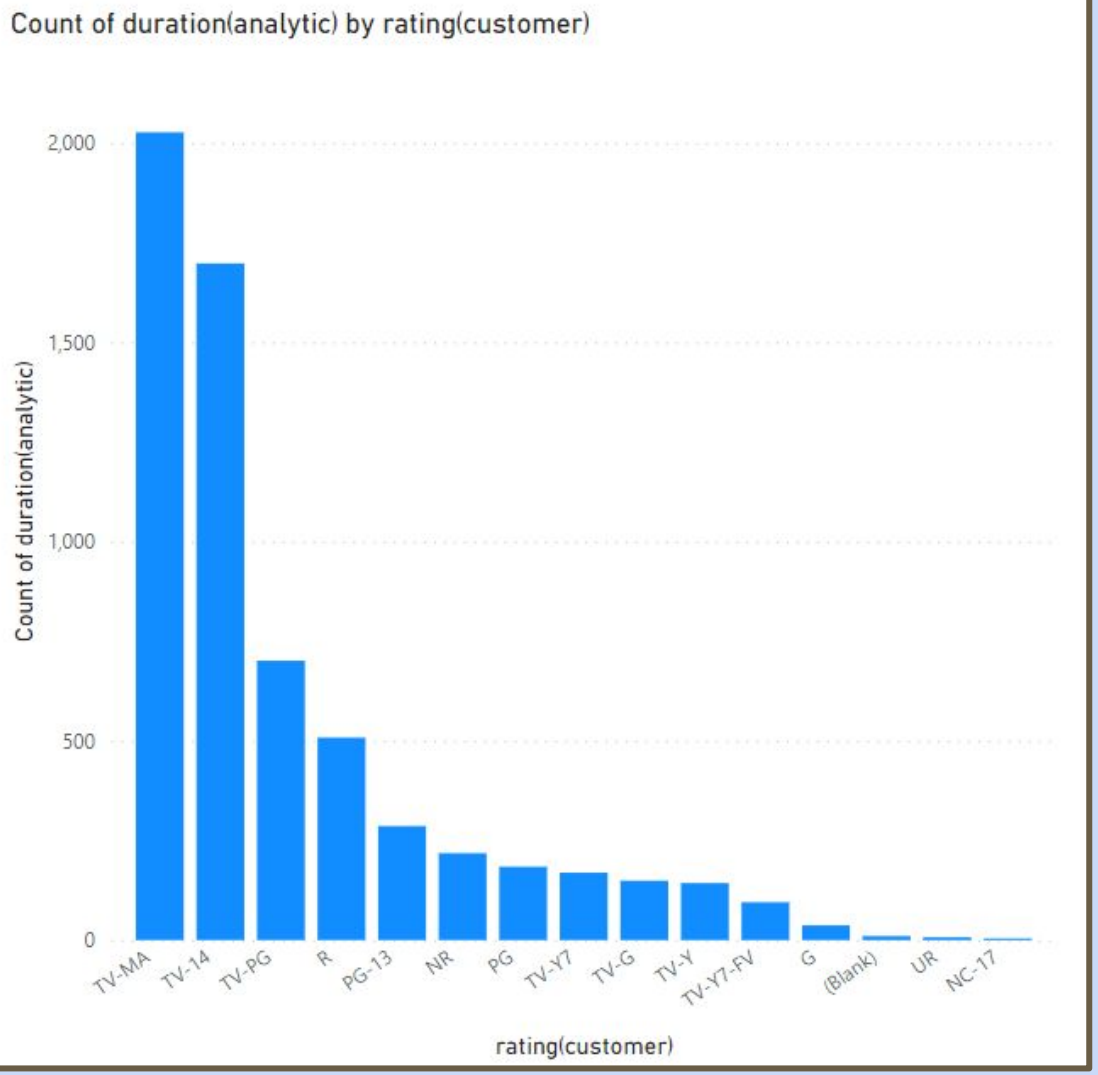
Content Service



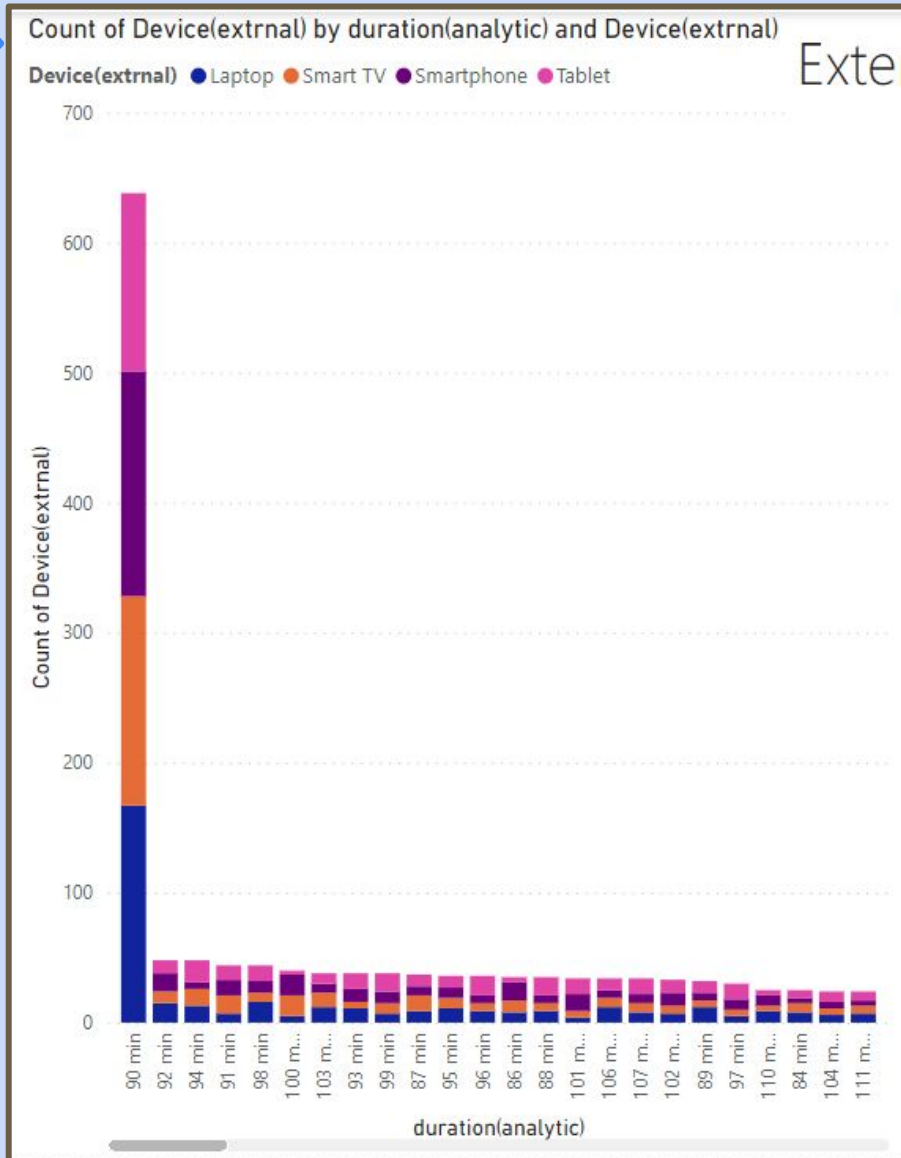


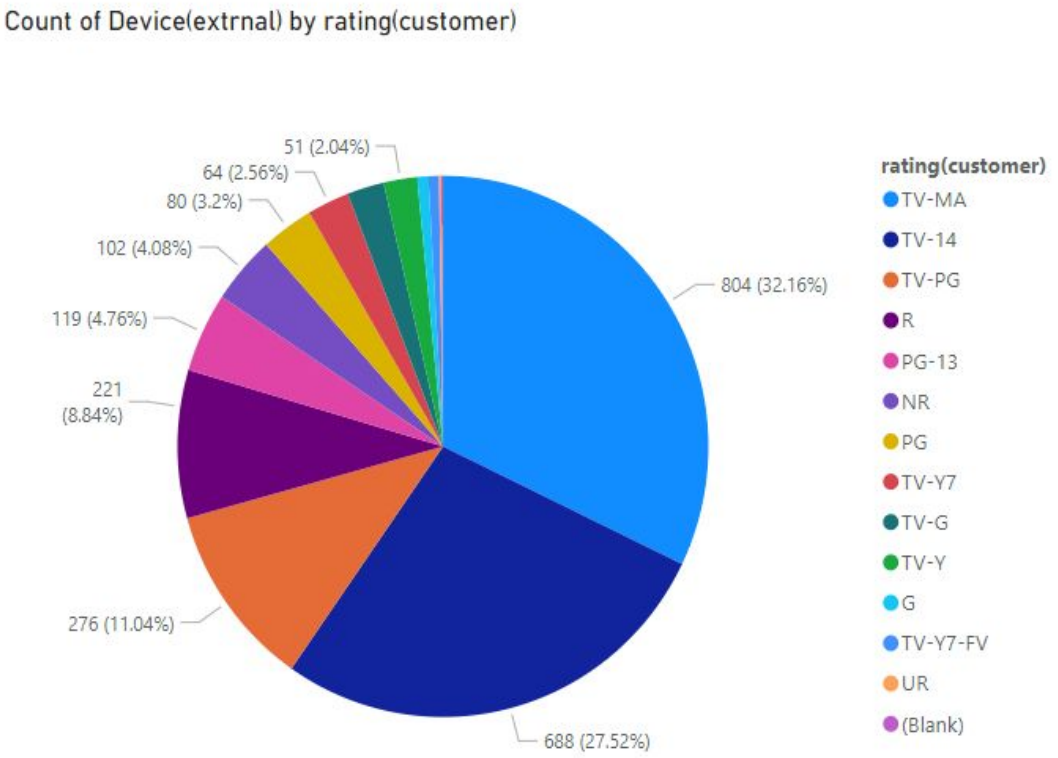
Customer Service

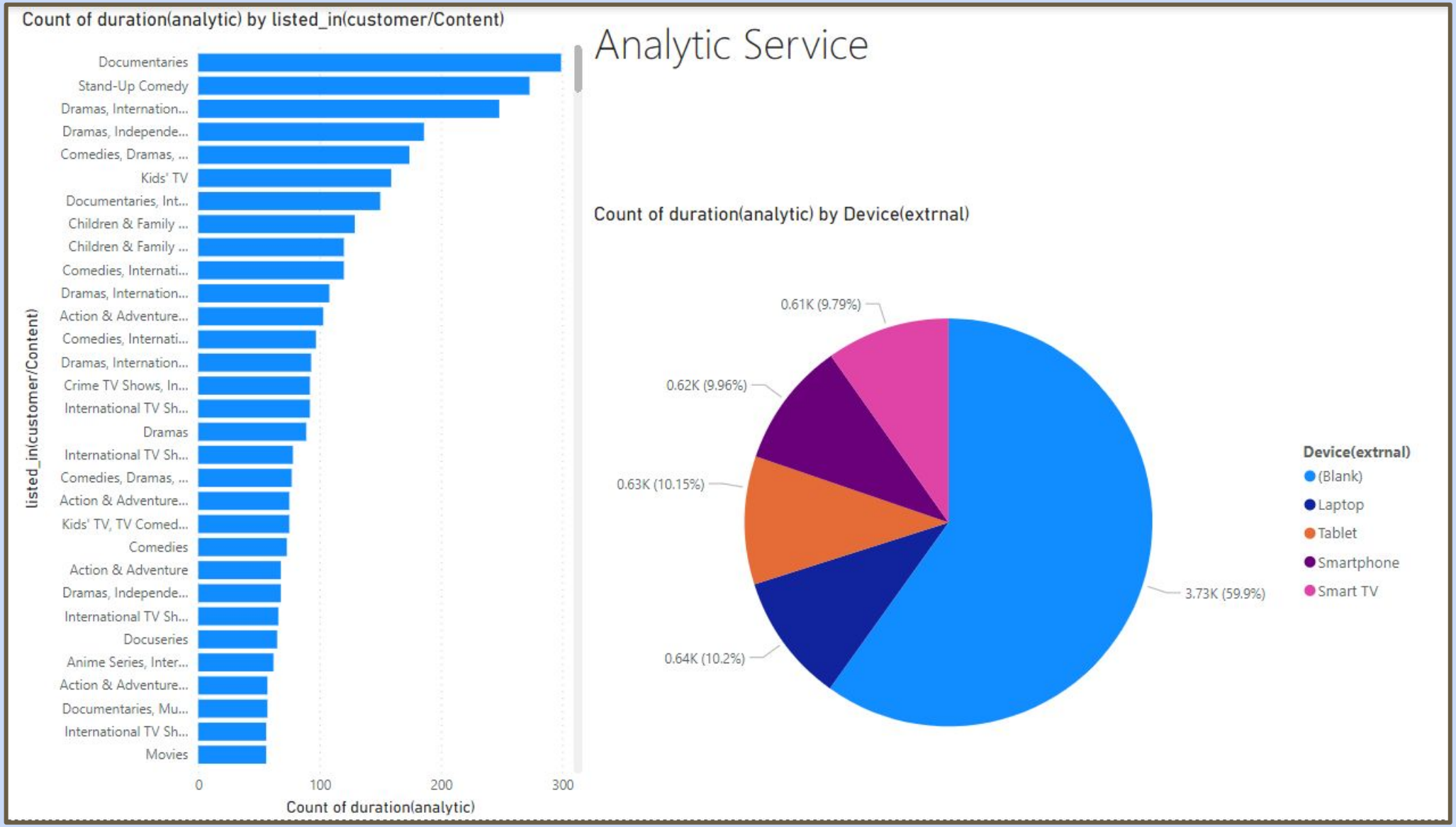




External Service

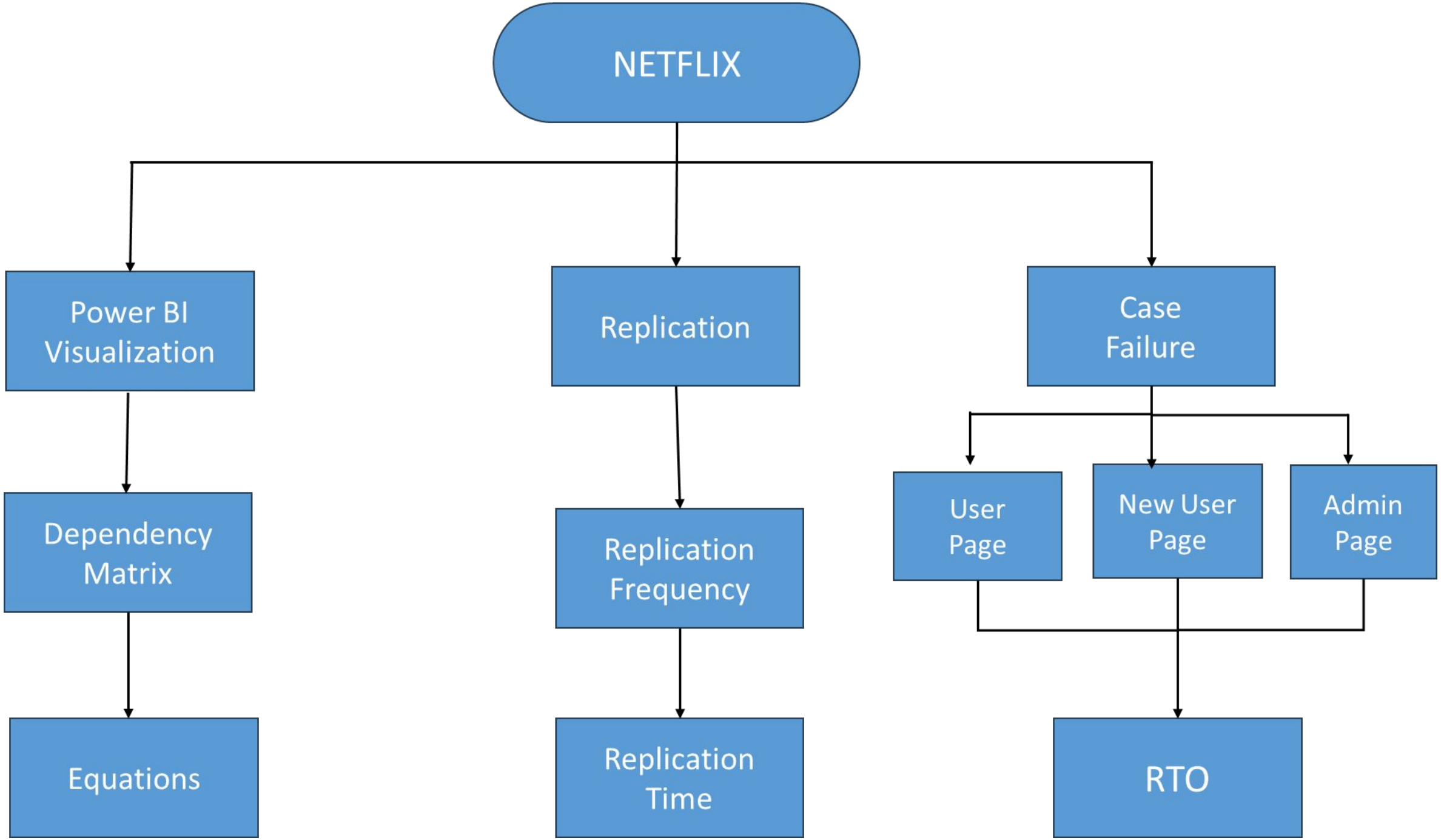





Count of duration(analytic) by listed_in(customer/Content)
Documentaries
Stand-Up Comedy
Dramas, Internation...
Dramas, Independe...
Comedies, Dramas, ...
Kids' TV
Documentaries, Int...
Children & Family ...
Children & Family ...
Comedies, Internati...
Dramas, Internation...
