SRI LANKA GOVERNMENT ENTERPRISE ARCHITECTURE

The Whole of Government Approach

Version 1.0

Information and Communication Technology of Sri Lanka (ICTA)

Contents

Revision History

DATE	VERSION	AUTHOR	DESCRIPTION
25/04/2022	V 0.1	ICTA	Draft Version – Initial
31/12/2022	V 0.2	ICTA	Draft Version - Second
18/04/2023	V 1.0	ICTA	First Version

1.0 Introduction

The Sri Lanka Government Enterprise Architecture (SL-GEA) is the whole of government architectural approach for a digitally inclusive Sri Lanka. It is a decision-making policy framework, which helps agencies to develop scalable, secure, and resilient digital capabilities by promoting reuse and unlocking emerging technologies.

This will eventually improve how government services are delivered to citizens, government organizations and businesses in a seamless manner.

2.0 What is an Enterprise?

An Enterprise is an organization or a cross organizational entity which supports a defined business scope. It includes independent resources such as people, organizations, and technologies whose functions must be coordinated, and information and knowledge resources shared to support common priorities and activities.

3.0 What is an Enterprise Architecture (EA)?

An Enterprise Architecture (EA) is a complete expression of an enterprise. It basically describes the goals of an organization, how these goals are realized by business processes and how these business processes can be better served through technology.

Furthermore, it can be used as a strategic planning tool for governments by facilitating the creation of linkages and improving interoperability among government agencies, benefiting both agency level business processes and as well as an improved public service delivery.

Some of the key benefits of having a well-defined Enterprise Architecture are:

1 Strategic Alignment
2 Cross Agency Collaboration
3 Capability Development
4 Business System Integration
5 Change Management
6 Technology Convergence

4.0 EA Frameworks (EAF)

In a large enterprise, a defined framework is necessary to capture a vision of the entire organization in all its dimensions and complexities.

The EA Framework (EAF) is a communication model for developing an Enterprise Architecture. It is a set of models, principles, services, approaches, standards, design concepts, components, visualizations, and configurations that guide the development of specific aspect architectures.

It is a generic problem space and a common vocabulary within which individuals can corporate to solve a specific problem.

There are multiple popular EAFs are in the market, such as:

1 The Open Group Architecture Framework (TOGAF) [1]
2 Zachman Framework for Enterprise Architecture [2]
3 US Government Federal Enterprise Architecture Framework (FEAF) [3]
4 Gartner Enterprise Architecture Framework (GEAF) [4]

All these EAFs are having its own evolution, purpose, scope, principles, structures, and approaches.

Developing a complete enterprise architectural model of every element in any enterprise is a complex and daunting task. Such an EA effort may prevent important cross business area collaboration processes, which are critical to the overall successful definition and implementation of the EA.

The level of enterprise architectural detail within the EA should be governed by the overall objectives of achieving collaboration, alignment, validation, and the ability to implement and assess the risk.

5.0 Enterprise Architecture Domains

In TOGAF, there are four (04) main overlapping EA domains discussed. This is known as the BDAT Framework (Figure 01).

1 **B**usiness Architecture
2 **D**ata Architecture
3 **A**pplication Architecture
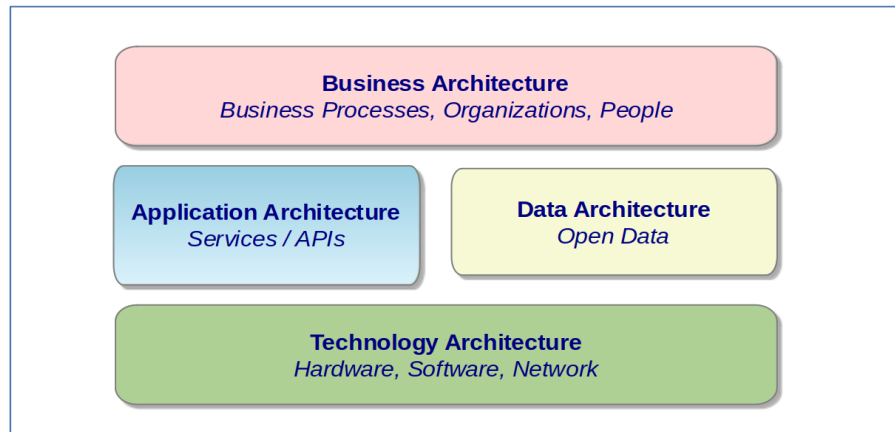4 **T**echnology Architecture

Figure 01 – BDAT Framework

The Business Architecture, defines the enterprise business outcomes, functions, capabilities and end-to-end business processes and their relationships to external entities required to execute business strategies.

The Data / Information Architecture defines the structure and utility of information within an organization, and its alignment with its strategic, tactical and operational needs.

The Application Architecture defines the structure of individual systems based on a defined technology

The Technology Architecture defines the technology environment and infrastructure

6.0 Enterprise Architecture Reference Models

In FEA [3], multiple Reference Models can be leveraged to identify duplicate investments, gaps, and opportunities for collaboration within and across government agencies.

With this approach, all government agencies can find wasteful and duplicate investments / applications, areas where investments could be made and where departments and agencies can collaborate each other to improve government operations and services.

There are five (05) Reference Models identified in a typical FEA setting and these could be very much applied to Sri Lanka GEA as well.

1 Performance Reference Model (PRM)
2 Business Reference Model (BRM)

3   Service Reference Model (SRM)
4   Data Reference Model (DRM)
5   Technical Reference Model (TRM)

Performance Reference Model (PRM)

PRM is a framework for performance measurement providing common output measurements throughout the Government. It allows agencies to better manage the business of government at a strategic level by providing a means for using an agency's enterprise architecture (EA) to measure the success of information systems investments and their impact on strategic outcomes.

This can be used to:

1   Promote strong alignment between business initiatives and agency and government strategies and outcomes.
2   Facilitate efficient and effective business operations.
3   Develop accurate cost models for ICT capabilities and services.
4   Increase effectiveness of infrastructure and cross agency capital investments
5   Increase transparency in operations and reporting on progress and performance.

Business Reference Model (BRM)

BRM is a function driven framework, which explains the business operations of the government independent of the government agencies.

