

**SIEMENS**



# **ITS Architecture Practical Approach**

**Richard Bossom**

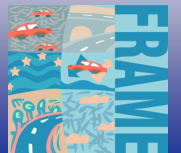
**EC ITS Workshop**

**The Ministry of Transport of Israel  
Jerusalem, 12 June 2007**



# Overview – Main Topics

- **Where are we with ITS implementation?**
- **What is an ITS Architecture?**
- **Is ITS Architecture a valid answer to plan and develop ITS projects?**
- **Which ITS architecture is more adequate for Israel?**
- **Is the architecture on the EU funded projects a practical answer?**



# Why are we here?

- **Most Intelligent Transport Systems (ITS) are an application of:**
  - **Informatics, or Information Technology (IT)**
  - **Telematics, or Information and Communication Technology (ICT)**
- **Many ITS implementations are: late and/or over budget and/or do not deliver what is expected**
- **Reasons:**
  - **Objectives not fully specified**
  - **Bad:**
    - **Planning and estimating**
    - **Project Management**
  - **New technology**
  - **Inappropriate resources**

## On-time IT Projects

Sweden 44%	Israel 8%
Switzerland 24%	France 6%
Czech Republic 20%	Belgium 4%
Germany 19%	Italy 4%
Denmark 16%	Netherlands 4%
UK 11%	Russia 4%
Finland 8%	Spain 4%

Source: EIU/HP/BBC (June 2007)

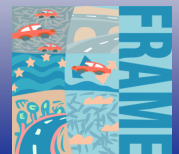
# ITS Challenges - Implementation

- **Can be complex & cover:**
  - **Several services**
  - **Several areas of road transport**
  - **Different transport modes**
- **Can involve several organisations:**
  - **Different types: Public, Private and Partnerships**
  - **All have different ways of working**
  - **Possible conflicts and poor relations**
- **Needs system integration so that components:**
  - **Work together with:**
    - **Each other**
    - **What already exists**
  - **Can be individually replaced**



# ITS Challenges - Integration

- Needs many components to be integrated
- Lots of data collected from many components
- Common interface style for each user type
- Have best possible links with outside world
- Economies of scale must be exploited
- Citizens expect consistent, seamless multi-modal services:
  - From individual organisations
  - Across all organisations
  - Across regions (urban and rural)
  - Across a Nation



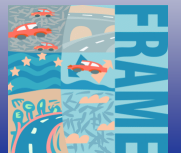
# ITS Integration - Consequences

- **Integrated system (and large)**
  - **Whole > sum of the parts**
- **Many stakeholders that need to co-operate**
  - **Vehicle Owners/Drivers**
  - **Road Operators**
  - **Operators of Other Transport Modes**
  - **Regulatory/Enforcement Authorities etc.**
- **Varying commercial interests**
  - **Public services, commercial services**
- **Multi-disciplinary activities**
  - **e.g. Software, Hardware, Traffic Engineering**
- **Multiple manufacturers / technologies**
  - **To build integrated systems**



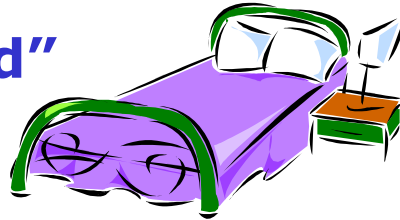
**ITS Architectures provide  
a tool to help solve these  
challenges**

**So, what is an ITS  
Architecture?**



# Specification - Confusion

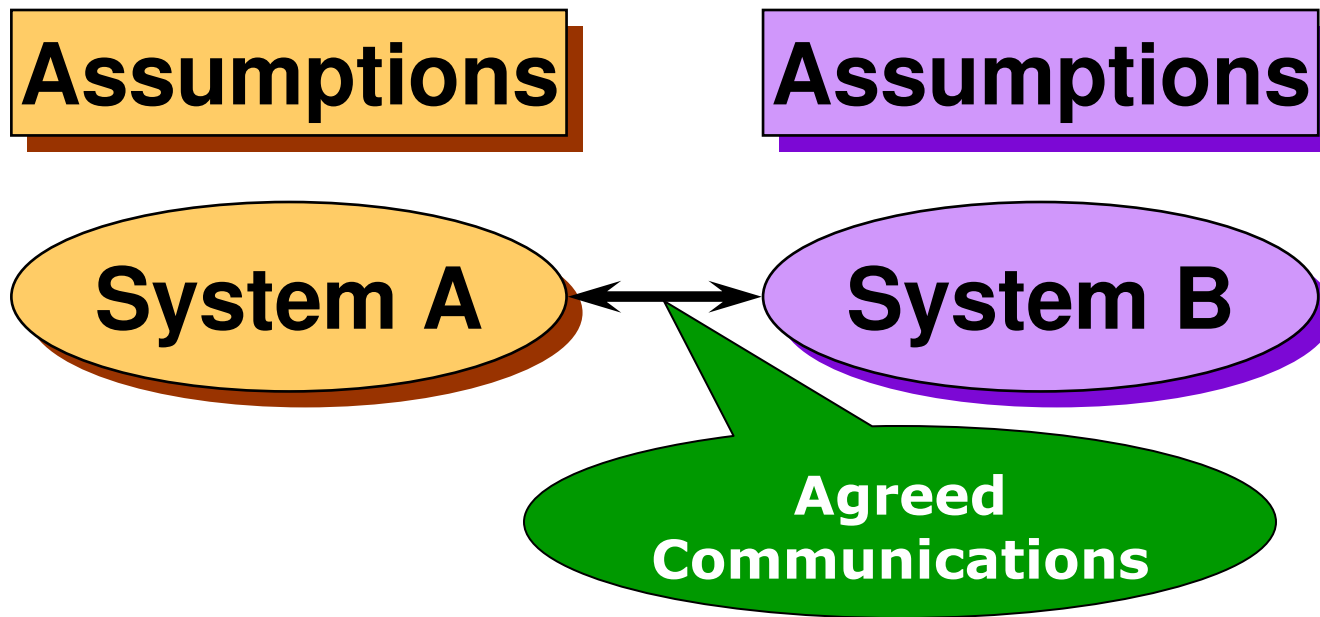
- "Specify a bed"



**Without sufficient information,  
different people make different assumptions**

# Partial System Integration

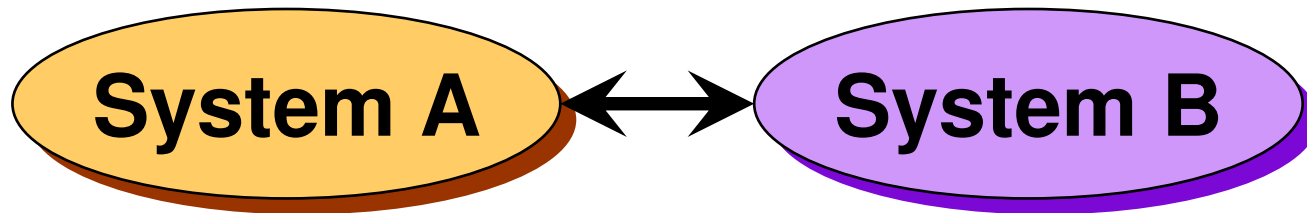
- Many people think that you only need good communications to integrate systems



- Different assumptions prevent inter-operability

# Consistent System Integration

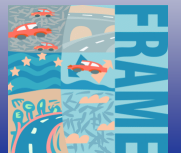
Assumptions



- Agreed communications **AND** common assumptions produce inter-operability
- Achieved with a System Architecture

# ITS Architecture Objectives

- To provide an **understanding** of both the **transport Problem** and its **Solution**
  - **Able to visualise {Whole >  $\Sigma$  (parts)}**
  - **Satisfies the aspirations of the stakeholders**
  - **Describe the problem as:**
    - **The desired Results**
    - **NOT in terms of its Solution**
- To provide a **stable** basis for a **Working and Workable** ITS implementation



# How does an ITS Architecture fit into the System Engineering Life-cycle?



# ITS Architectures – What do we mean?

- **Architectures can operate at different levels:**
  - **High-Level:**
    - Created after requirements definition to provide initial “view” of system
    - Start of “Top-Down” System Design approach
    - Technology independent
    - Can be understood by decision makers
  - **Low-Level:**
    - Sometimes called “Design Level”
    - Created as precursor to code generation
    - Technology dependent
    - Used by system developers/programmers
- **Rest of presentation is about High-Level ITS Architectures**



# What is a High-Level ITS Architecture?

- **Top-level framework**

e.g. Functional, Physical, Communication Viewpoints

- **Strategic plan for designs**

- "What is needed"

Understand both the problem and its solution

**NOT**

- "How is it to be implemented"

Future proof!