Action & Adventure...
Comedies, Internati...
Dramas, Internation...
Crime TV Shows, In...
International TV Sh...
Dramas
International TV Sh...
Comedies, Dramas, ...
Action & Adventure...
Kids' TV, TV Comed...
Comedies
Action & Adventure
Dramas, Independe...
International TV Sh...
Docuseries
Anime Series, Inter...
Action & Adventure...
Documentaries, Mu...
International TV Sh...
Movies
listed_in(customer/Content)
0
100
200
300
Count of duration(analytic)
Analytic Service
Count of duration(analytic) by Device(extrnal)
0.61K (9.79%)
0.62K (9.96%)
0.63K (10.15%)
0.64K (10.2%)
3.73K (59.9%)
Device(extrnal)
(Blank)
Laptop
Tablet
Smartphone
Smart TV

Dependency Matrix

	Content	User	Playback	Recommendation	Payment	Analytic	External	Customer
Content	0	0	0	1	0	1	1	1
User	0	0	1	1	1	1	0	0
Playback	0	1	0	1	0	1	0	1
Recommendation	1	1	0	0	0	0	1	0
Payment	0	1	0	0	0	1	1	1
Analytic	1	1	1	1	0	0	1	0
External	1	0	0	1	0	1	0	1
Customer	1	1	0	1	0	1	0	0


NETFLIX
Power BI Visualization
Dependency Matrix
Equations
Replication
Replication Frequency
Replication Time
Case Failure
User Page
New User Page
Admin Page
RTO