BRM allows agencies to classify the functions of government program into a defined structure. It provides value to business architecture by providing:

1   A functional view of agency business.
2   A standard classification of business functions
3   Identifying reusable services

Service Reference Model (SRM)

SRM provides a framework, which classify service components with respect to how they support business/ performance objectives. It helps to identify opportunities for re-use of business components and services.

Government *agency level service classification* is the key output of this effort.

SRM provides value by providing a framework for:

1 Cataloging services
2 Identifying gaps and duplicate or redundant services
3 identifying reusable services

Data Reference Model (DRM)

Provides a flexible framework that supports information sharing and reuse across the government. This provides a uniform data management practice by enabling agencies to agree, establish and support a common language and standards for information sharing.

Government wide *Interoperability Frameworks (IF)* are being used for this purpose.

Technical Reference Model (TRM)

TRM is a component-driven technical framework used to identify standards, specifications, and technologies that and enable the delivery of service components and capabilities.

This can be used to:

1 Generate software and hardware inventories
2 Classify ICT standards
3 Identify Gaps, duplicate and redundant technology components

7.0 Sri Lanka Government Enterprise Architecture (SL-GEA)

Like most of the countries, which are ranked higher in e-Government rankings [5], Sri Lanka also have adopted a connected Digital Strategy Road map aligning to Enterprise Architectural concepts [6].
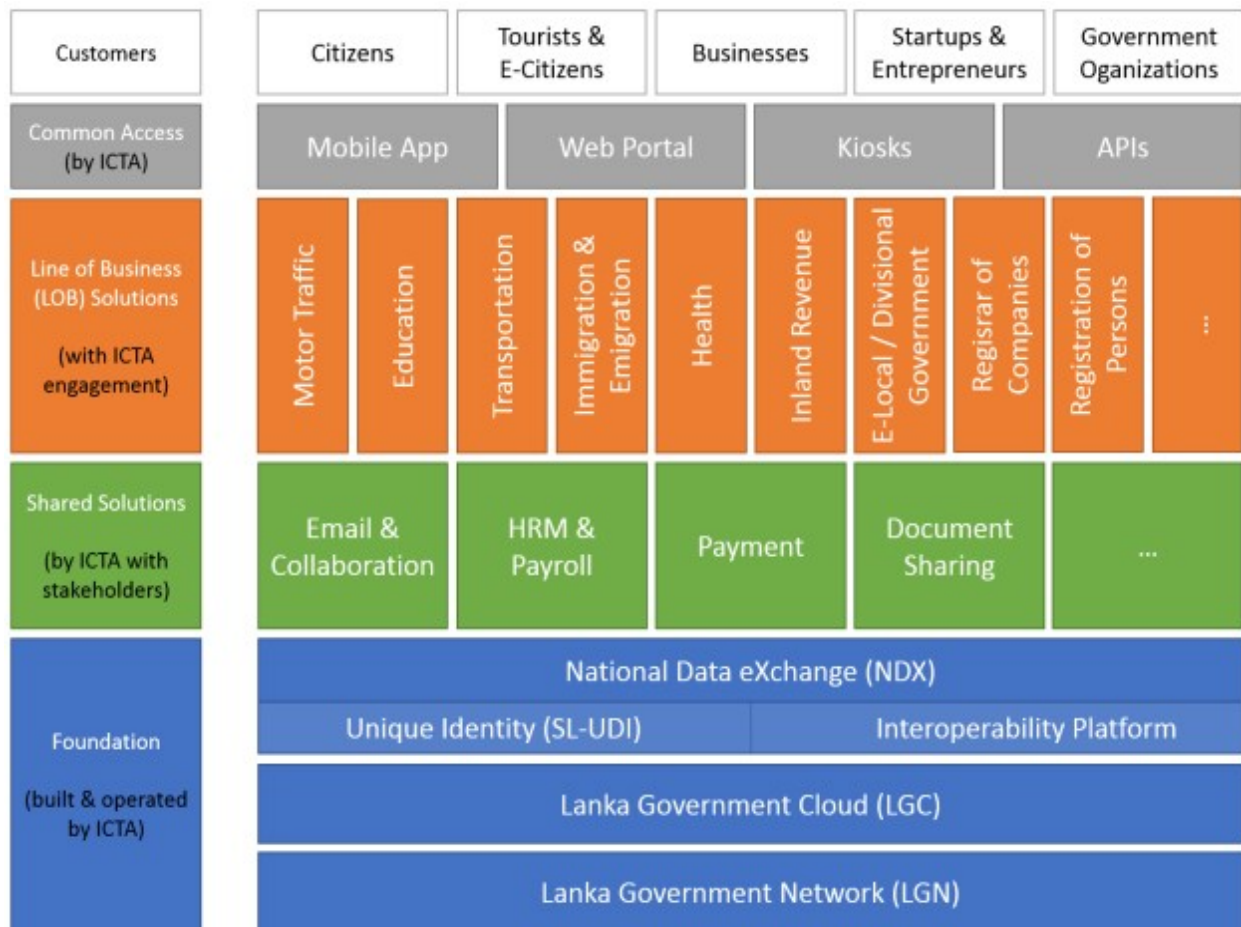

Figure 02 - Digital Government Strategy Blueprint [6]

The Sri Lanka Digital Strategy Blueprint (Figure 02) primarily focuses on three (03) key *values*:

1   Citizen First
2   Government as Platform
3   Empowered Government Officer

and, it has four (04) key strategies:

1. **Citizens and business focused solutions** – A more user and business centric approach is adopted
2. **Shared digital services and platforms** – A set of key and strategically important digital services are developed
3. **Developing a highly available and secure systems** – All the digital services, which are developed will be resilient to threats and high loads. These services will be supported with a more robust digital infrastructure
4. **Unified approach towards a digital transformation** – Digital services developed can be integrated in a seamless manner giving more emphasis to government agency level data and technological interoperability.

In addition to *values* and *strategies* discussed, there are three main levels are shown in the Digital Strategy Road map (Figure 02).