- Technology independent

- **Top-level assumptions**

- Minimum necessary

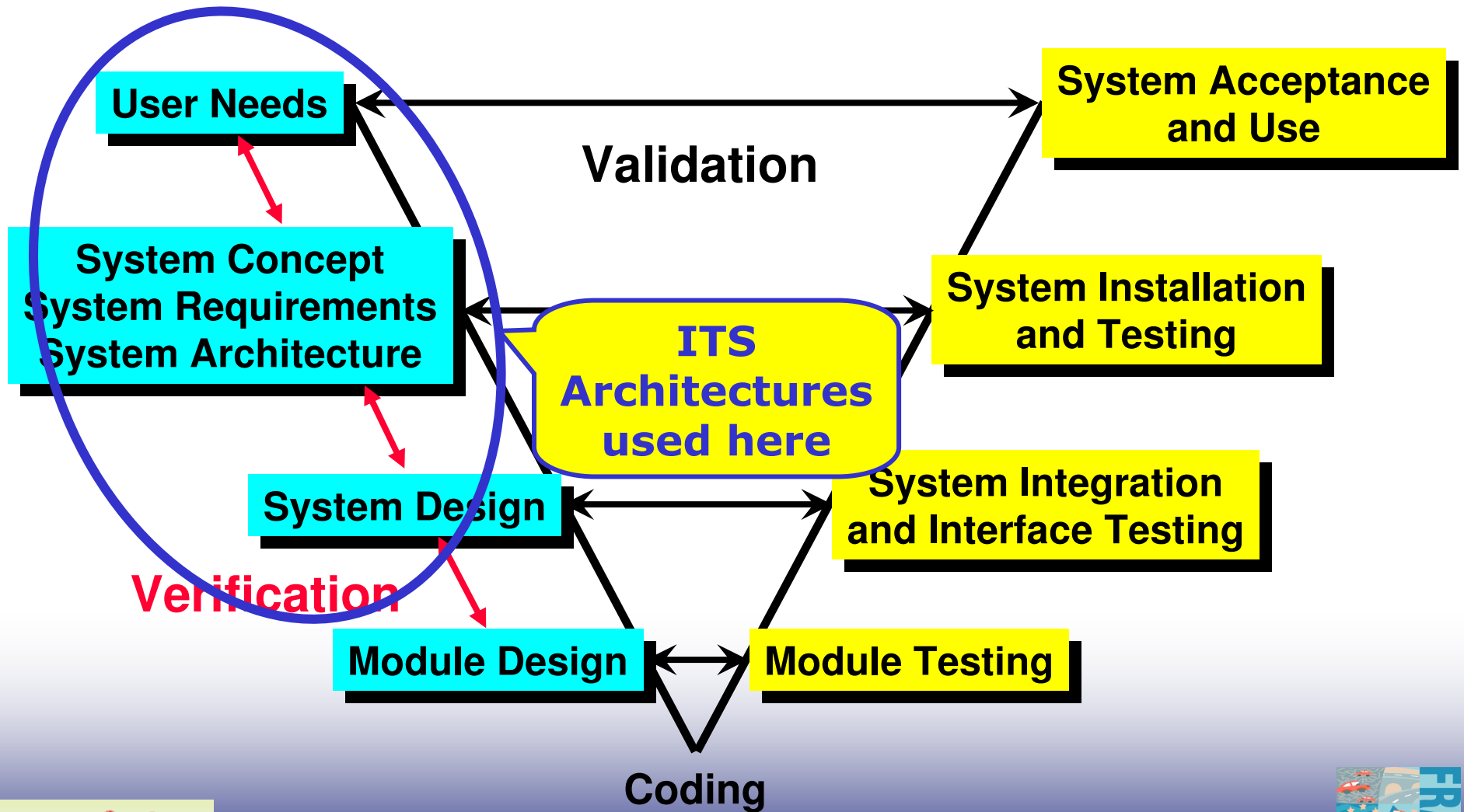
Stable basis for working and workable systems