Dependency Matrix Equations

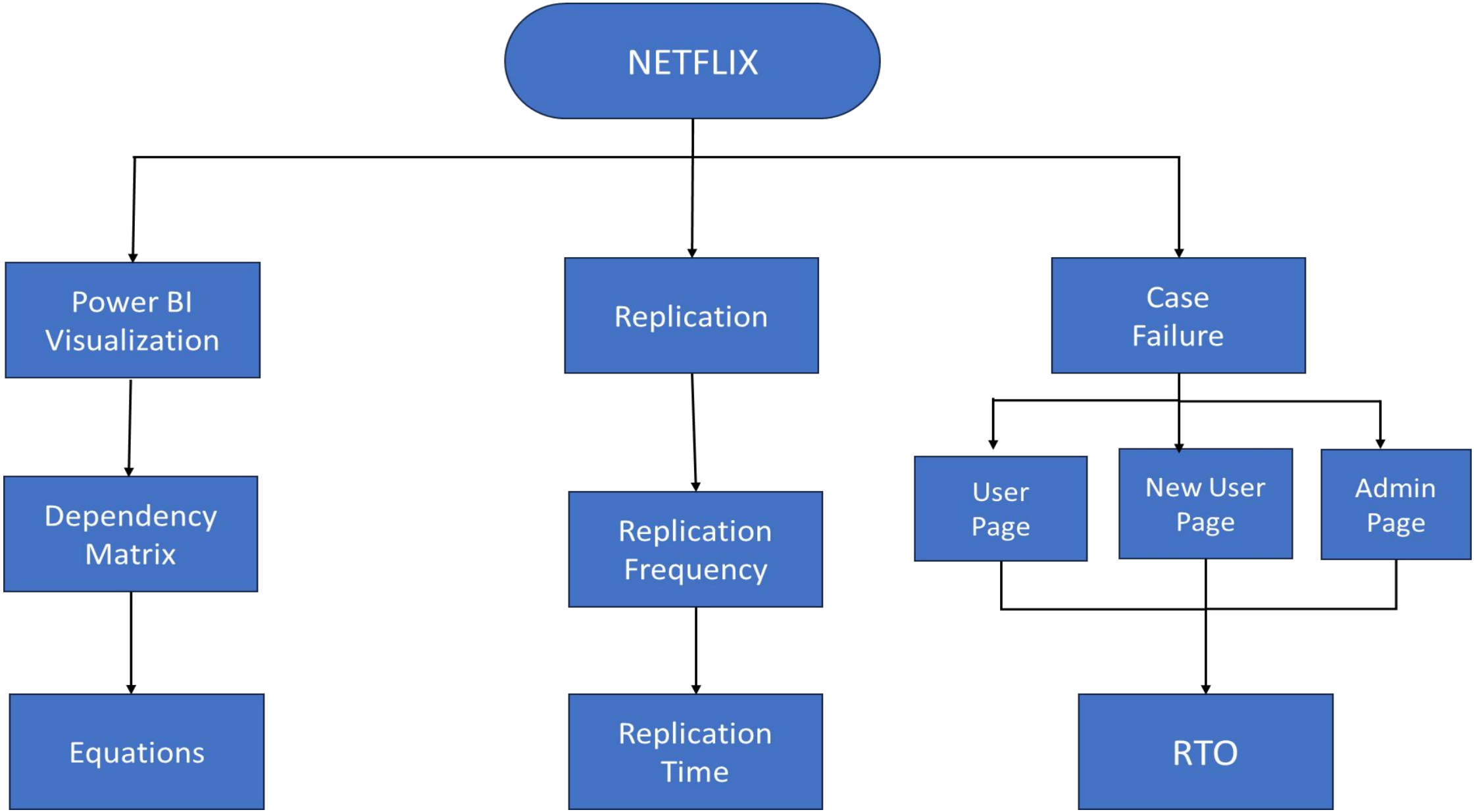
1. Content (A) $x_A = C_{DA} \cdot x_D + C_{FA} \cdot x_F + C_{GA} \cdot x_G + C_{HA} \cdot x_H$
2. User (B) $x_B = C_{CB} \cdot x_C + C_{DB} \cdot x_D + C_{EB} \cdot x_E + C_{FB} \cdot x_F$
3. Playback (C) $x_C = C_{BC} \cdot x_B + C_{DC} \cdot x_D + C_{FC} \cdot x_F + C_{HC} \cdot x_H$
4. Recommendation (D) $x_D = C_{AD} \cdot x_A + C_{BD} \cdot x_B + C_{GD} \cdot x_G$
5. Payment (E) $x_E = C_{BE} \cdot x_B + C_{FE} \cdot x_F + C_{GE} \cdot x_G + C_{HE} \cdot x_H$
6. Analytic (F) $x_F = C_{AF} \cdot x_A + C_{BF} \cdot x_B + C_{CF} \cdot x_C + C_{DF} \cdot x_D + C_{GF} \cdot x_G$
7. External (G) $x_G = C_{AG} \cdot x_A + C_{DG} \cdot x_D + C_{FG} \cdot x_F + C_{HG} \cdot x_H$
8. Customer (H) $x_H = C_{AH} \cdot x_A + C_{BH} \cdot x_B + C_{DH} \cdot x_D + C_{FH} \cdot x_F$

RTO- Recovery Time Objective

The RTO is the target time you set for how quickly you want to recover a service, after it fails.

1) Detection Time (Dt)
2) Diagnosis Time (Dt)
3) Fix Time (Ft)
4) Restoration Time (Rt)
5) Verification Time (Vt)

Total RTO = Dt + Dt + Ft + Rt + Vt


NETFLIX
Power BI Visualization
Dependency Matrix
Equations
Replication
Replication Frequency
Replication Time
Case Failure
User Page
New User Page
Admin Page
RTO

Assigning the Weights

1. Content Service (A - Weight: 0.20):
- Content Ingestion and Catalog Management: 0.05
- Content Recommendation Engine: 0.05
- Content Delivery and CDN Management: 0.03
- Content Metadata Management: 0.04
- Content Licensing and Rights Management: 0.03

2. User Service (B - Weight: 0.10):
- User Authentication and Authorization: 0.03
- User Profile Management: 0.03
- User Preferences and Personalization: 0.02
- User Account Billing and Subscription: 0.02

3. Playback Service (C - Weight: 0.10):
- Video Playback Engine: 0.03
- Audio Playback Engine: 0.03
- Video Quality Optimization: 0.02
- Playback Control and User Interaction: 0.02

4. Recommendation Service (D - Weight: 0.15):
- Recommendation Algorithms: 0.06
- User Behavior Tracking: 0.05
- Content Similarity Analysis: 0.04

5. Payment Service (E - Weight: 0.15):
- Payment Gateway Integration: 0.06
- Subscription Management: 0.05
- Billing and Invoicing: 0.04

6. Analytic Service (F - Weight: 0.10):
- Data Analytics and Reporting: 0.04
- User Engagement Analytics: 0.03
- Content Quality Analytics: 0.03

7. External Service (G - Weight: 0.05):
- Integration with Third-Party Services: 0.02
- External Content Providers: 0.01
- External API Management: 0.02