1. Foundational / Core Services
2. Shared Solutions / Services
3. Line of Business (LoB) Solutions / Services

The BDAT Framework under the TOGAF EA, has been the base of designing the Sri Lanka Government Enterprise Architecture (SL-GEA).

While designing the Digital Sri Lanka strategy,

Foundational / Core Services → Mapped to *Technical, Data* and *Application* architecture domains

Shared Services and Line of Business Services → Mapped to Business Architecture domain

In the SL-GEA context, the BDAT Framework can be mapped to a layered architecture with four (04) key layers (Figure 03).

1. Application and Data Layer
2. Service Layer
3. Integration Layer
4. Service Delivery Layer

Out of these four layers, the Application, Data and Service layers are conceptualized within **organizational level**, and they represent application / data back-ends along with service APIs.

The integration layer and the service delivery layer are conceptualized within **national level** and reside within ICTA managed government core infrastructure.
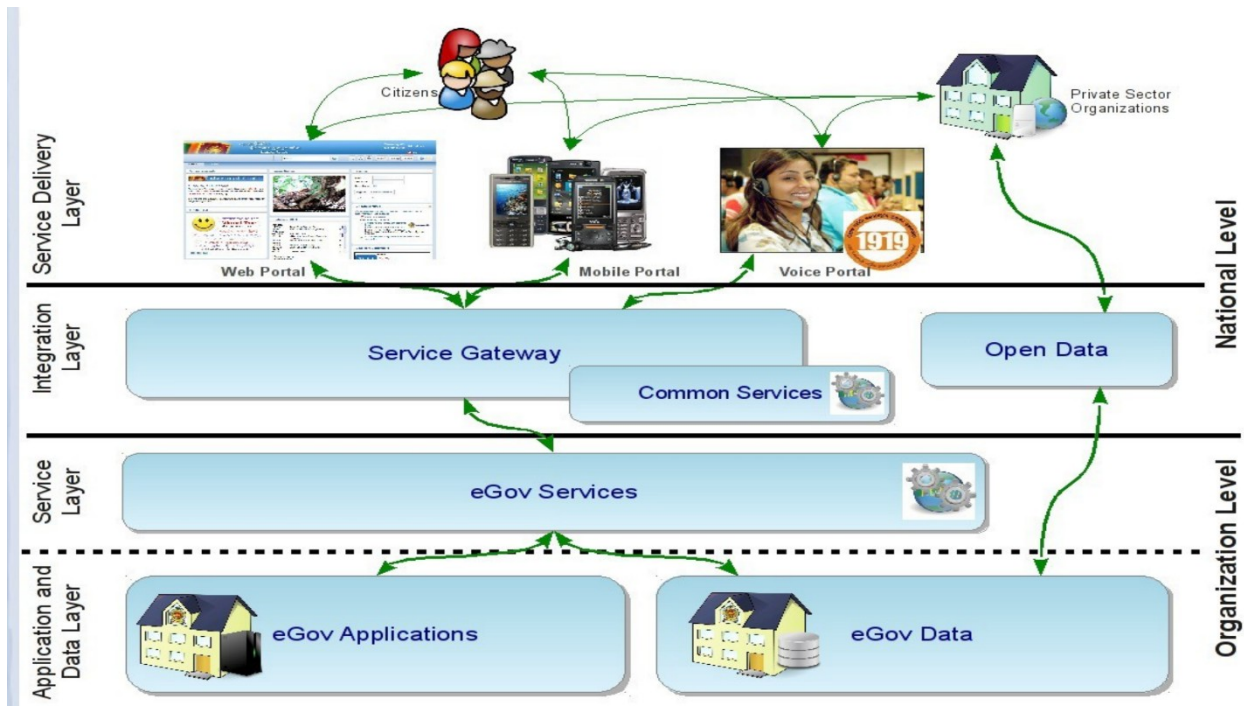

Figure 03 – The Layered Architecture

All these core services, shared services, line of business services and other supporting services are part of the Whole-of-Government / Connected Government approach and they are summarized in Figure 04.
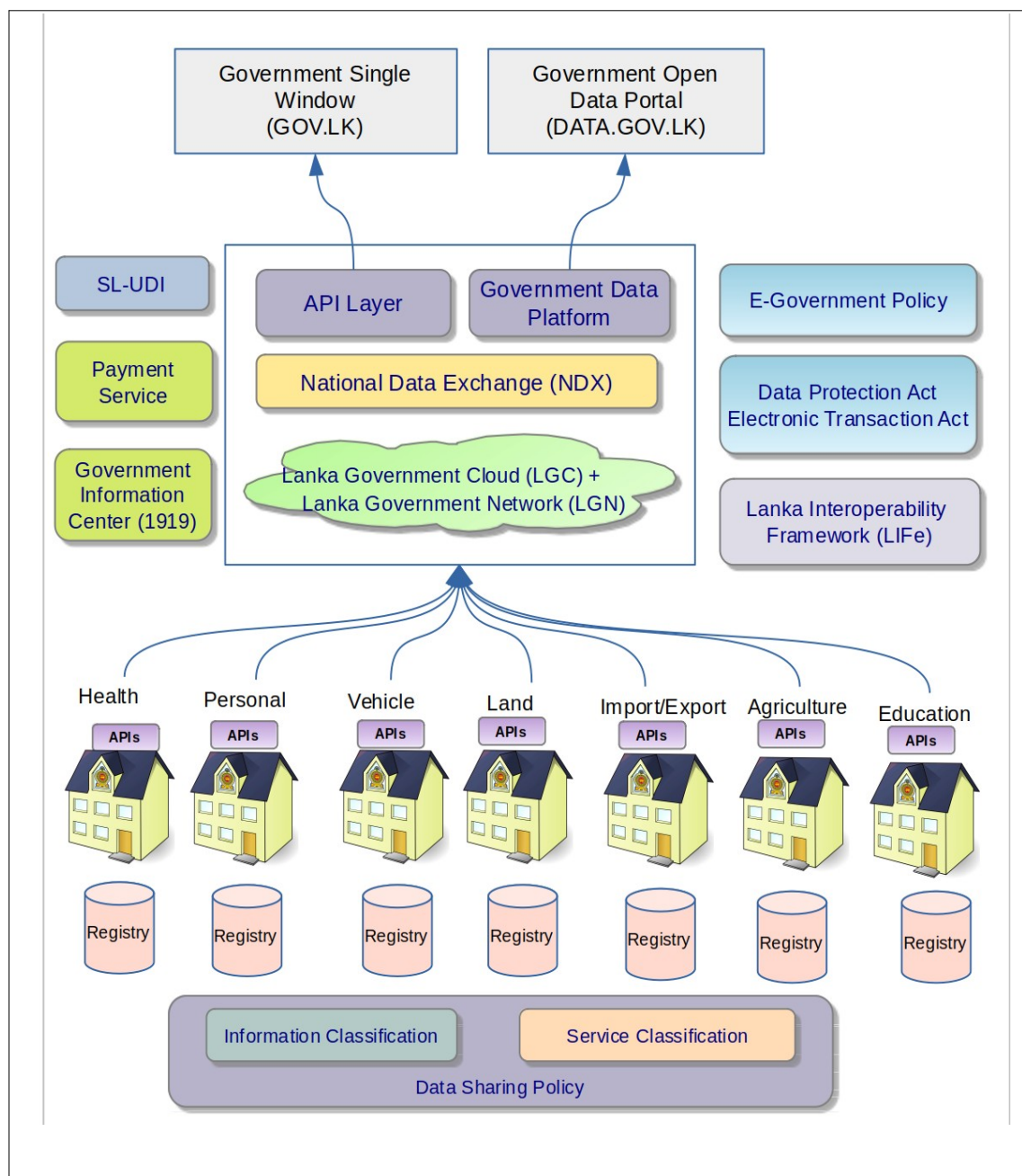
Figure 04 – The Whole-of-Government / Connected Government

