TATA CONSULTANCY SERVICES

# Mass Personalizing Smart and Intelligent City Services Using Digital Human Twin

## Abstract

Smart Cities are not just limited to smartness in operations, but they are also a means to improve the quality of life of a citizen. Citizen-centric cities are a pressing need for citizens and for agencies offering these services.

Currently, these services are generic and siloed, requiring multiple hop-in hop-out. Also, if the services do not consider the real-time intent and the context of the citizen engaging with the service, the user will get disengaged in no time.

This demand, that services be designed, developed and orchestrated keeping the citizen at the center, can be made possible with the proliferation of technologies such as Cloud, IoT and AI.

## Introduction

A Digital Twin[1] is a digital representation of physical systems, factoring in real-time data for real-time decision making. While Digital Twins help enterprises reimagine and offer myriad possibilities, here, we try to use the Digital Twin concept and how it can be applied to enhance citizen-centric services in smart cities. This paper explores the concept of the Digital Human Twin.

Digital Human Twins facilitate simulation of a digital representation of a citizen and is enriched with real-time context on orchestrated digital services. This helps predict any abnormal events for citizens and validates various what-if scenarios, providing the citizen with the best choice of engagement.

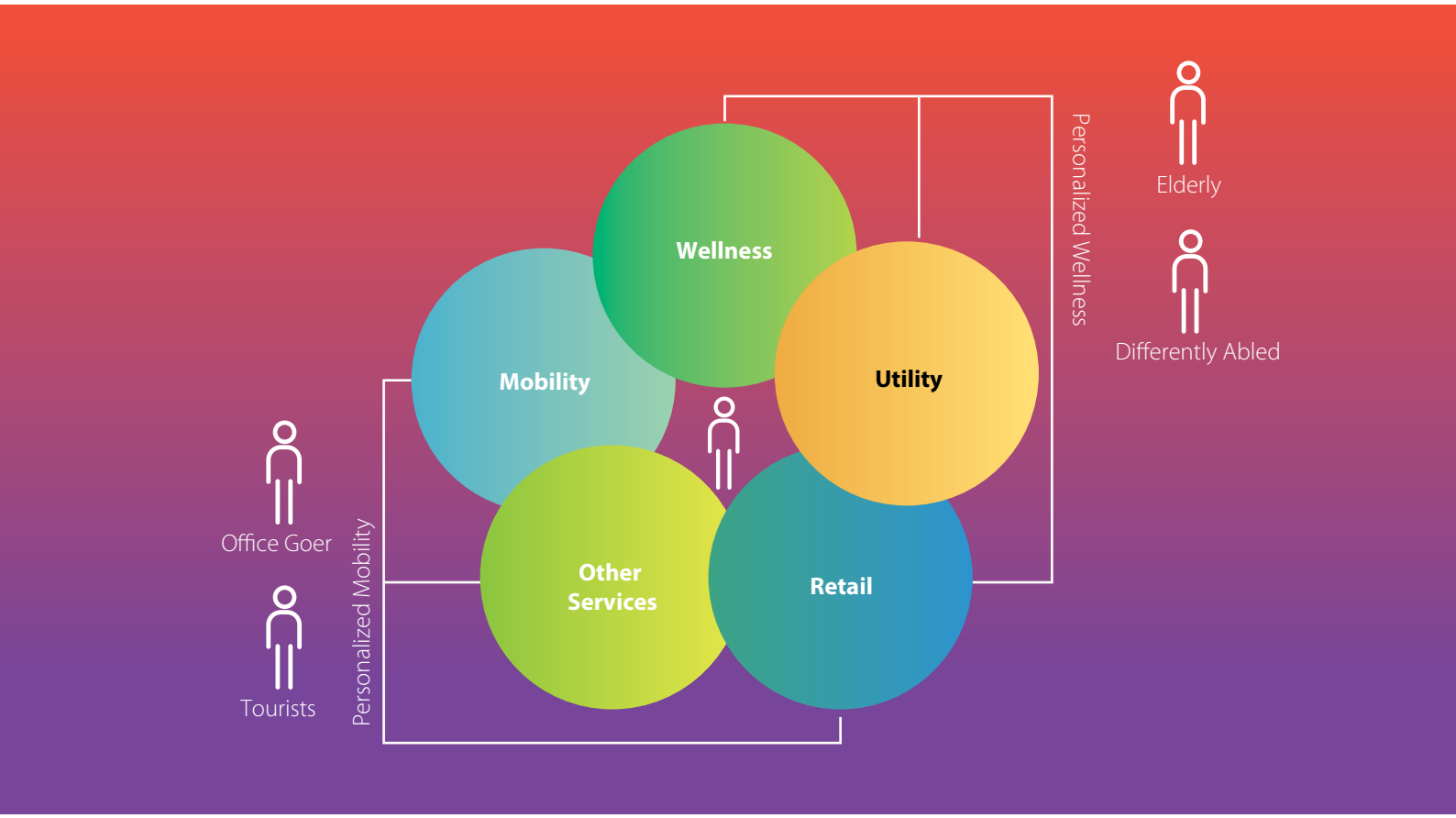


*Figure 1 – Orchestration across multiple services*

Be it urban mobility, social services, or wellness, orchestrating services across multiple service providers is critical to enhance user engagement and make it user -centric. (See Figure 1).

For example, a citizen engagement with an urban mobility provider will orchestrate multiple services offered by other service providers like retailers, public services, and utility services. Here, an urban mobility provider is a multi-mode transport operator. They can provide transport services for point-to-point movement with the different modes of transports that they operate. For example, buses, trains etc. They don't factor in the citizen engaging with the service with a specific intent, or real-time context. Also, they don't orchestrate services across other service providers irrespective of the domain, leading to siloed transactional engagements.

This is where a Digital Human Twin becomes useful.

Conceptually, a Digital Human Twin is enabled by multiple components as represented below in Figure 2.