8. Customer Service (H - Weight: 0.15):
- Customer Support and Helpdesk: 0.07
- Customer Feedback and Surveys: 0.05
- User Community Forums: 0.03

Replication Time

$$\text{Replication Time} = \text{Volume of Data} \times \text{Network Latency} \times 2$$

$$\text{Replication Time (seconds)} = 1\ \text{GB} \times (0.1\ \text{seconds per GB}) \times 2 = 0.2\ \text{seconds}$$

Replication Frequency

Content Service (A - Weight: 0.20):
- Content Ingestion and Catalog Management: Real-time (0 seconds delay).
- Content Recommendation Engine: Every 30-90 seconds
- Content Delivery and CDN Management: Every 60-150 seconds
- Content Metadata Management: Every 90-180 seconds
- Content Licensing and Rights Management: Every 150-300 seconds

User Service (B - Weight: 0.10):
- User Authentication and Authorization: Real-time (0 seconds, 0 minutes delay).
- User Profile Management: Every 30-90 seconds
- User Preferences and Personalization: Every 60-150 seconds
- User Account Billing and Subscription: Every 90-180 seconds

Playback Service (C - Weight: 0.10):
- Video Playback Engine: Real-time replication (0 seconds, 0 minutes delay).
- Audio Playback Engine: Every 60-150 seconds
- Video Quality Optimization: Every 90-180 seconds
- Playback Control and User Interaction: Every 150-300 seconds

Recommendation Service (D - Weight: 0.15):
- Recommendation Algorithms: Real-time (0 seconds, 0 minutes delay).
- User Behavior Tracking: Every 30-90 seconds
- Content Similarity Analysis: Every 90-180 seconds

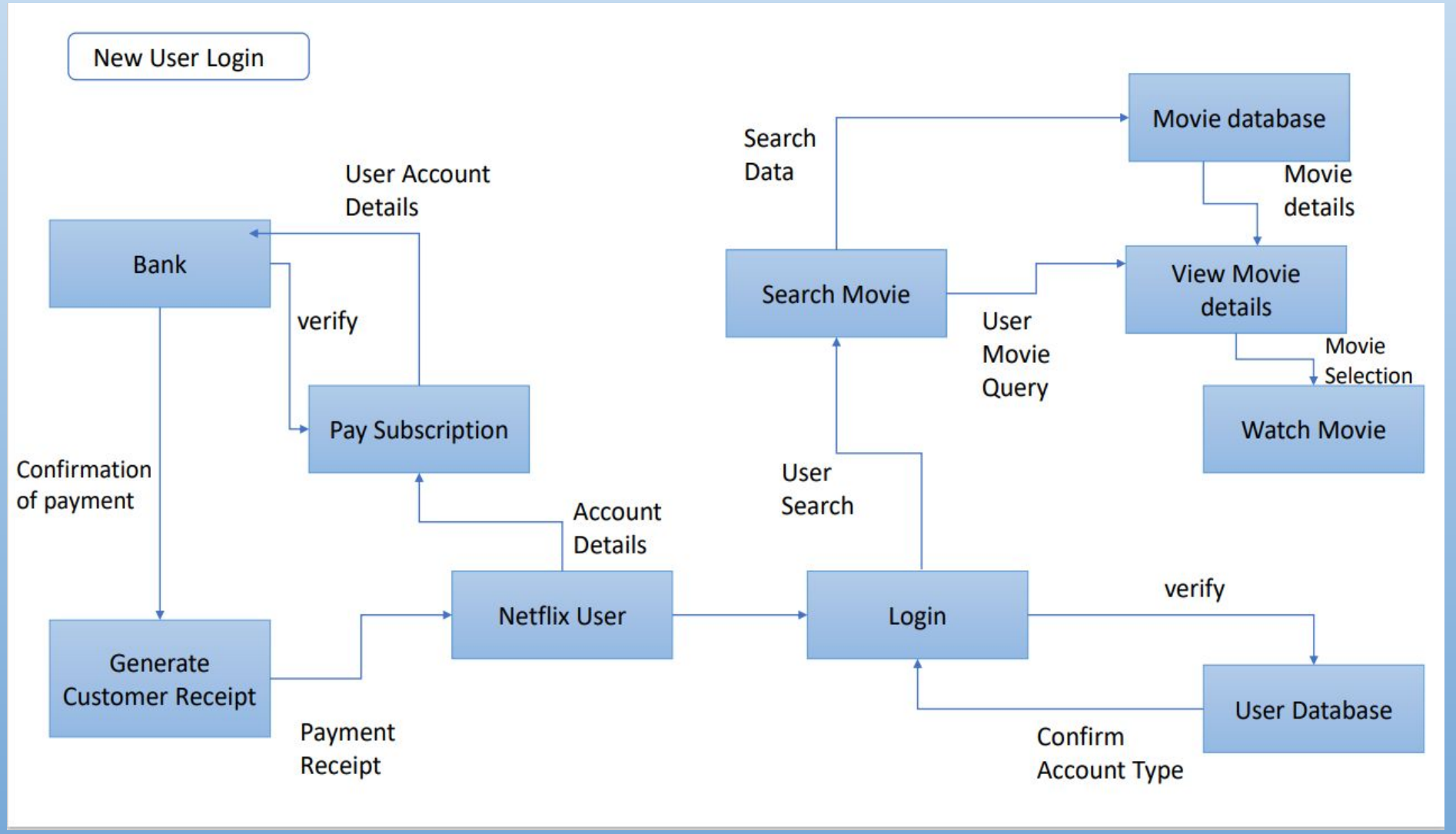
Payment Service (E - Weight: 0.15):
- Payment Gateway Integration: Every 30-90 seconds
- Subscription Management: Every 60-150 seconds
- Billing and Invoicing: Every 90-180 seconds

Analytic Service (F - Weight: 0.10):
- Data Analytics and Reporting: Every 300-900 seconds
- User Engagement Analytics: Every 450-1350 seconds
- Content Quality Analytics: Every 600-1800 seconds