8.0 Foundational / Core Services

The Foundational / Core Services of Sri Lanka Digital Road map are as follows:

1. SL-UDI (Sri Lanka Unique Digital Identify)
2. National Data Exchange (NDX)
3. Lanka Government Network (LGN)
4. Lanka Government Cloud (LGC)
5. Lanka Interoperability Framework (LIFe) – life.gov.lk
6. Lanka Government Payment Service (LGPS)
7. GovSMS Portal
8. Government Single Window Portal - gov.lk
9. Open Data Portal – data.gov.lk
10. Government Information Center (GIC) – gic.gov.lk
11. National Spatial Data Infrastructure (NSDI) – nsdi.gov.lk
12. Digital Government Policies
13. Legal Framework and Acts

Out of these services except SL-UDI and NDX, other services have been completed.

8.1 Sri Lanka Unique Digital Identify (SL-UDI)

SL-UDI is the Sri Lanka Government's national level program for the establishment of a Unique Digital Identity Framework. The main objective of having a Sri Lanka Unique Digital Identity is to provide secure and trusted authentication platform for all Sri Lankan citizens.

SL-UDI will provide the citizen identity by having a bio-metric back-end and a set of digital credentials. The tight coupling of physical and digital credentials yields a unique digital identity that enables a citizen to authenticate and transact seamlessly either physically or on-line.

SL-UDI project is currently in progress and it will consist of multiple steps.

1. **Pre-Registration / Enrollment** – Provides citizens an option to submit mandatory demographic details. For this, citizen needs to complete demographic details, upload any identity documents and finally schedule an appointment.

2. **Enrollment / Registration** – One the citizen is pre-registered, he/ she is required to go through the enrollment process at an enrollment center.

3. **UDI number generation, validation, and issuance** – This goes through a set of checks such as validation, de-duplication, quality checks and finally the generation of the UDI number.

4. **E-NIC card issuance** – Once the UDI number is generated and gone through the required quality checks, citizens are issued with an e-NIC card.

5. **e-KYC authentication** – An authentication API provided by the SL-UDI system for any online real-time authentication at the point of service delivery of various agencies that have been subscribed to SL-UDI.

6. **Lifecycle updates** - This allows citizens to update their demographic details either online or in an assisted mode in an enrollment center. This will ensure that the demographic information in the system is up to date.

8.2 National Data Exchange (NDX)

The National Data Exchange (NDX) represents the **"Interoperability Layer"** of the Sri Lanka Government Digital core infrastructure. This primarily consists of three software middleware components.

1. Enterprise Service Bus (ESB)

2. API Gateway (APIG)

3. Identity Manager (IM)

An ESB can handle multiple transformation methods such as data transformation / mediation, protocol transformation, application of various security policies, message monitoring and the message eco-system governance complying to the Enterprise Integration Patterns [9] in the software design. Considering the heterogeneity in a typical enterprise architecture, an Enterprise Service Bus is an essential feature to connect legacy back-ends.

However, if there are any green field applications, you can always bypass the ESB and directly expose their Application Program Interfaces (APIs) via the API Gateway (APIG). The APIG can handle the direct *North-South* bound traffic in the infrastructure, and can work as the main secure entry point to the government infrastructure. In a nutshell, this layer is responsible for API management, governance, and security of all government level APIs, which are exposed to the citizens, businesses or any other non-governmental institutions. Furthermore, it can be used to do any data transformation / mediation as well if required. However, mediations at the API Gateway level are very much an anti-pattern in a more distributed microservices based back-end design. But mediation at the API Gateway level is always a possibility in exceptional circumstances.

Identity Manager (IM) will provide the required Single Sign On (SSO), identity brokering and user federation for any government application leveraging the NDX infrastructure.

NDX is still in the development stage and will replace the legacy Lanka Interoperability Exchange (LIX) platform, which was implemented in 2009.

8.3 Lanka Government Network (LGN)

Lanka Government Network is high available, high speed, secure, reliable, and centrally managed dedicated government network linking most of the government institutions to a single digital infrastructure. It is encouraging public sector employees to get better acquainted with Information and Communication Technology (ICT), assuring efficiency and smooth flow of information as well as improving standards of service in the public sector to be able to provide efficient citizen services.

LGN connects government organizations in a cost-effective and secure manner to provide centralized Internet, Email, and video conferencing services, enable access to Lanka Government Cloud (LGC) services from any government organization. Also, it provides trusted and secure connectivity to all government organizations to exchange government data and information.