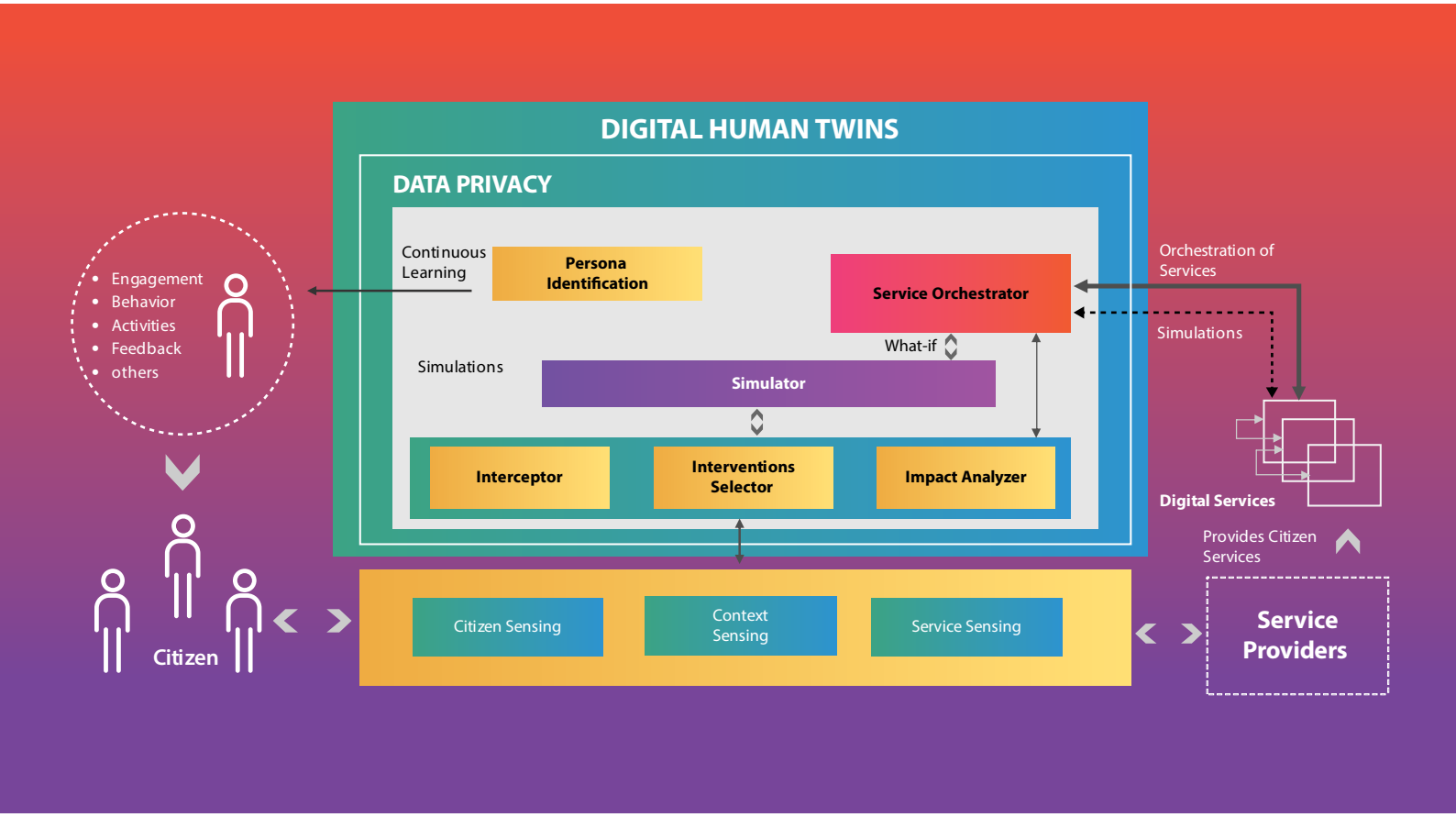


*Figure 2 – Components of a Digital Human Twin*

Key to the concept is a 'persona'. Continuous learning about the citizen from past engagements, exhibited behavior, activities, feedback, preferences help to map the citizen to the most appropriate grouping called personas. Based on the persona, further personalization of services becomes possible. At any moment in time, the twin has real-time information about the citizen (information that can be detected) and this is shared. Sensing real-time will help in understanding the current state and behavior of the citizen and service they are engaging with. For example, in the case of mobility, the current state and behavior would include a citizen's walking speed, location, network delays, accidents and so on.

So, how does the twin know which services are more appropriate for the citizen? The three pillars of interceptor, intervention selection and impact analyzer help in contextualization, appropriate intervention and impact assessment.

## Interceptor

The interceptor [see Figure 3] comes into play when there are:

- Changes in citizens' behavior, state
- Service interruptions, delays and breakages