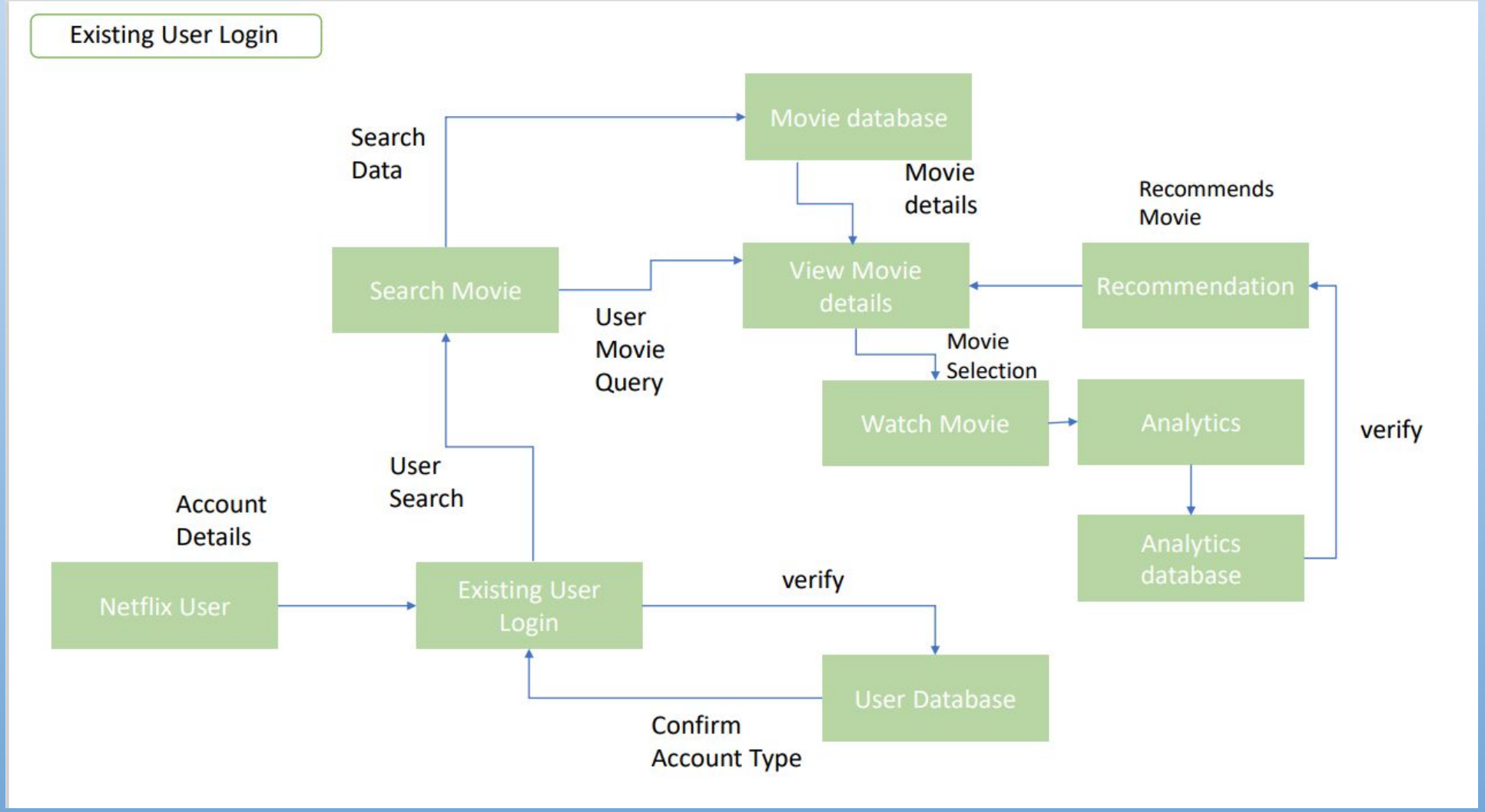
External Service (G - Weight: 0.05):
- Integration with Third-Party Services: Every 60-150 seconds
- External Content Providers: Every 90-180 seconds
- External API Management: Every 60-150 seconds

Customer Service (H - Weight: 0.15):
- Customer Support and Helpdesk: Real-time replication (0 seconds, 0 minutes delay).
- Customer Feedback and Surveys: Every 300-900 seconds
- User Community Forums: Every 450-1350 seconds