The main objectives of Lanka Government Network are as follows.

- To provide high speed Wide Area Network connectivity to 860 government locations to connect with LGN main backbone.
- To provide Wi-Fi facility to access government services for employees and for citizens.
- To establish a common digital infrastructure to government for share information and provide digital content and electronic services to public.
- To facilitate the government organizations to utilize this LGN network for effective and efficient service delivery.
- To provide uninterrupted, reliable, and fast Internet connectivity to the government organizations/buildings.
- To provide trusted and secure connectivity to other government organizations to exchange government data.
- To secure integration of government organization's existing Local Area Networks into LGN 2.0
- Integrated with Lanka Government Cloud (LGC)
- Centralized Technical support and assistance

The current version of LGN, which is LGN 2.0, will be further streamlined to improve its efficiency by bring in more public-private partnerships in the future considering its sustainability for the future.

8.4 Lanka Government Cloud (LGC)

Lanka Government Cloud (LGC) [11] is the Sri Lanka Government private cloud, and it minimizes or eliminates purchasing and maintaining of servers and/or data centers by government organizations, which could be time consuming, ineffective, and insecure.

The main objective is to eliminate all constraints and limitations to the government organizations for adopting to the "Cloud First" strategy and thereby increase ICT usage to enhance the effectiveness and efficiency of government appications.

Currently it only provides the *Infrastructure as a Service (IaaS)* service to its clients. However, now ICTA is in the process of conceptualizing an integrated *Platform as a Service (PaaS)* comprising some of the important core services such as the Kubernetes Cluster Management Solution. This would further streamline the current core infrastructure and will eliminate duplicates and enforce central governance across all core services. Furthermore, it will improve the infrastructure scalability of all tenant level applications.

The current version of LGC, which is LGC 2.0, will be further streamlined to improve its efficiency by bring in more public-private partnerships in the future considering its sustainability for the future.

8.5 Lanka Interoperability Framework (LIFe)

Interoperability in the public sector is all about enabling connections between ministries, departments, agencies, sectors, government levels and counties through data, information systems, legal agreements, organizational processes and shared values and customs [19].

As per the European Interoperability Framework [20], four (04) key Interoperability layers have been identified in the public sector.

1. **Technical Interoperability** – The definition of interfaces, Data formats, Protocols and Standards

2. **Semantic Interoperability** – Ensures the precise meaning of exchanged information

3. **Organizational Interoperability** – Is concerned about modeling business processes, aligning information architectures with organizational goals and helping business processes to corporate.

4. **Legal Interoperability** – Is about ensuring that organizations operating under different legal frameworks, policies and strategies can work together.

In order to execute all above four interoperability layers, it is essential to have a proper defined plan in operation. The Interoperability Framework is one such effort, which most of the successful countries have adopted.

Sri Lanka Government too has envisioned this early part of its e-Government journey. It is known as **Lanka Interoperability Framework (LIFe)** [7].

These LIFe Standards are defined to:

1. To ensure data is not captured in multiple locations.

2. To ensure data captured has a single owner

3. To ensure data is always current and accurate

4. To ensure the data is shared only with other authorized systems.

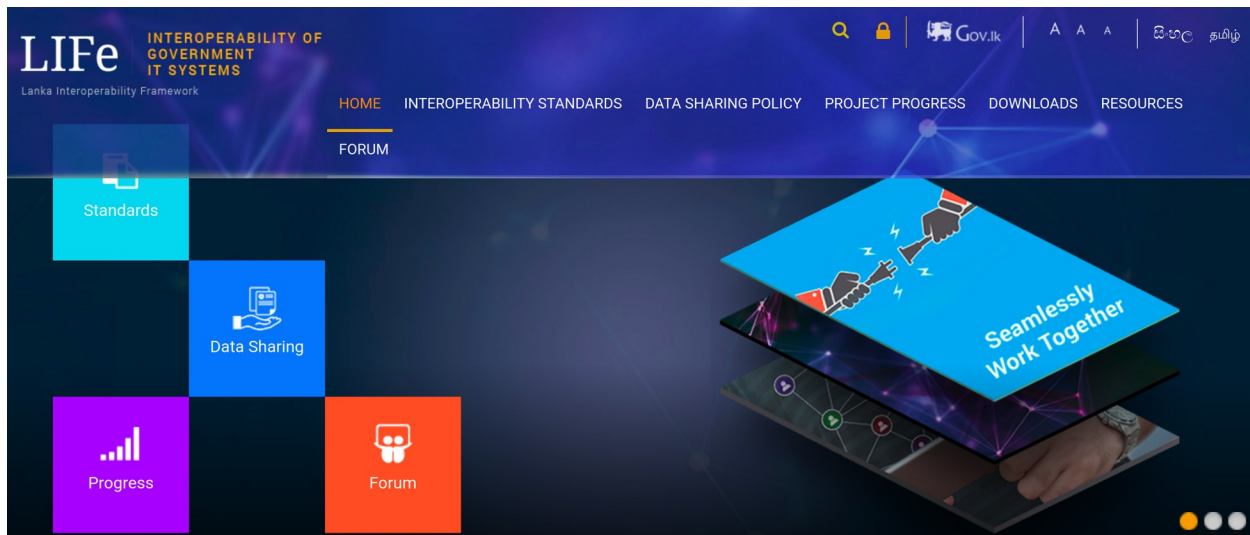5. To ensure the shared data could be easily understood and used.

Figure 05 - LIFe

Currently four (04) government domains have been completed in LIFe.

- Personal Domain
- Land Domain
- Vehicle Domain
- Project Coordination Domain

Two more domains (Health and Education) are being developed with the help of respective domain ministries (Ministry of Health and Ministry of Education).

While defining the complete "Whole-of-Government" strategy, it is imperative to identify specific government domains as you define them in LIFe and drill them down to identify required interoperability levels.