**NOT**

- Maximum Possible

Flexible systems should be built on a stable architecture

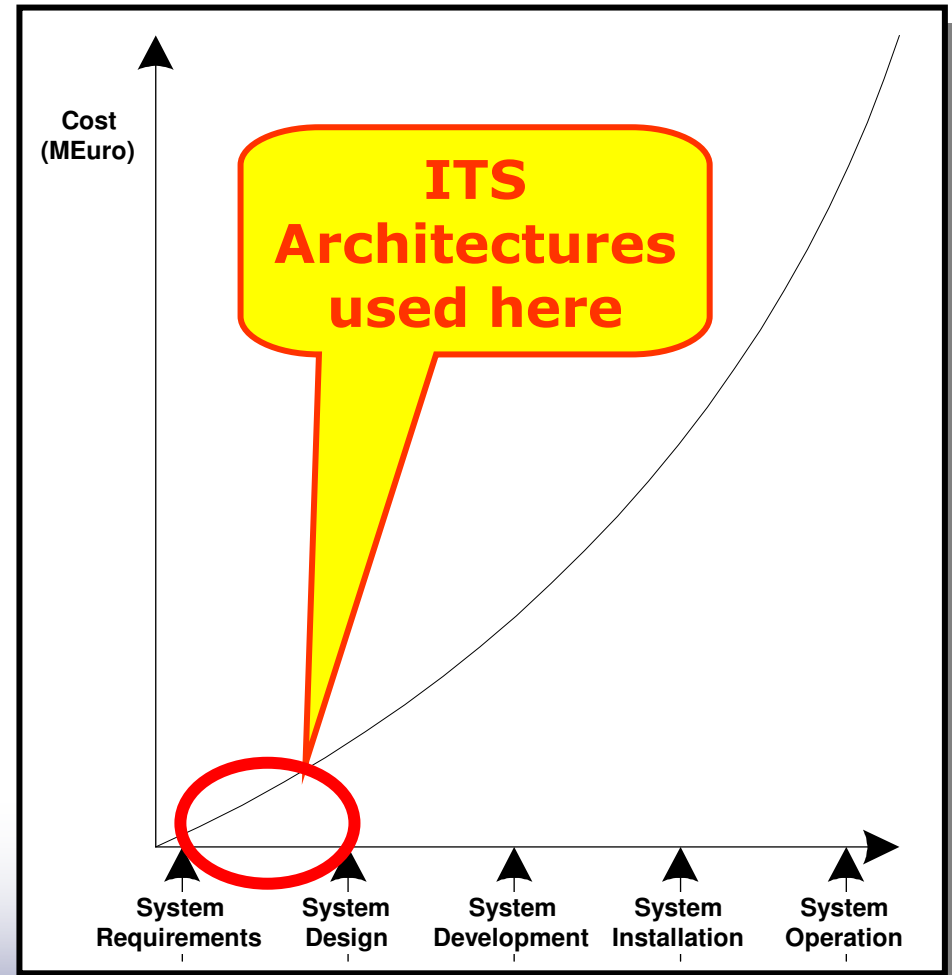
# Place in the V Model



# Impact on Development Costs

## 10 : 100: 1000 Rule

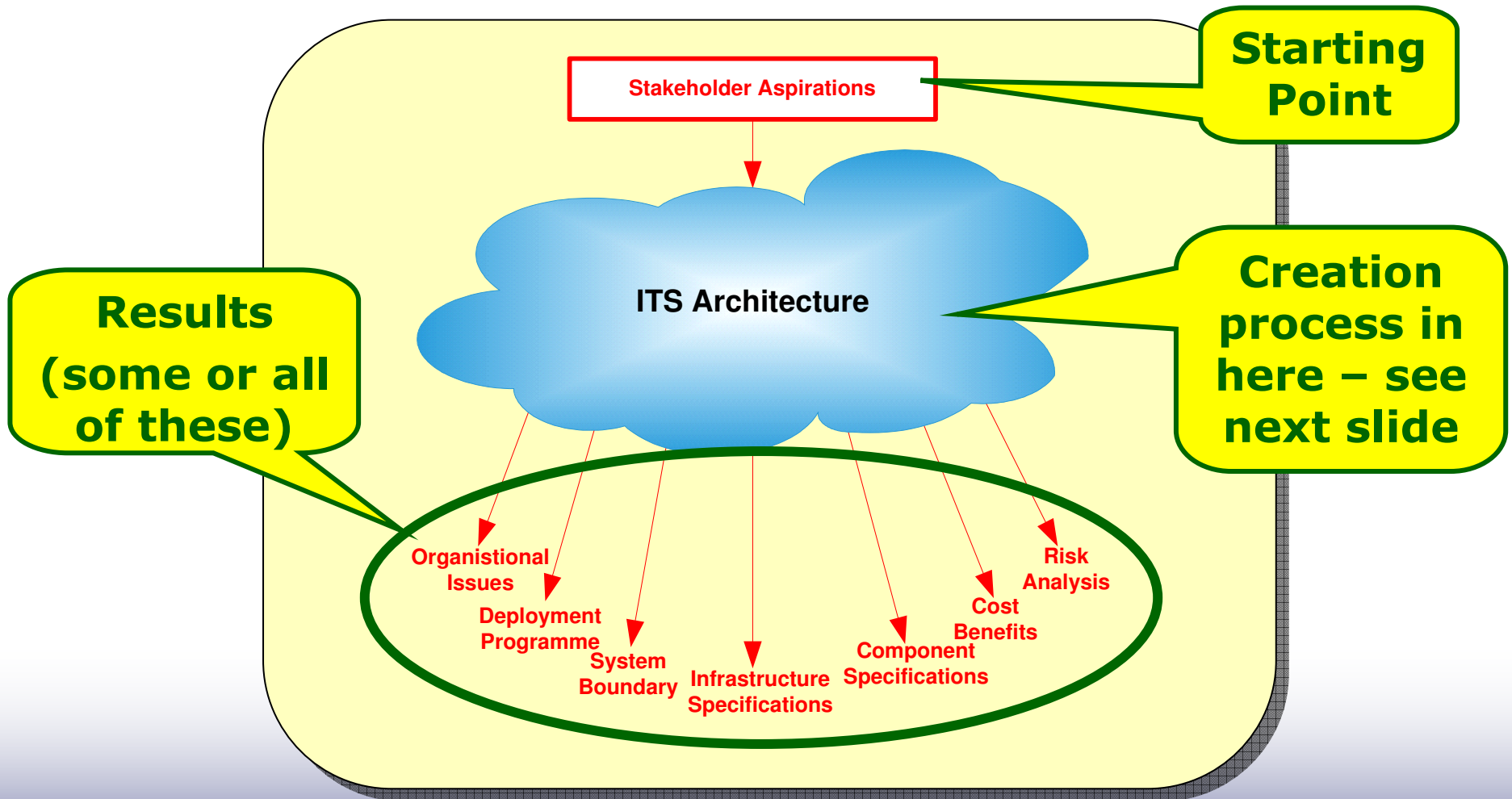
- Cost of fixing problems in System development increases exponentially with time
- System Architectures can expose these problems early in the development cycle
- Early fixing costs less
  - “70% of faults found after unit testing are requirements errors”



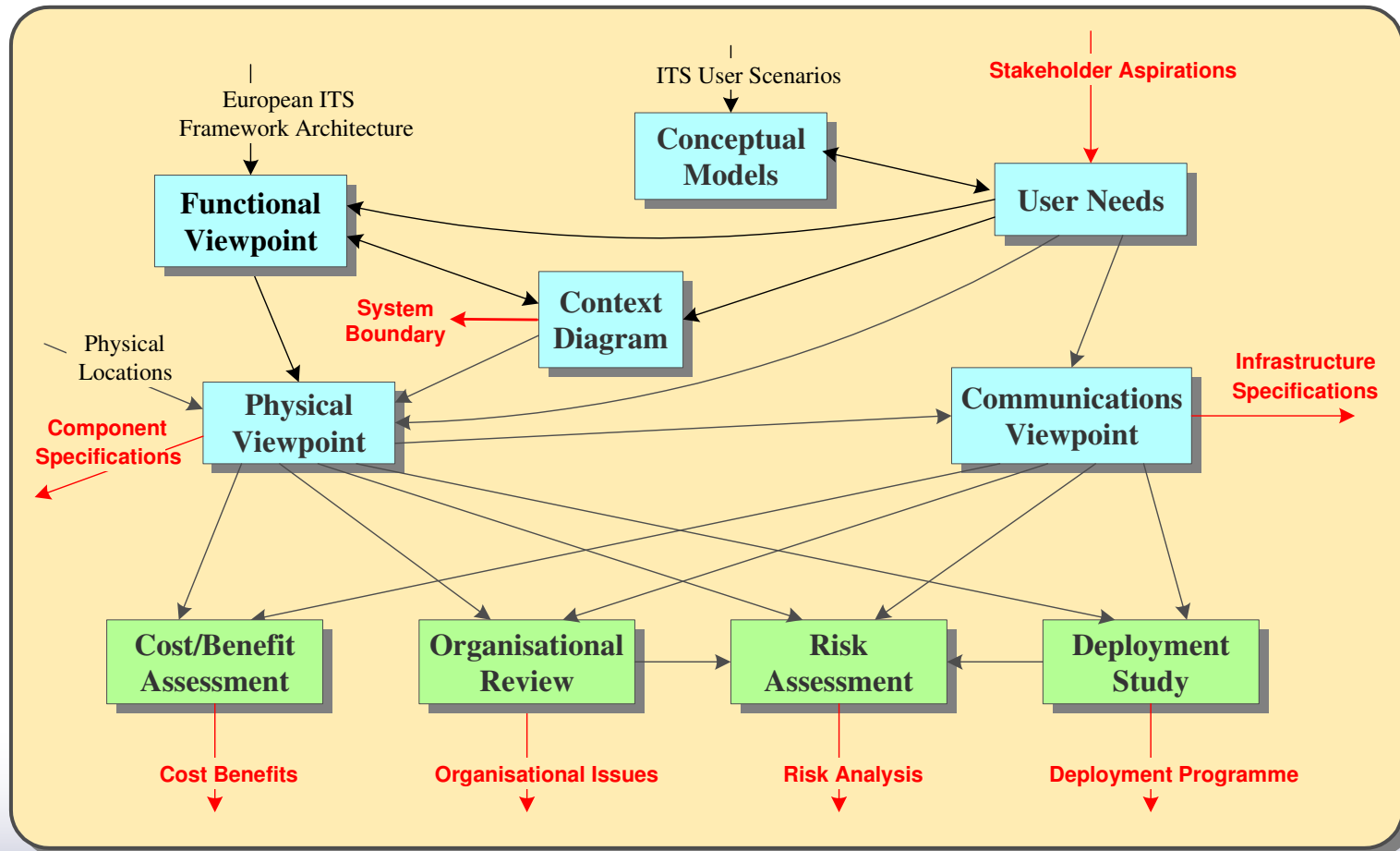
# How is an ITS Architecture created?



# ITS Architecture Creation Process Overview



# Full Architecture Creation Process



# ITS Architecture Contents (1)

- **Typically:**
  - **A set of User Needs:** single sentence statements that define the Services to be provided
  - **A Functional (or Logical) Viewpoint:** describes the processes needed to provide the Services
  - **A Physical Viewpoint:** shows where the processes are located
  - **A Communications Viewpoint:** describes the links between the locations
- **“Viewpoint”:** the new name for some parts of an architecture:
  - The US and elsewhere still call them “Architectures”
  - Some users find the name “Architectures” confusing
  - Use of “Viewpoint” accords with IEEE Standards.