- Infrastructure challenges
- Environment and other challenges

## Intervention Selector

The interceptor Invokes the intervention selector [see Figure 3] to call appropriate interventions to understand the impact on the citizen. These interventions include:

- Identifying the impact by calling the impact analyzer
- Checking for alternate orchestrations and invoking simulations for a what-if analysis
- In case of an impact, the interventions to identify alternate orchestrations of services by calling back the intervention selector. What-ifs are performed again to validate alternate orchestrations.

## Impact Analyzer

Impact analyzer [see Figure 3] performs various calls to orchestrators to assess impact.

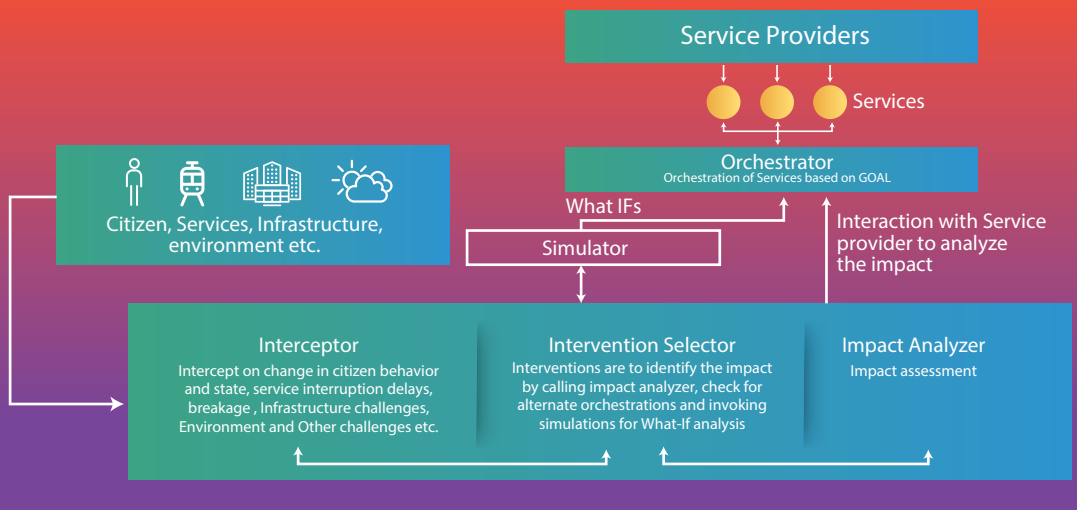


*Figure 3 - Interceptor, Intervention Selector and Impact Analyzer*

The right choice of service and personalization will depend on simulating for possible scenarios and choosing the right intervention and orchestration. Multiple possible orchestrations of digital services are created keeping the contextual data about the citizen as the focus. This is used to augment a contextually enriched citizen on different orchestrations to validate various what-if scenarios.