For example, the *Land Domain* (Figure 06) will consists of multiple government entities and other external stakeholders. All these stakeholders should come to an understanding regarding the data and service level classifications and sharing policies within the scope. This allows a seamless integration among all stakeholders with minimal distractions in the future.
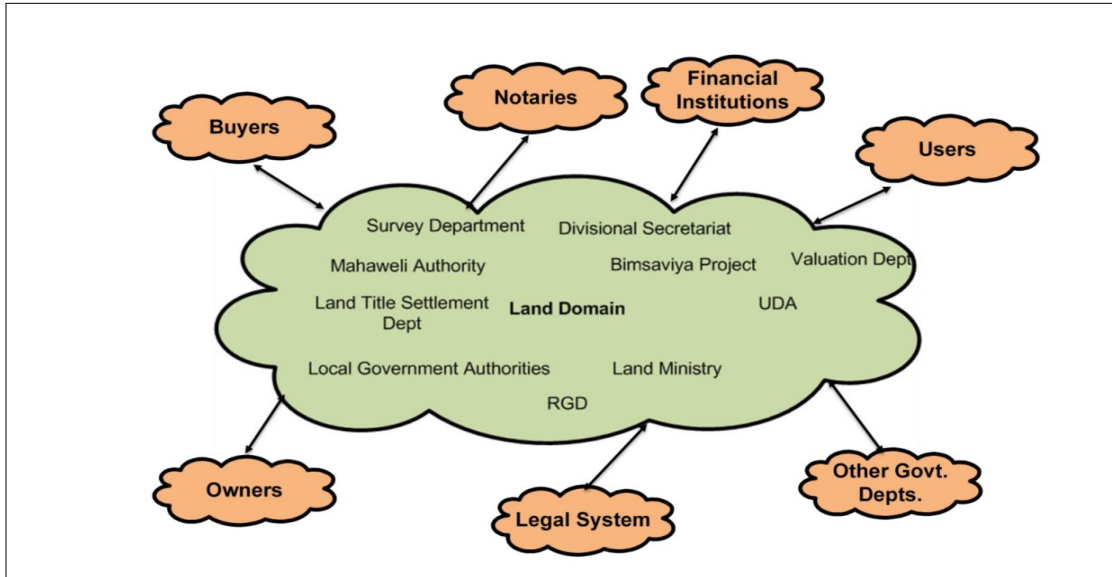
Figure 06 – Land Domain [7]

Cross Government Coordination and the Institutional Arrangement

In order to achieve above, the cross governmental coordination is a vital factor and it is important to identify an entity, which can force all government ministries at the very top. Most of the countries have formed an **inter-ministerial committee (IMC)** or a similar agency to enable this.

Hence, it is advisable in Sri Lanka also to go down in the same path as all the other successful countries have done.

8.6 Lanka Government Payment Service (LGPS)

The Lanka Government Payment Service (LGPS) is an abstract payment service, which allows government departments to connect to a single interface / layer rather connecting to multiple payment service providers. With this approach, government departments can have a significant cost and a time saving.

The first-ever government transactional e-service with online payments was launched in Sri Lanka in 2009, enabling vehicle owners of the Western Province to obtain their revenue licenses. The LGPS was introduced along with this e-service providing multiple payment options through a single integrated payment point for making electronic payments to the government.

Currently, three payment gateways are integrated, serving 27 departments. The total number of transactions processed to date (14-03-2023) is nearly two million. The top ten performing departments are as follows,

	Department Name	Count
1	Department of Motor Traffic – Western Province	471,063
2	Sri Lanka Police	328,956
3	Registrar of Companies	328,956
4	Department of Motor Traffic – Southern Province	167,050
5	Department of Motor Traffic – Southern Province	72,744
6	Postgraduate Institute of Medicine	64,376
7	National Water Supply and Drainage Board	54,951
8	Department of Motor Traffic – Sabaragamuwa Province	52,850
9	North Western Province (Financial Management Unit)	52,211
10	SLTDA -UNDP - Visit Sri Lanka	50,122

Figure 07 – LGPS Usage

Discussions are now underway to integrate LGPS with **Lanka Clear LPOPP (Lanka Pay Online Payment Platform)** [21] to have additional payment options to citizens.

8.7 GovSMS Service

This is the SMS service given to all government back-end applications, which are connected via the government core infrastructure. Citizens can use 1919 short code to access this service.

This service has been in operation since 2009 and there are multiple government applications. which leverage this infrastructure thus far.

Some of the government organizations are as follows:

Sri Lanka Postal Department, University Grants Commission, Ministry of Health, Employee Trust Fund, Sri Lanka Police, Ministry of Foreign Affairs, Department of Motor Traffic, Ministry of Public Management Reforms,Department of Examinations, Election Commission, Development Lotteries Board, Sri Lanka Parliament, Sri Lanka Tea Board, Sri Lanka Railway, Colombo Municipal Council, Department of Wild Life Conservation, Ceylon Fisheries Corporation, Marine Environment Protection Authority, etc.

8.8 Government Single Window Portal (gov.lk)

Currently, all the government services can be disseminated to the public via the **gov.lk** web portal. Citizens can search for required government services via this portal rather remembering them individually.

Government organizations are encouraged to expose their government services via this portal for the better reach.
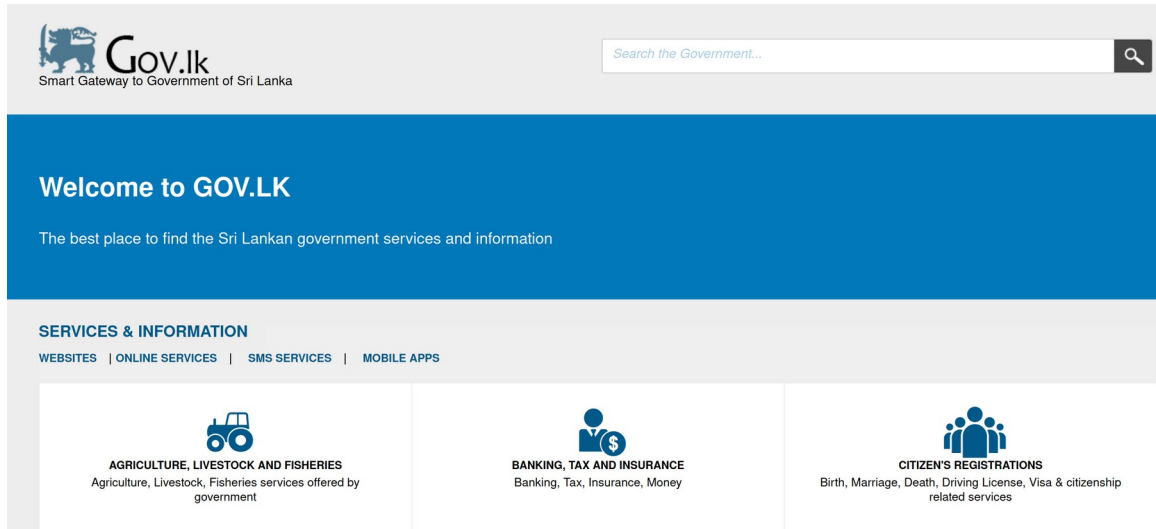