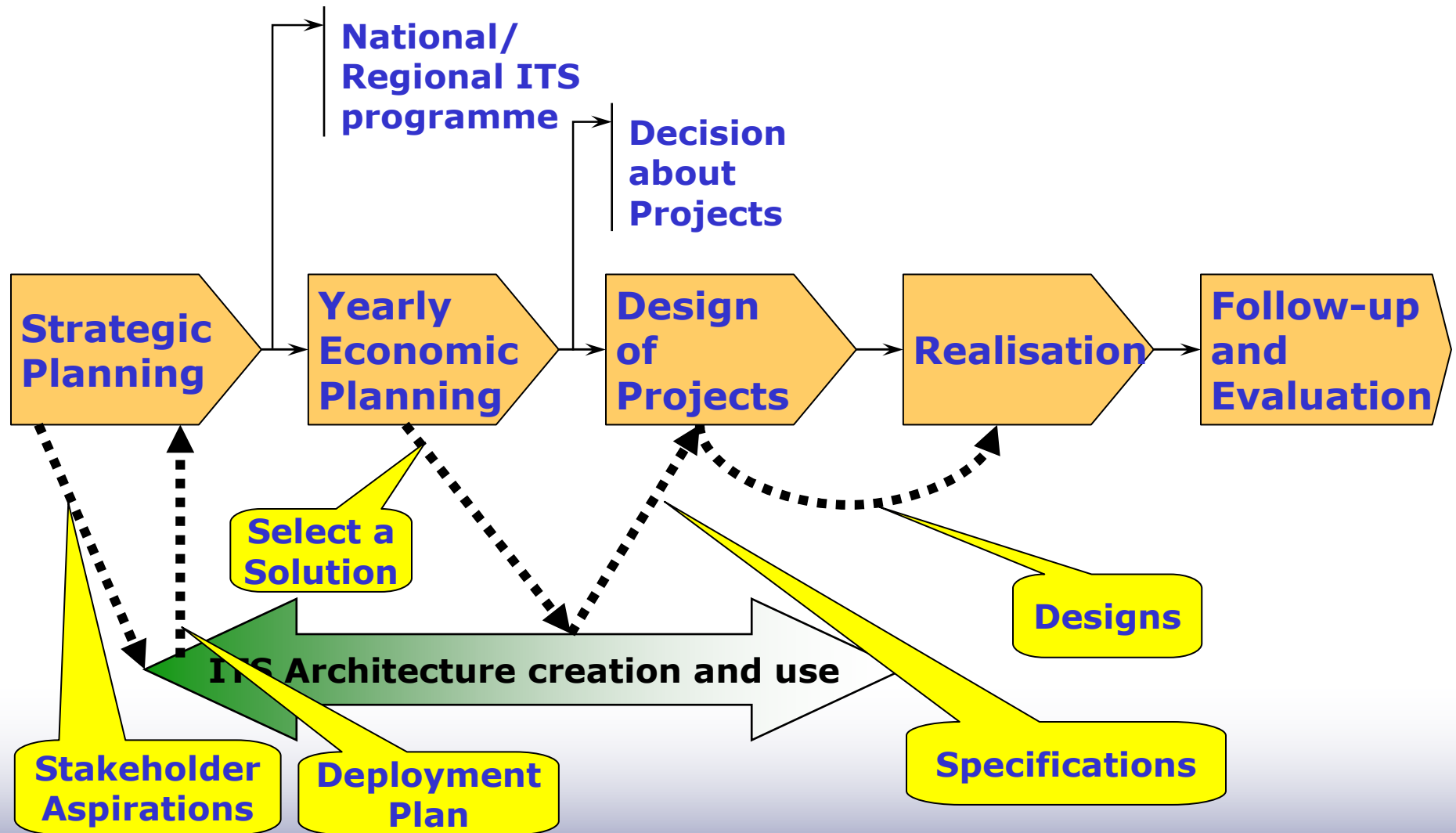


# ITS Architecture Contents (2)

- **Optionally:**
  - **An Organisational Viewpoint:** identifies any management/operational issues
  - **A Deployment Programme:** provides a high-level view of how the Services will be deployed
  - **A Risk Analysis:** things that potentially threaten the deployment of the Services
  - **A Cost Benefit Analysis:** the costs of providing the Services and the benefits provided
- **Inclusion of some or all of these depends on why the architecture is being created**



# Creation and Use of an ITS Architecture



# Different types of High-Level ITS Architecture and how to decide which one to use?



# Framework ITS Architecture

- **Contains:**

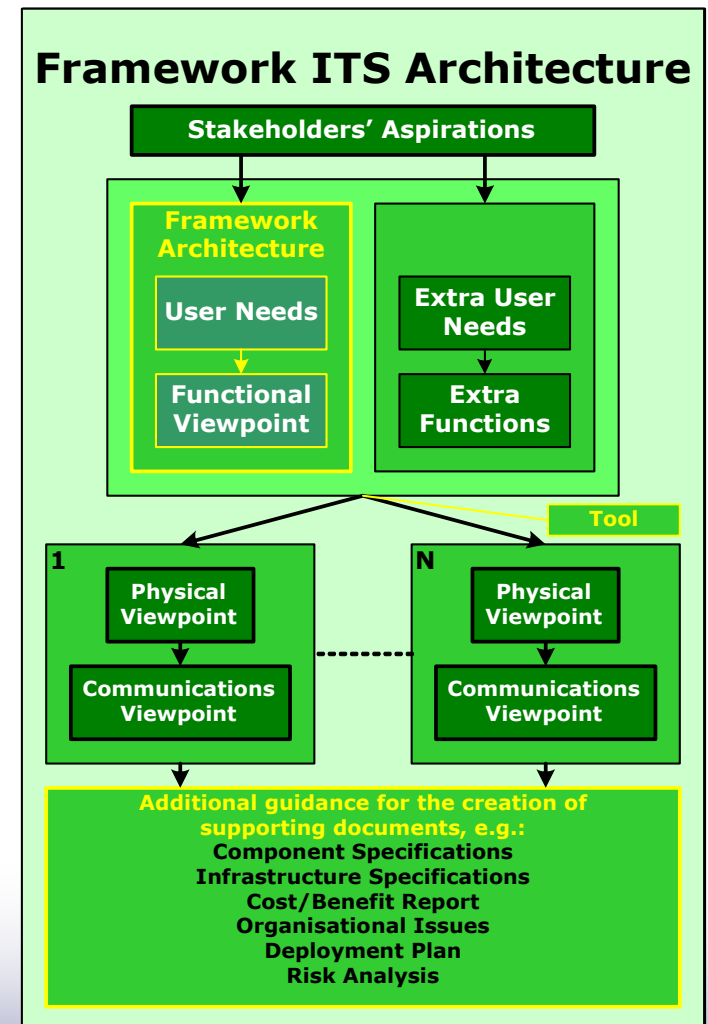
- **User Needs**
- **Functional/Logical Viewpoint**
- **Provides guidance documents to assist Users**

- **Using it:**

- **Very flexible – easily adapted**
- **Needs effort from User to create Physical Viewpoint, etc.**
- **Can develop “local” architectures from it of either type:**
  - **Framework**
  - **Defined**
- **Configuration Management practice needed**

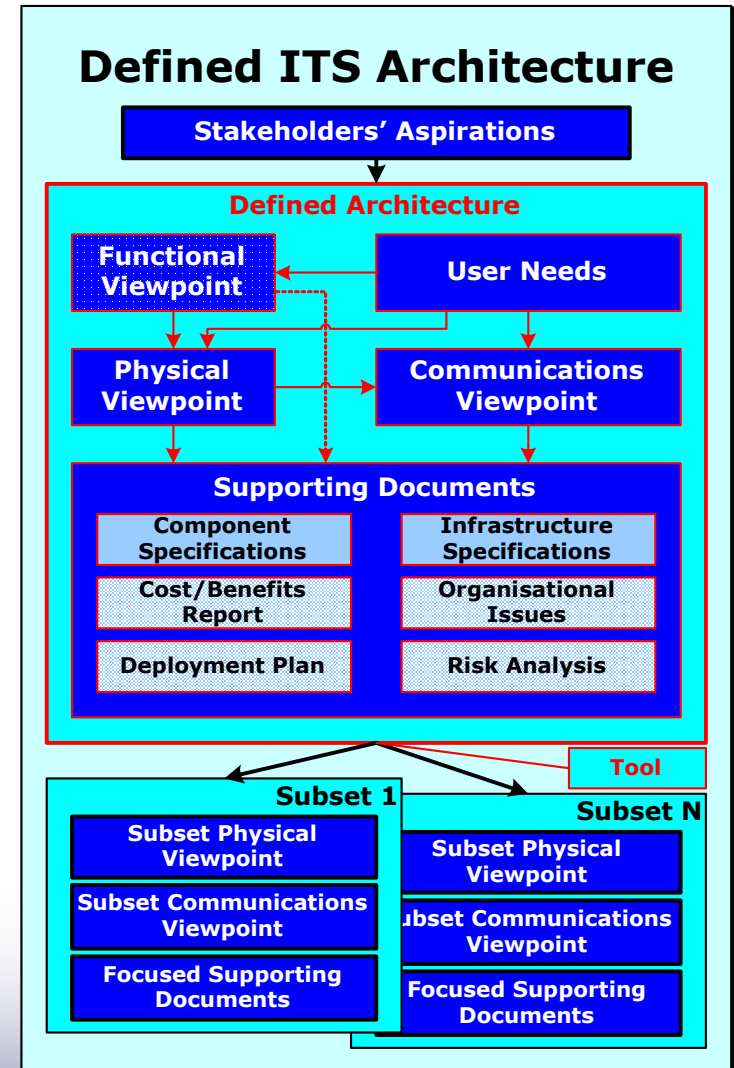
- **Needs its own tool**

- **Best example: European ITS Framework Architecture (FRAME)**



# Defined ITS Architecture

- **Contains:**
  - **User Needs**
  - **Functional, Physical and Communications Viewpoints**
  - **Supporting Documents to identify implementation issues, etc.**
- **Using it:**
  - **Lacks flexibility – difficult to adapt to changing requirements**
  - **Use can be made flexible with “overlapping” modules in Physical Viewpoint**
  - **Needs less effort from User**
- **Needs its own tool**
- **Best example: US National ITS Architecture**