All possible orchestrations (engagements) that will help the citizen achieve their goal at that point and at that time are suggested as options for the citizen to choose from. The citizen always has the control. This process continues till the citizen completes the engagements.

But the immediate concern this raises is that of privacy[2].

Digital Human Twin uses both generic information and information that the citizen consents to, to be tracked. The extent of transformation to citizen-centricity / personalization differs based on the information available, which in turn evolves from "no personalization", to "limited personalization" or "mass personalization". Privacy will be under the control of the citizen, except for regulators -- their access is to be determined by policy.

It is true that even with a subset of data shared by the citizen, it is sometimes possible to infer the true identity of the citizen by augmenting it with other data. Clear policies and ever improving privacy techniques, therefore, need to be implemented.

The application of Digital Human Twins cuts across multiple domains. COVID-19 has brought to the fore the concept of Personal Twins in the health domain too[3]. The Digital Human Twin concept thus cuts across citizen services in different domains.

How an urban commuter leverages Digital Human Twin in personalization is illustrated below.

## Illustration of an Urban Commuter

Digital Human Twins can be applied where personalization is critical. Their use cases are across domain, and typically across providers, where multiple services get orchestrated to achieve a citizen's commuting goals. We describe here a sample use case on urban mobility that uses Digital Human Twin to transform it to personalized urban mobility. Traditional urban mobility suffers from the following limitations:

- Every journey is the same, and individual preferences are not considered
- Limited collaboration leading to no / limited benefit sharing
- Real-time context is not considered while engaging with the citizen
- Citizen disengages often from public transport and opts for private mobility options

John Smith, who aims to reach office before 9am using urban transport, will engage as seen in Figure 4 below:

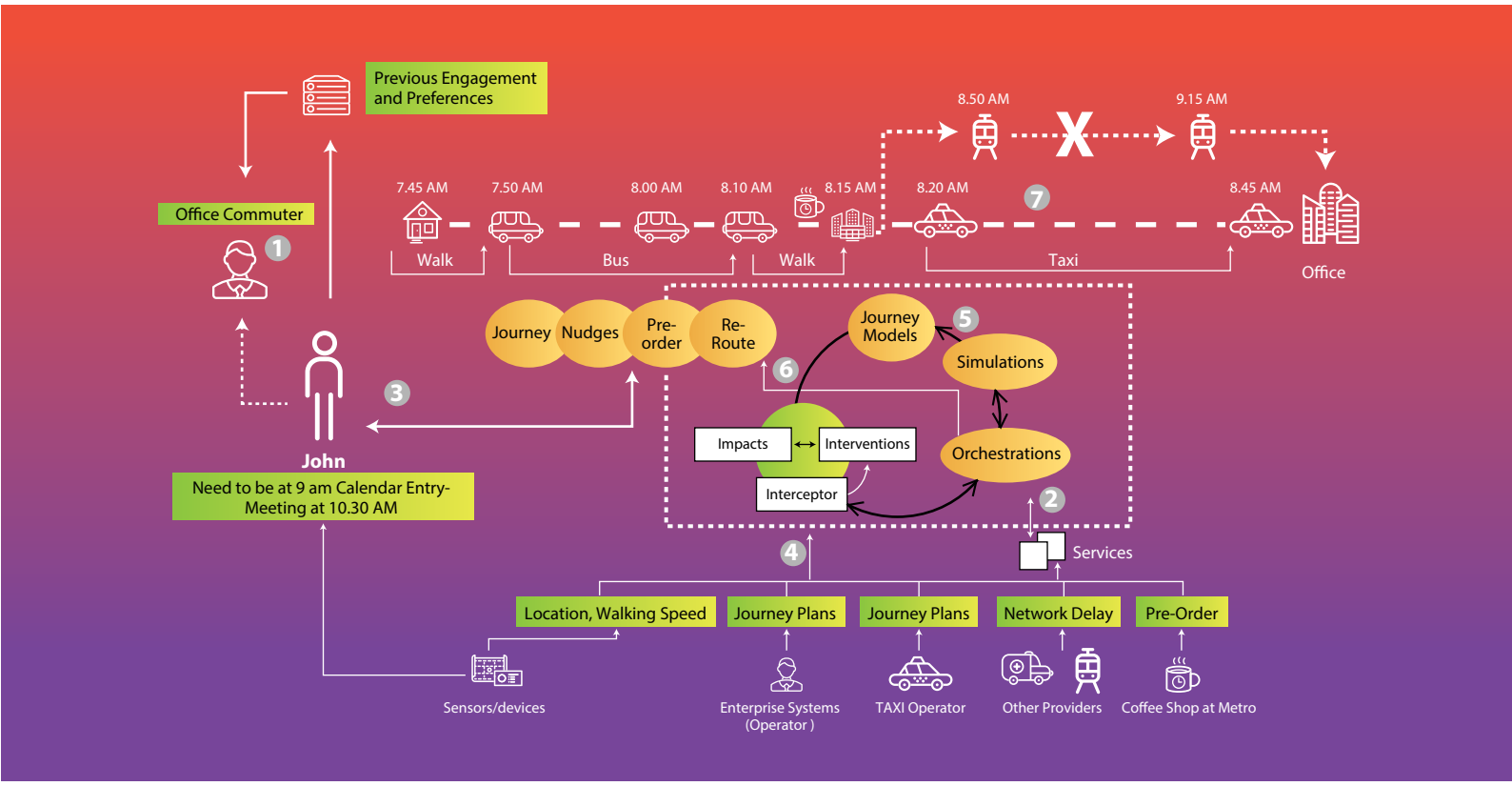


*Figure 4: John Smith as an office commuter, leveraging Digital Human Twins*

1. By continuous learning on past engagements, activity patterns, John, who subscribed to the services, gets mapped to an 'office commuter' persona.
2. The interceptor at 7am will call the intervention selector for appropriate interventions to check with the different mobility providers to facilitate itineraries for him based on goal at destination and preferences. Here, the goal is to reach the office by 9am and preferences could be Metro and Taxi as mode of transport during winter, including a coffee break at a café. The mobility service provider being a multiple mode operator uses their inhouse routing engine to

provide options for the commute. This is based on the office commuter persona, the need at that point and at that time and the preferences. The difference from the traditional approach is that here, the system can facilitate more details to the operator/provider to facilitate a

3. journey plan which helps John in meeting his needs and preferences.

   John selects one of the options or refines the criteria to avail the next possible option. The system informs the operators/providers about John's choice.

4. In parallel, the system starts the process of capturing John's location, walking speed and other real-time information and passes it on to interceptor. The system will also aggregate information from transport operators such as network delays, accidents, and weather conditions -- factors that could impact John's journey.

5. An appropriate intervention looks for changes in context and validates if it impacts the time to destination by the impact analyzer. For example, the system detects that John will miss the bus based on his walking speed.

6. This is where simulations come in. In case of an impact, multiple alternate journey plans are simulated. What-ifs are performed to find the ETA for each journey plan. These journey plans will include multiple options like change in route, change of mode, continue in same mode, combining modes etc.

7. Based on the outcome of simulation, John is suggested with a newer set of options, all meeting his needs.

8. John chooses the most preferred option and continues his journey. His choices and preferences are saved for future engagements.

## Key Considerations

Digital Human Twins can be a powerful way to model citizens and their interactions with digital services. However, there are a few considerations.

- Any restriction imposed by the citizen on the type of information captured, can bring down the extent of personalization.
- The ability to personalize the service and to deliver benefits is based on the amount of data from the past.
- The network of service providers becomes a differentiator. The more freely they share data among themselves, the easier is it to simulate the various options for the citizens through simulations.
- It is a complex task to achieve collaboration among multiple agencies. Information exchange using common standards is critical.

## Conclusion

We have seen that the Digital Human Twin is an elegant way to create a digital model of a citizen and connecting and predicting the best engagements for them.

Personalization of services are made possible. Orchestrating multiple services providers, eliminating multiple siloed interactions, and facilitating a collaborative environment for the citizen, and at the same time enabling benefit sharing among providers – all become possible.

"What-if" can be done at two levels – 1) To predict on the engagement and possible outcomes which will be realized on successful completion of the engagement. 2) At the aggregate level by the regulator, government and the service providers while designing services for citizen.

Real-time simulations using Digital Human Twin will derive macro insights on city services.

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