Figure 08 – gov.lk web site

8.9 Government Open Data Portal (data.gov.lk)

The Open Data Portal has been designed to disseminate classified data from government back-ends to citizens, businesses and all the other relevant stakeholders.

In order to classify data at the government agency level, the **National Data Sharing Policy** [13] can be used. This complements well with the **Data Protection Act** [10], which has been recently drafted in 2022.

Currently the open data portal [8] is hosted in the government core infrastructure pulling some of the key data sets from some of the government department level back-ends.

Government organizations are encouraged to expose their data, which are classified as public via this portal allowing it to be the one stop shop for their government data needs.

These data will be invaluable especially for the private sector entities, whom can make a profitable business model around it, which can further boost digital economy in Sri Lanka.

Figure 09 – Open Data Portal (data.gov.lk)

8.10 Government Information Center (GIC)

The Government Information Center (GIC) was conceptualized a decade ago to introduce government information to the public. The GIC web site, which is gic.gov.lk gives the government information on a web page, while they can get the same information by just dialing 1919 from any of the telephone network available in Sri Lanka.

On average GIC receives nearly 1.8 million calls annually, with a daily call volume of 5,000 (Statistics from 2021).
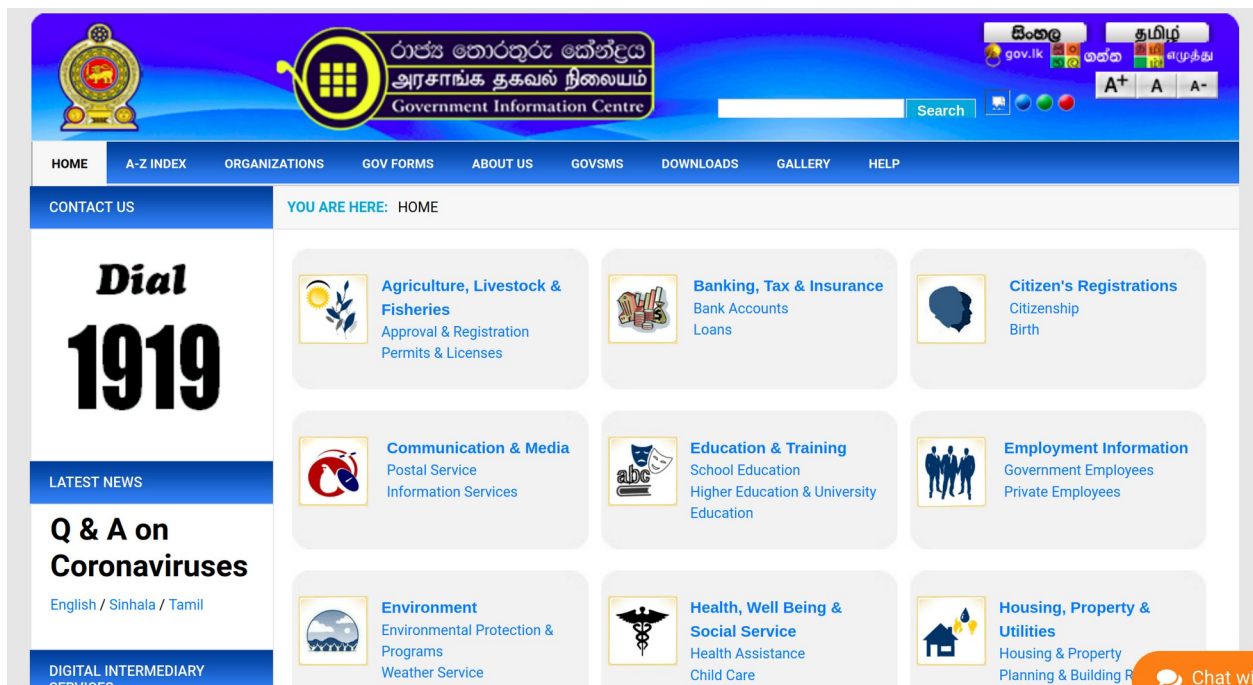

Figure 10 – GIC Web site (gic.gov.lk)

8.11 National Spatial Data Infrastructure (NSDI)

The NSDI has been defined as "the technology, policies, standards, and human resources necessary to acquire, process, store, distribute, and improve utilization of geospatial data.

NSDI is conceived as a national programme to harmonize, integrate and optimize the development and sharing of geographical information across all government agencies and institutions for evidence based decision making. The NSDI platform was established and is live on **nsdi.gov.lk** from the year 2018.

The main objectives of the NSDI are to reduce redundancy and costs in geospatial data creation and maintenance, improve access and accuracy of geospatial data used by the broader community.

The development of the NSDI was proposed by the Secretary, Ministry of Land and Land Development along with the key Ministries and organizations in 2012. A cabinet approval was granted in 2013 for the Cabinet Paper No 13/1198/533/013 dated on 07.08.2013 in this regard. Based on the decisions adopted at the Inter-Ministerial Committee meeting held on 16th October 2015, authority of implementation, management and control of the NSDI was given to ICTA.

Figure 10 – nsdi.gov.lk

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8.12 Digital Government Policy

The draft version of the Digital Government Policy is now available pending government cabinet approval [22]. Having this updated policy will further strengthen the digital government eco-system aligning to the new strategy.