# How to choose most appropriate ITS Architecture type – Scope and Type

- **How is ITS implementation in Israel to be managed?**
  - **Services:**
    - Same everywhere?
    - Different in some parts of country?
  - **Range of transport modes to be included?**
  - .....
- **Type of Architecture:**
  - **Defined:** there needs to be a fairly common approach throughout the country of Israel
  - **Framework:** the regions and/or cities of Israel will expect to have their own ITS Architectures



# How to choose most appropriate ITS Architecture type – Resources

- **Creating architecture without another architecture as a starting point is:**
  - **Time consuming ( $\approx 2$  years)**
  - **Expensive (lots of resources needed)**
  - **Incompatible with anything else**
- **Best option is to use another architecture as starting point:**
  - **Saves time (6 – 18 Months)**
  - **Two starting points:**
    - **US National ITS Architecture**
    - **European ITS Framework Architecture**
  - **Choice depends on which has the “best fit” with what the proposed ITS deployment will include**

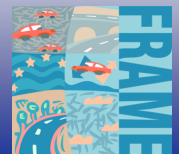
# Starting from US National ITS Architecture

- **Advantages:**

- **Well developed**
- **Lots of users in US**
- **Easy to use: Turbo<sup>®</sup> Architecture Tool available**
- **Not much effort needed to use it**
- **No particular “architecture” expertise required**

- **Disadvantages:**

- **Inflexible:**
  - **Israeli ITS service requirements must be “exact” fit**
  - **Difficult to change if not**
  - **Physical deployment options:**
    - **Are what the US uses**
    - **Have limited flexibility through “Market Packages”**
- **No real ownership for Israel – like a US County?**



# Starting from European ITS Framework Architecture (FRAME)

- **Advantages:**

- **Flexible:**

- Extra Israeli specific Services can be easily added
    - Can be “Framework” or “Defined” Architecture
    - Designed to be adapted by Users

- **Physical deployment options can suit Israel**

- **Becomes “Israel’s own” ITS architecture**

- **Disadvantages:**

- **Needs more effort to produce ITS architecture for Israel because of need to create:**

- Physical & Communications Viewpoints
    - Own (Israeli) tool for Architecture Users

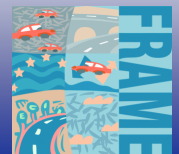
- **Expertise for creation may not be available within Israel**

# Suggested Choice of Architecture for Israel

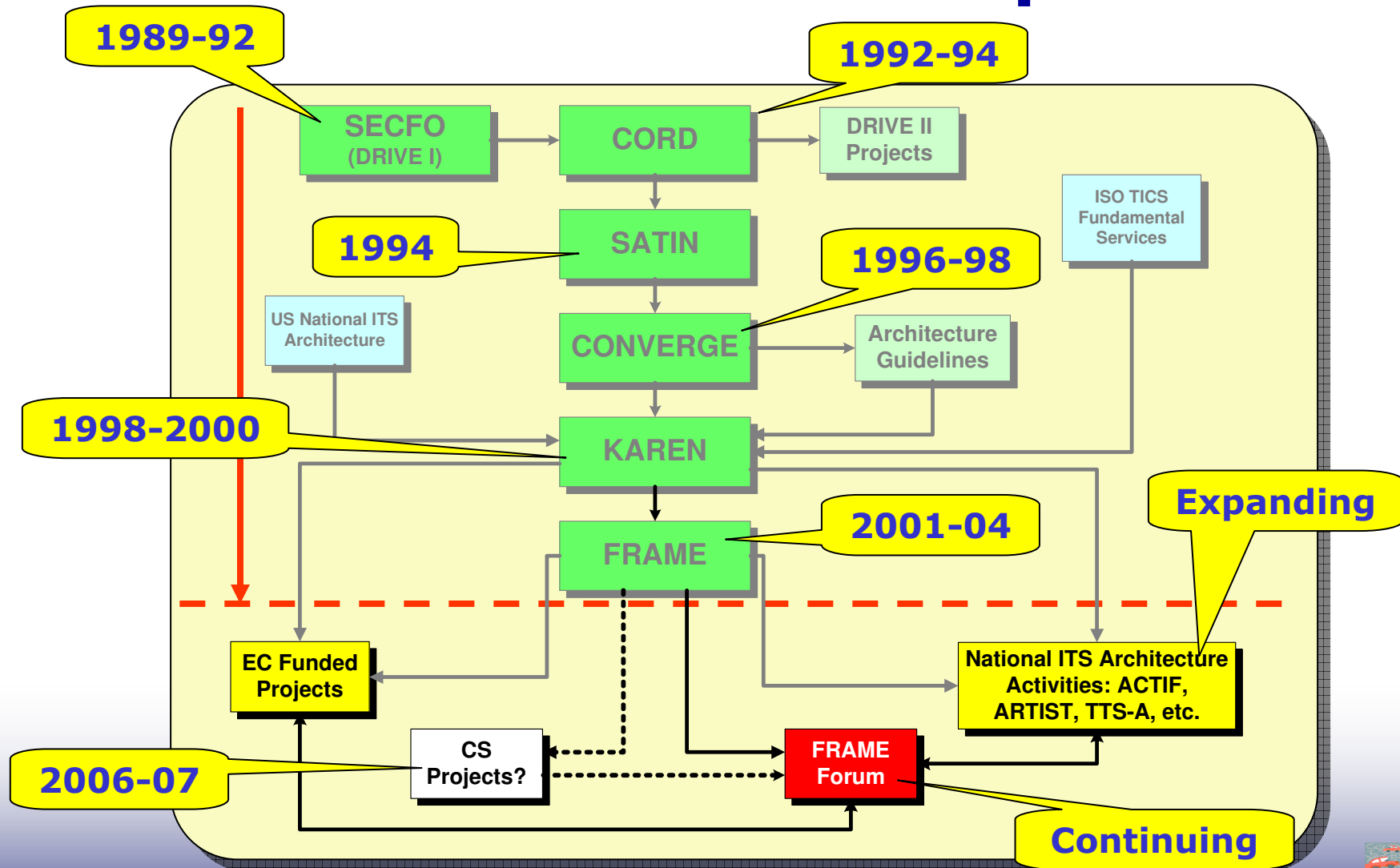
- **Use a Defined Architecture:**
  - **Small country so not much variation in Services**
  - **Gives control of ITS implementation**
- **Start from FRAME:**
  - **Enables creation of “ITS Architecture for Israel” that is “customised” to local needs**
  - **Designed to be adaptable for different Services**
  - **Not dependent on others, e.g. US for architecture changes/updates**
  - **Help and support available through joining the FRAME Forum**