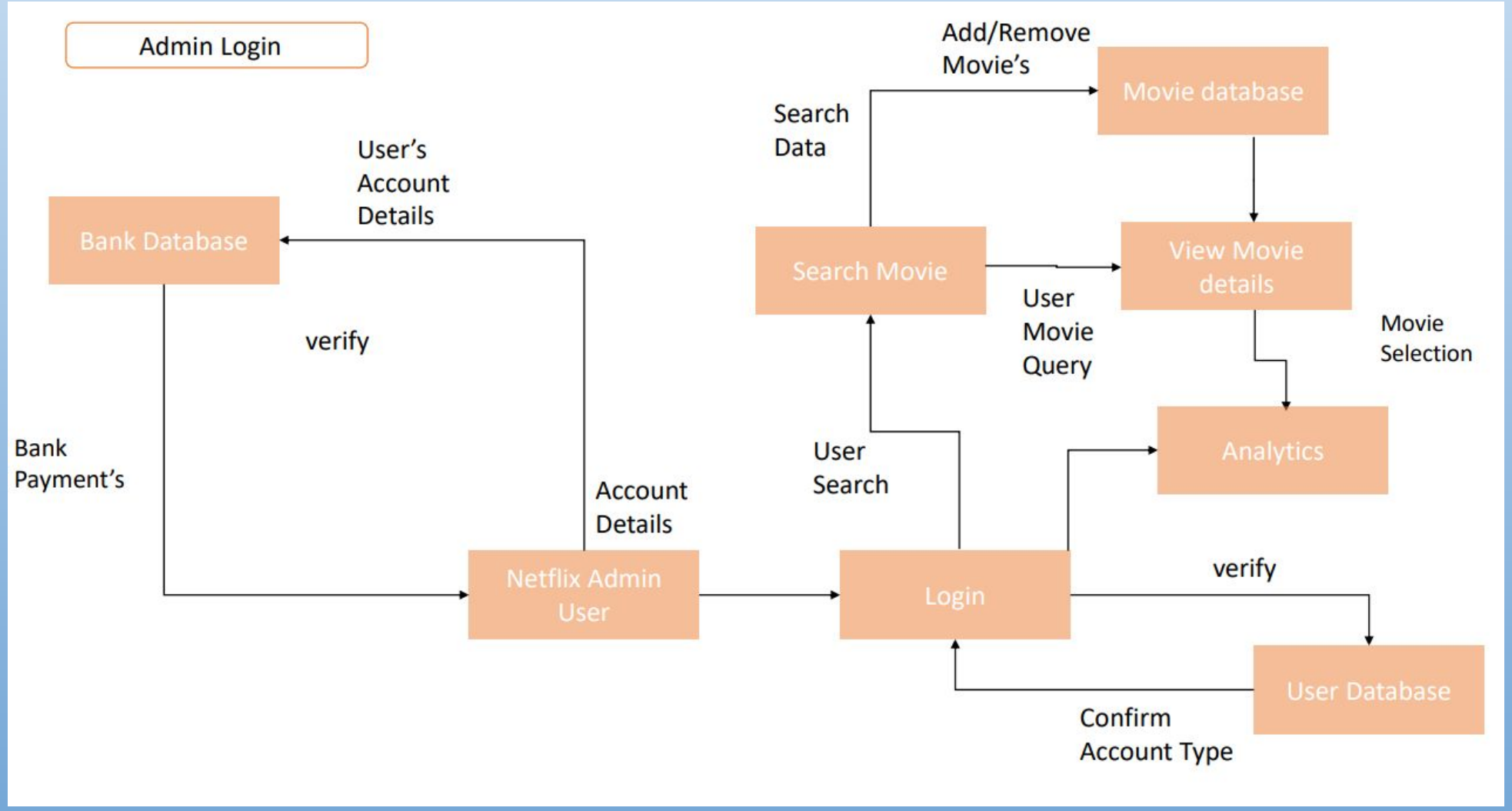
Netflix New User Login Model



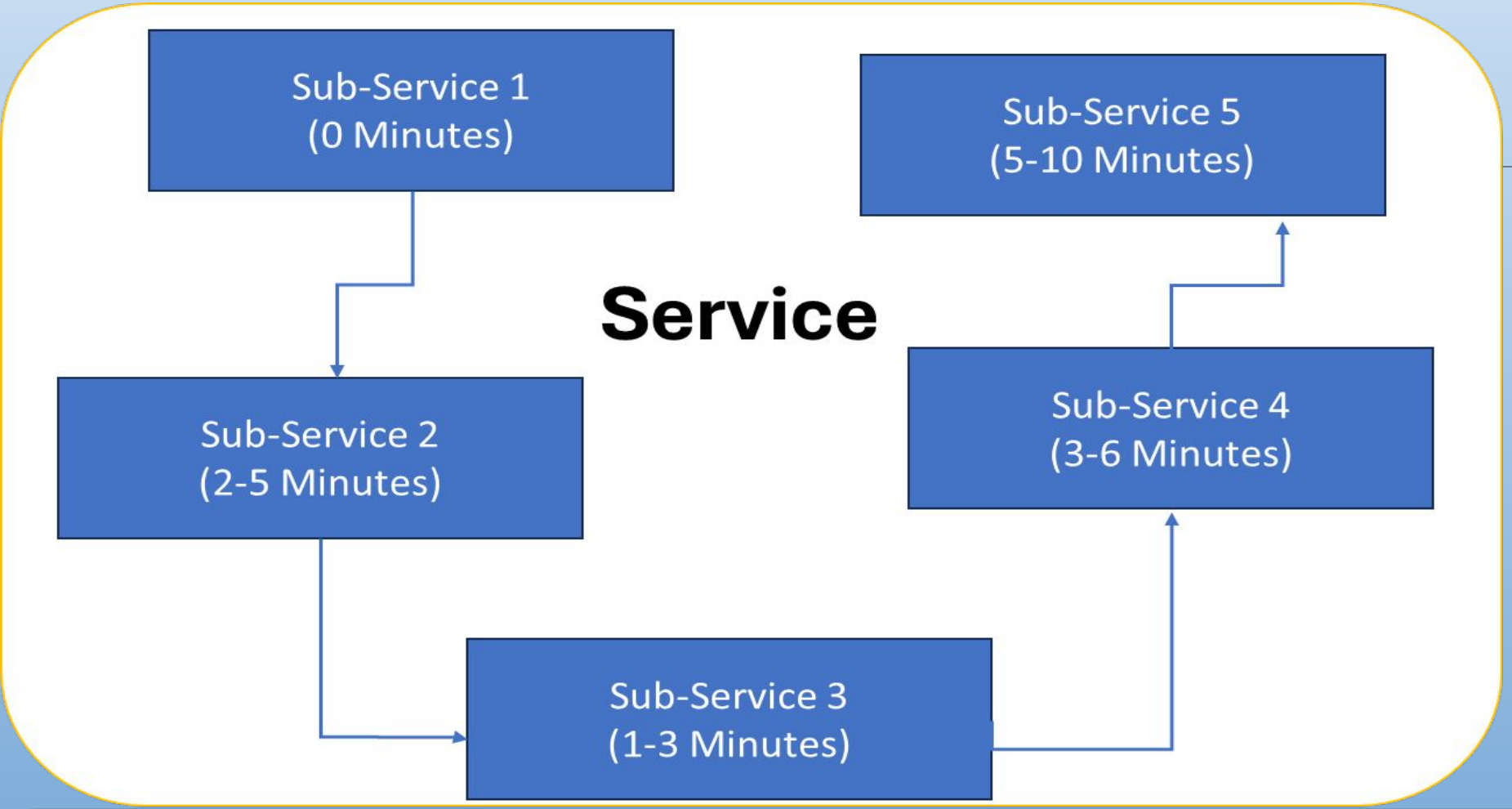
Netflix Existing User Login Model



Netflix Admin Login Model



Replication Time Calculation



Replication Time
24 Minutes

Service Replication time = 0 + 5 + 3 + 6 + 10 = 24 Minutes.

Replication Time Calculation

A) Content Service:
- Content Ingestion and Catalog Management: Real-time replication (0 seconds, 0 minutes delay).
-Content Recommendation Engine: Every 60-180 seconds (1-3 minutes)
- Content Delivery and CDN Management: Every 120-300 seconds (2-5 minutes).
- Content Metadata Management: Every 180-360 seconds (3-6 minutes).
-Content Licensing and Rights Management: Every 300-600 seconds (5-10 minutes).
Total replication time of content service=3+5+6+10=24 minutes

B) User Service:
- User Authentication and Authorization: Real-time replication (0 seconds, 0 minutes delay).
- User Profile Management: Every 60-180 seconds (1-3 minutes).
- User Preferences and Personalization: Every 120-300 seconds (2-5 minutes).
-User Account Billing and Subscription: Every 180-360 seconds (3-6 minutes).
T**otal replication time of user service=3+5+6=14 min**utes

C) Playback Service:
- Video Playback Engine: Real-time replication (0 seconds, 0 minutes delay).
- Audio Playback Engine: Every 120-300 seconds (2-5 minutes).
- Video Quality Optimization: Every 180-360 seconds (3-6 minutes).
-Playback Control and User Interaction: Every 300-600 seconds (5-10 minutes).
Total replication time of playback service=5+6+10=21 minutes

D) Recommendation Service:
- Recommendation Algorithms: Real-time replication (0 seconds, 0 minutes delay).
- User Behavior Tracking: Every 60-180 seconds (1-3 minutes).
-Content Similarity Analysis: Every 180-360 seconds (3-6 minutes).
Total replication time of recommendation service=3+6=9 minutes