8.13 Legal Framework and Acts

There are multiple acts completed and enacted by the parliament during the past. Some of the key acts are:

1. Personal Data Protection Act No. 9 of 2022

2. Electronic Transaction Act No. 19 of 2006 (amended by Act No. 25 of 2017)

3. Computer Crimes Act No. 24 of 2007

Out of these acts, Personal Data Protection Act (PDPA) and the Electronic Transaction Act have been a great enablers in the Digital Government space.

PDPA is a direct enabler while doing the data and information classification efforts at the government entity level. In addition to that, it gives you a clear indication where to store data especially while deploying in a cloud environment. Having such demarcation facilitate digital transformation efforts in a big way.

Enabling Electronic Transaction Act, enabled ICTA to launch the first on-line transactional e-service (e-Revenue License application) in 2009.

9.0 Shared and Line of Business Services

From 2010 to 2020, Sri Lanka Government Core Infrastructure Line of Business Services were exposed through a Service Oriented Architecture (SOA) approach [14]. In early 2010, with this design, ICTA was able to launch its first transactional based e-service application, which is known as *e-Revenue License application* [15], where citizens could renew their vehicle revenue license online.

Along with e-Revenue License application, there were quite a few online e-services exposed via this SOA based infrastructure formerly known as *Lanka Gate* [16][17].
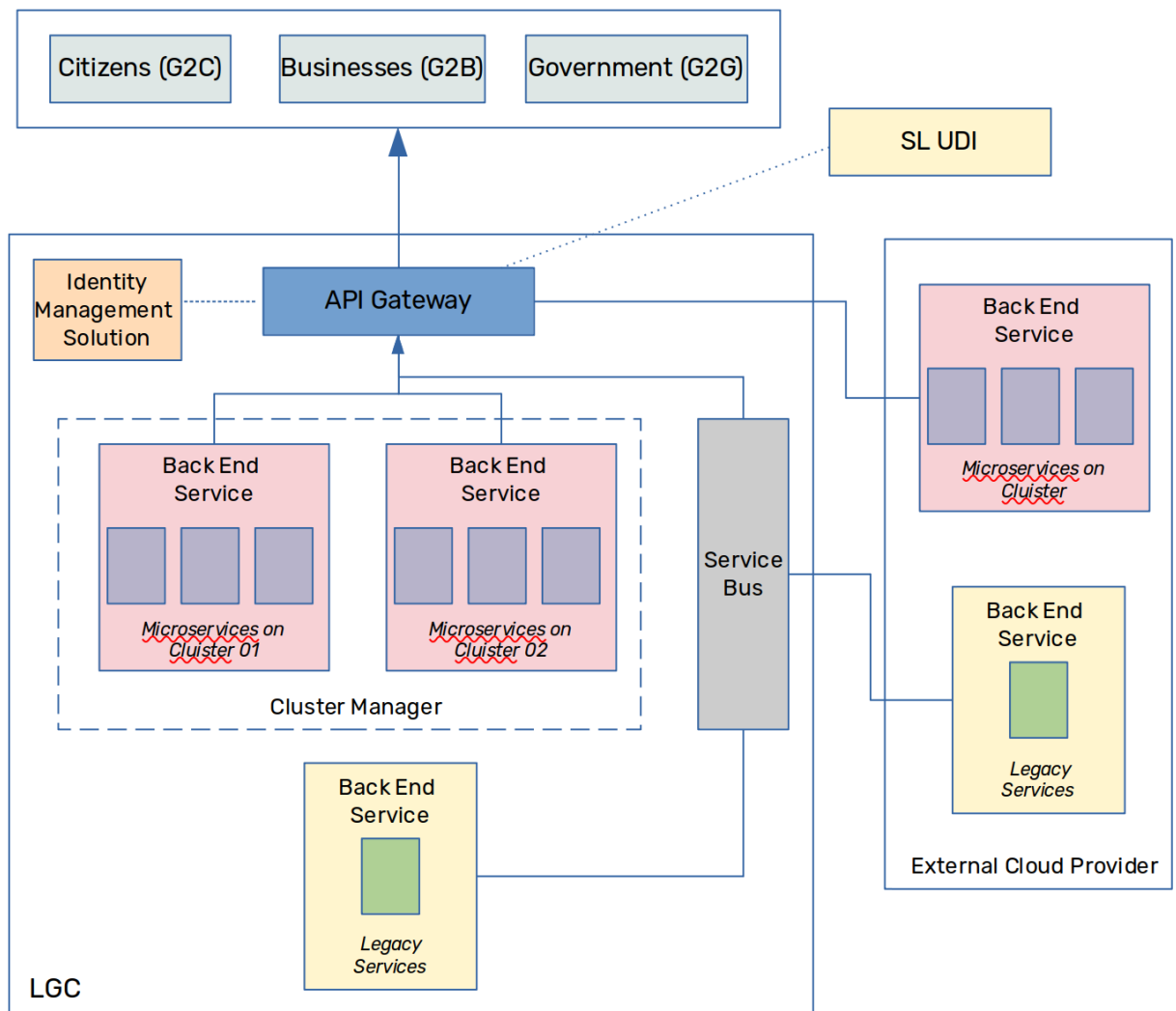
Figure 11 – SL-GEA Government Business Layer Integration

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After adopting this architecture for more than a decade, from 2020 onward, ICTA core services changed its back-end infrastructures to support more decentralized approach by adopting Microservices Architecture (MSA). This was further strengthened with the support of container based LGC 2.0 design.

However, there a quite few monolithic legacy back-ends still this new infrastructure needs to deal with. Considering this, ICTA came up with a more hybrid approach supporting both Monolithic and Microservices back-ends (Figure 11).

In this approach, all the new services will be developed using the *Mocroservice Architecture (MSA)* architectural pattern [12] and the rest of the legacy back-ends will be connected via a Service Bus (*Enterprise Service Bus – ESB*).

If any external party wants to connect to the government infrastructure (North-South communication), they will be funneled through the more strategic API layer, where *API Gateway* works as the key architectural component.

If any government entity wants to consume some of the back-end APIs, those could be exposed via another API Gateway instance confined only to the internal (LGN) communications.

Citizen / Government level government services will be primarily authenticated via the SL UDI platform and authorization could be routed through the domain level Identity Management solution(s).

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