# FRAME

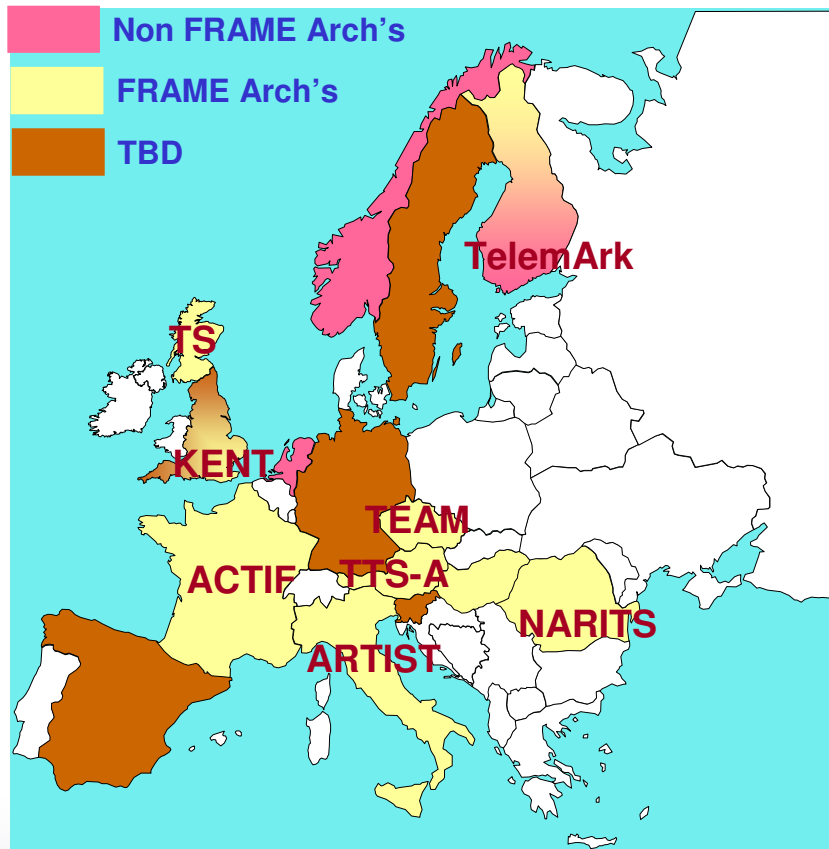
## The European ITS Framework Architecture



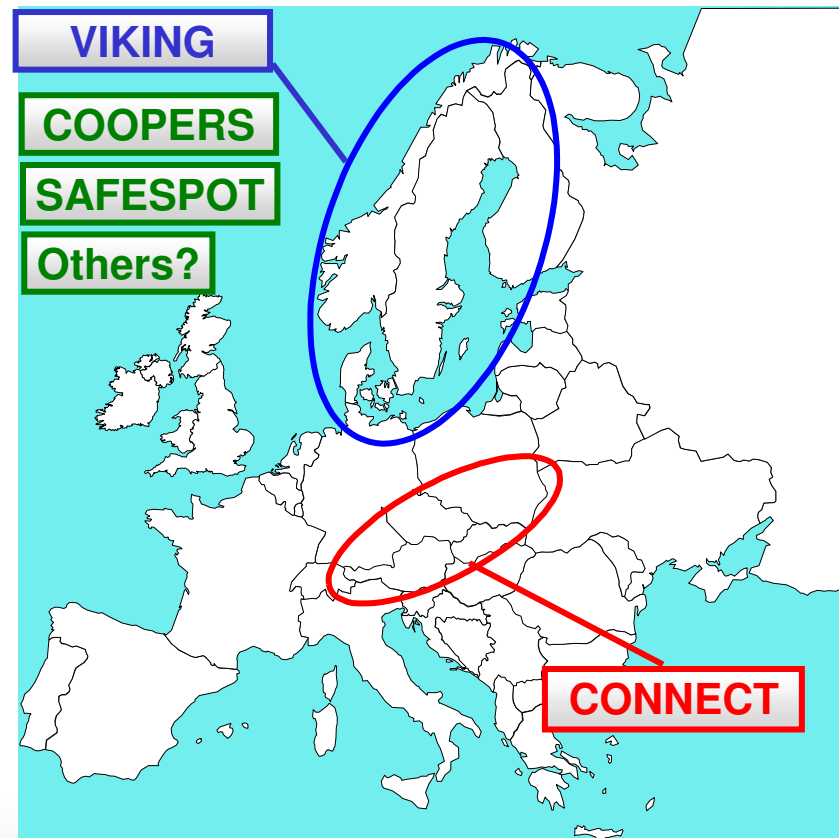
# History of ITS Architecture activities in Europe



# Current FRAME deployment in Europe



**Countries involved with FRAME**



**Projects using FRAME**

# Navigation Tools Objectives

- To make the FRAME easy to use
- Support developers of ITS architectures
- Help the dissemination of FRAME
- Two tools available:
  - Browsing Tool
  - Selection Tool

# Browsing Tool

MEGA\_Process\_600 - Microsoft Internet Explorer provided by BTopenworld

File Edit View Favorites Tools Help

Address <C:\Documents and Settings\phj\My Documents\Copies from Main PC\FRAME Navigation Tool - V\HomePage.html> Go Links »

GENERAL QUERY

Home Page Acronym Definitions General Definitions

## European Architecture Navigation Version (Browsing Tool)

This **Browsing Tool** provides access to a HTML view of part of the European ITS Framework Architecture. It enables in fact the **Functional Viewpoint** and part of the **Trace Tables** to be viewed interactively using a standard Internet Browser. Further information about the Functional Viewpoint and the Trace Tables can be found in the documents listed below, that can be read or downloaded from the ['LIBRARY'](#) page of the FRAME Web Site.

- **Functional Viewpoint:** D3.1 (Functional Viewpoint Document)
- **Trace Tables:** Annex 1 of D3.6 (Overview Document)

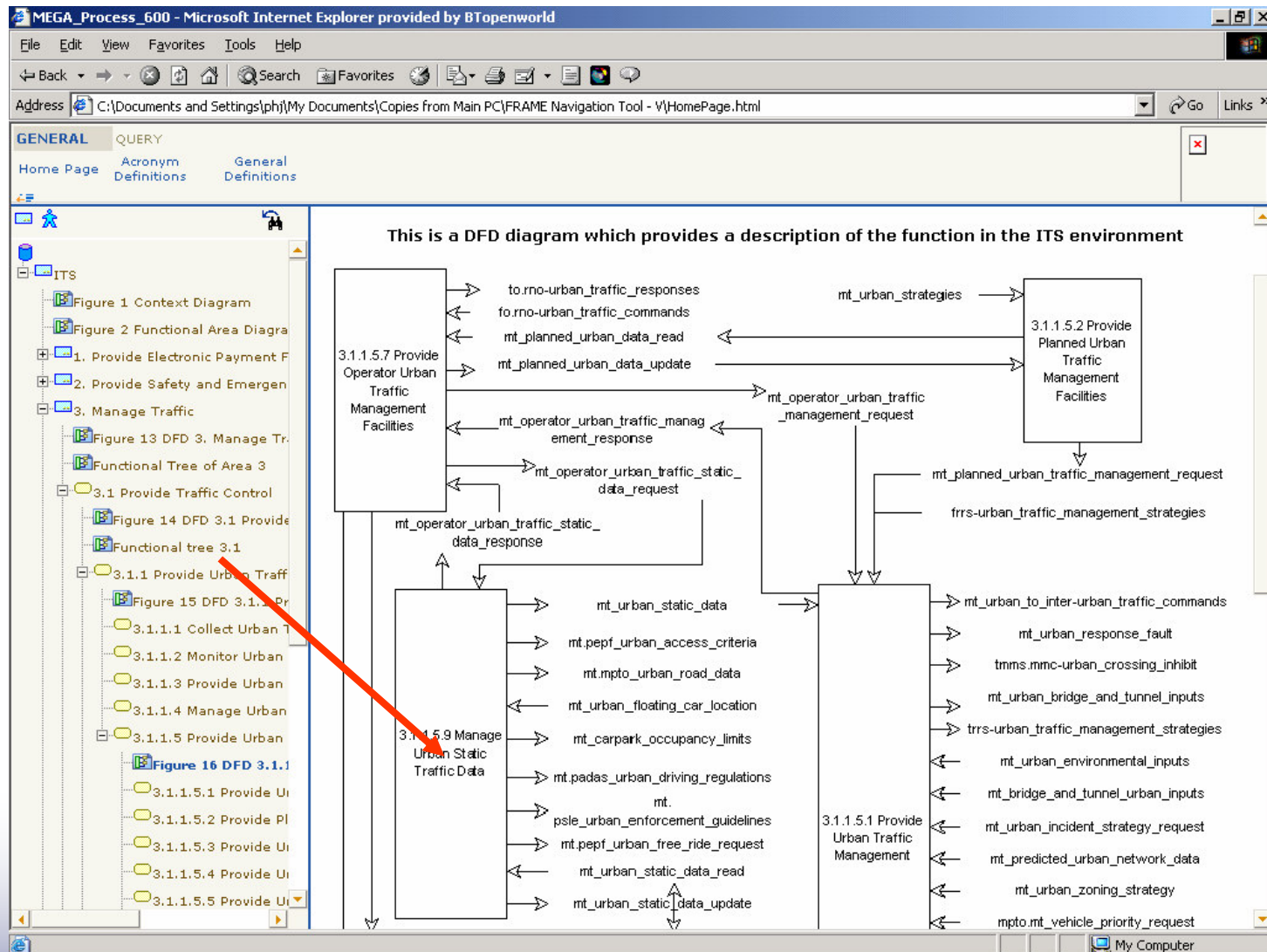
If you are a first time or infrequent User of this Tool and/or of the Framework Architecture itself, it is recommended that you also read the [last sections](#) of this Home Page and the ['Navigation Diagram'](#) page. Others Users should directly access the Browsing Tool pages through the links in the Main Indexes list below (or in the menus on the left).