E) Payment Service :
- Payment Gateway Integration: Every 60-180 seconds (1-3 minutes).
- Subscription Management: Every 120-300 seconds (2-5 minutes).
- Billing and Invoicing: Every 180-360 seconds (3-6 minutes).
Total replication time of analytic service=3+5+6= 14 minutes

F) Analytic Service:
- Data Analytics and Reporting: Every 600-1800 seconds (10-30 minutes).
- User Engagement Analytics: Every 900-2700 seconds (15-45 minutes).
-Content Quality Analytics: Every 1200-3600 seconds (20-60 minutes).
Total replication time of analytic service=10+15+20= 45 minutes

G) External Service:
- Integration with Third-Party Services: Every 120-300 seconds (2-5 minutes).
- External Content Providers: Every 180-360 seconds (3-6 minutes).
- External API Management: Every 120-300 seconds (2-5 minutes).
Total replication time of external service=5+6+5=16 minutes

H) Customer Service:
- Customer Support and Helpdesk: Real-time replication (0 seconds, 0 minutes delay).
- Customer Feedback and Surveys: Every 600-1800 seconds (10-30 minutes).
- User Community Forums: Every 900-2700 seconds (15-45 minutes).
Total replication time of customer service=10+15= 25 minutes

Replication Time of Services

A) Content Service:
Total replication time =3+5+6+10=24 minutes.

B) User Service:
Total replication time =3+5+6=14 minutes

C) Playback Service:
Total replication time =5+6+10=21 minutes

D) Recommendation Service:
Total replication time =3+6=9 minutes

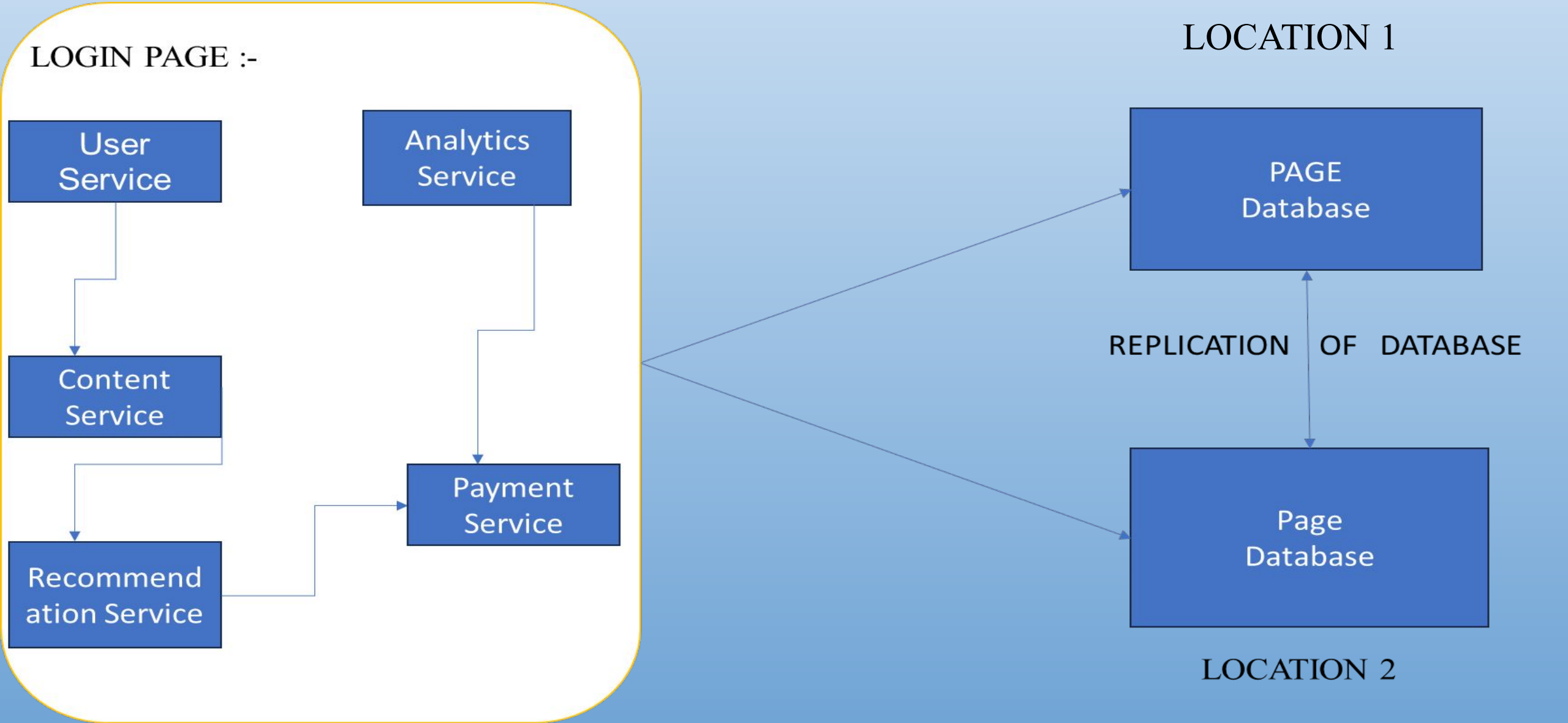
E) Payment Service:
Total replication time =3+5+6=14 minutes

F) Analytic Service:
Total replication time =10+15+20= 45 minutes

G) External Service:
Total replication time =5+6+5=16 minutes

H) Customer Service:
Total replication time =10+15= 25 minutes

Case Failure



Results

Case 1 :- Payment service Failed
Only the payment service hang ; new user can't register :
Expected RTO :- Payment Gateway Integration + Subscription Management + Billing and Invoicing = 3+5+6=14 minutes For Recovery.

Case 2 :- Content Service and Recommendation Failure
Expected RTO which is calculated is :- Content Service + Recommendation Service Time :- 33 Minutes Recovery .

Case 3 :- Login page Failure :
Services Includes:
Expected RTO when the whole page get hang:
User Service + Content Service + Recommendation Service + Payment Service + Analytics Service +External Service=
122 Minutes For Recovery.

References :-

1.Mario Villamizar, Oscar Garcés, Harold Castro, Mauricio Verano, Lorena Salamanca, Rubby Casallas,Evaluating the Monolithic and the Microservice Architecture Pattern to Deploy Web Applications in the Cloud,2015

2.Antonio Bucchiarone, Fondazione Bruno Kessler Nicola Dragoni,From Monolithic to Microservices An Experience Report from the Banking Domain.2018

3.Arne Koschel, Irina Astrova, Jeremias Dötterl,Making the move to microservice architecture,2017

4.Alexander A. Dontsov1 Igor A. Sutorikhin1,2,Development of a geographic information system for data collection and analysis based on microservice Architecture.,2021