### Main Indexes

- [User Needs against Functions](#)
- [Terminators](#)
- [Functional Areas](#)
- [Data Flow Diagrams \(DFD's\)](#)
- [Functions](#)
- [Data Flows](#)
- [Data Stores](#)
- [Acronym Definitions](#)
- [General Definitions](#)

My Computer

# A Data Flow Diagram

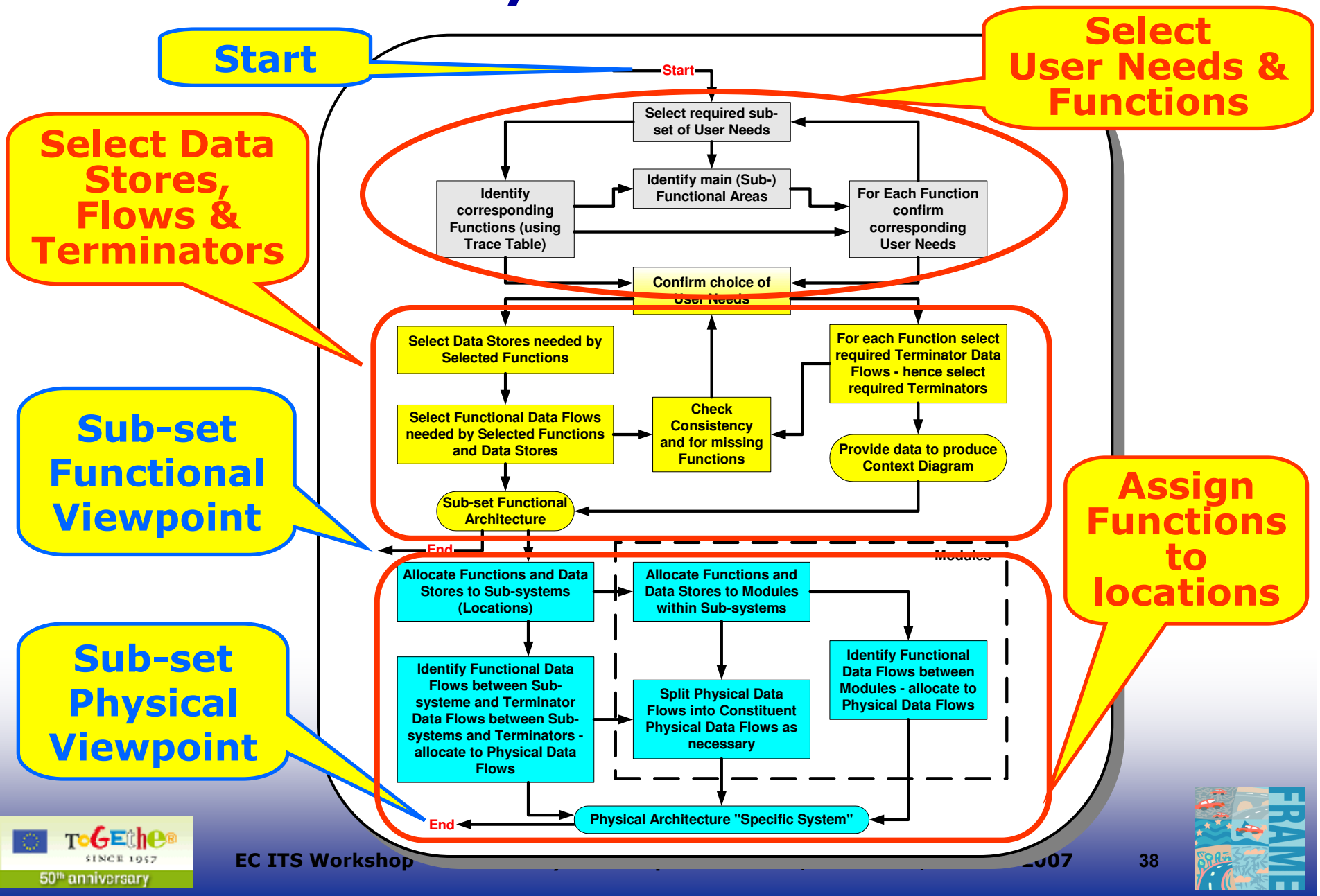


# Selection Tool

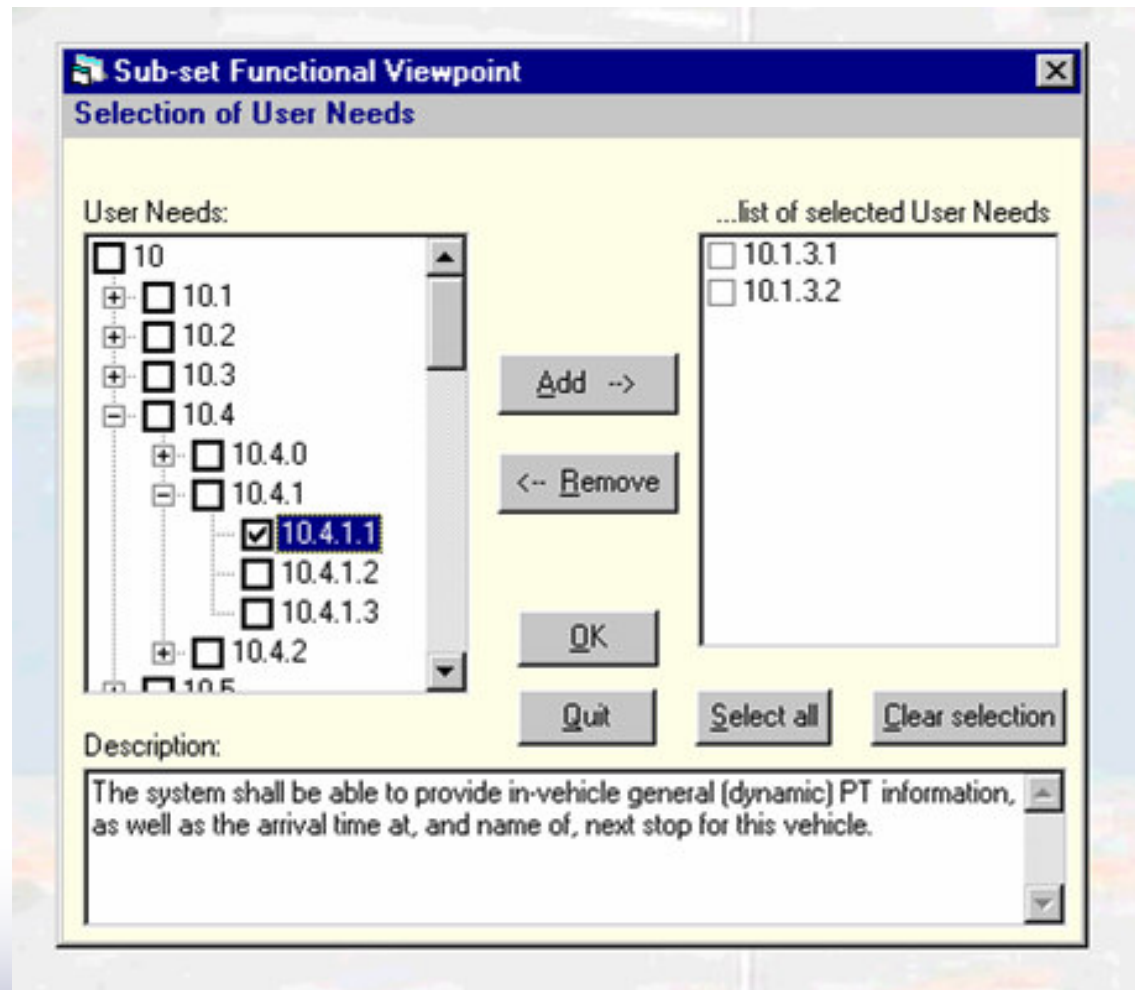
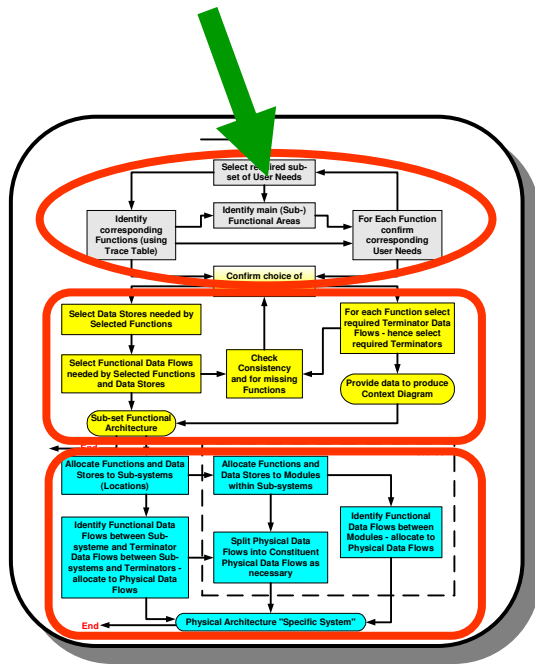
- **Designed to be free, 'open' and easy to use**
  - **With an interactive user interface**
  - **Written in Access and VB**
- **Users have the ability to create their own Architecture sub-set:**
  - **Both Functional & Physical Viewpoints**
- **When necessary, users have to:**
  - **Draw their own diagrams**
  - **Add new User Needs, Functions, etc.**



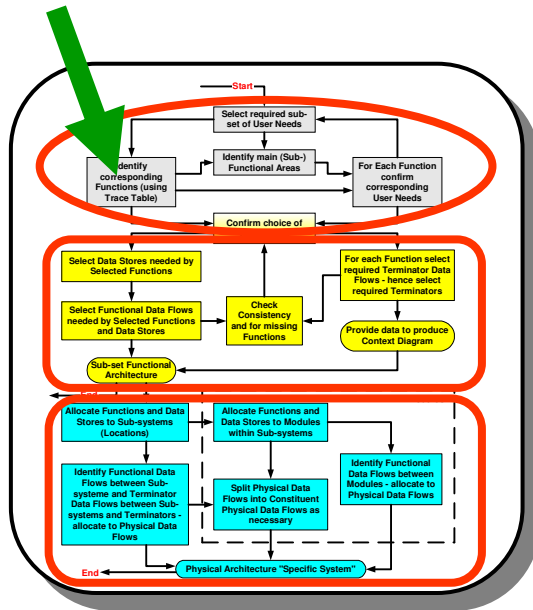
# Selection/Creation Process



# Selecting User Needs



# Selection of Functions



**Sub-set Functional Viewpoint**  
 Selection of low level Functions related to selected User Needs

Low level Functions

- Area 4
  - 4.1
  - 4.4
    - 4.4.3
    - 4.4.4

...list of selected Functions

- 4.1.2
- 4.4.1

Add -->

--> Remove

OK

Quit

Select all

Clear selection

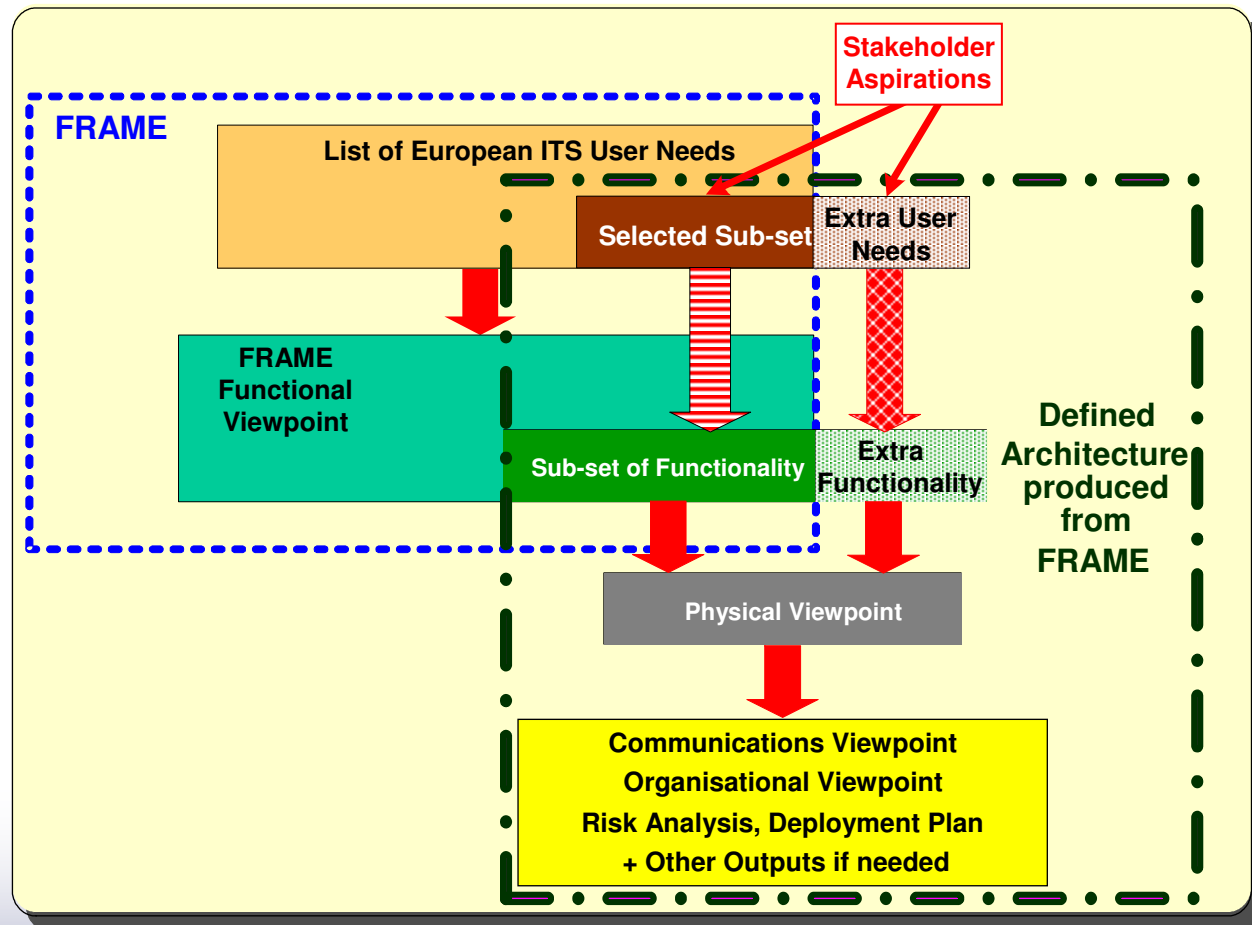
Description:

Control Vehicle Driving - This Low Level Function shall convert the actions defined by the control strategies into commands to be acted upon directly by the controlled vehicles or their drivers. The control of automatically driven Public Transport vehi...

User Need Satisfied:

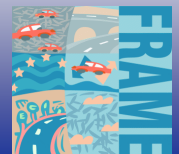
10.4.1.1 : The system shall be able to provide in-vehicle general (dynamic) PT information, as well as the arrival time at, and name of, next stop for this vehicle.

# Using FRAME



# What happens after the Architecture is created?

- **Use it!!**
- **How:**
  - **Depends on:**
    - The type of architecture?
    - How ITS is deployed in Israel?
  - **You may have to:**
    - Train people in its use
    - Promote its use
- **Get feedback on its use:**
  - **"How was it for you?"**
  - **Are there:**
    - Things that need changing?
    - New Services to add/modify/delete?



# Standards

- **Only apply to “Physical” links:**
  - **Roadside – Vehicle (DSRC)**
  - **Vehicle to Vehicle (V2V)**
  - **Roadside – Centre**
  - **Etc.....**
- **Try to use existing standards:**
  - **CEN & ISO work together**
  - **Already cover many ITS aspects**
- **If you have to create new standards:**
  - **It takes a long time**
  - **Work through CEN TC278**



# Thank you for listening

**FRAME Web Site: <http://www.frame-online.net>**

**“BROWSING TOOL” – on its own page**

**“SELECTION TOOL” – on its own page**

**“LIBRARY” – contains documentation**

**“ABOUT ITS ARCHITECTURE” – contains background information and brochures**