



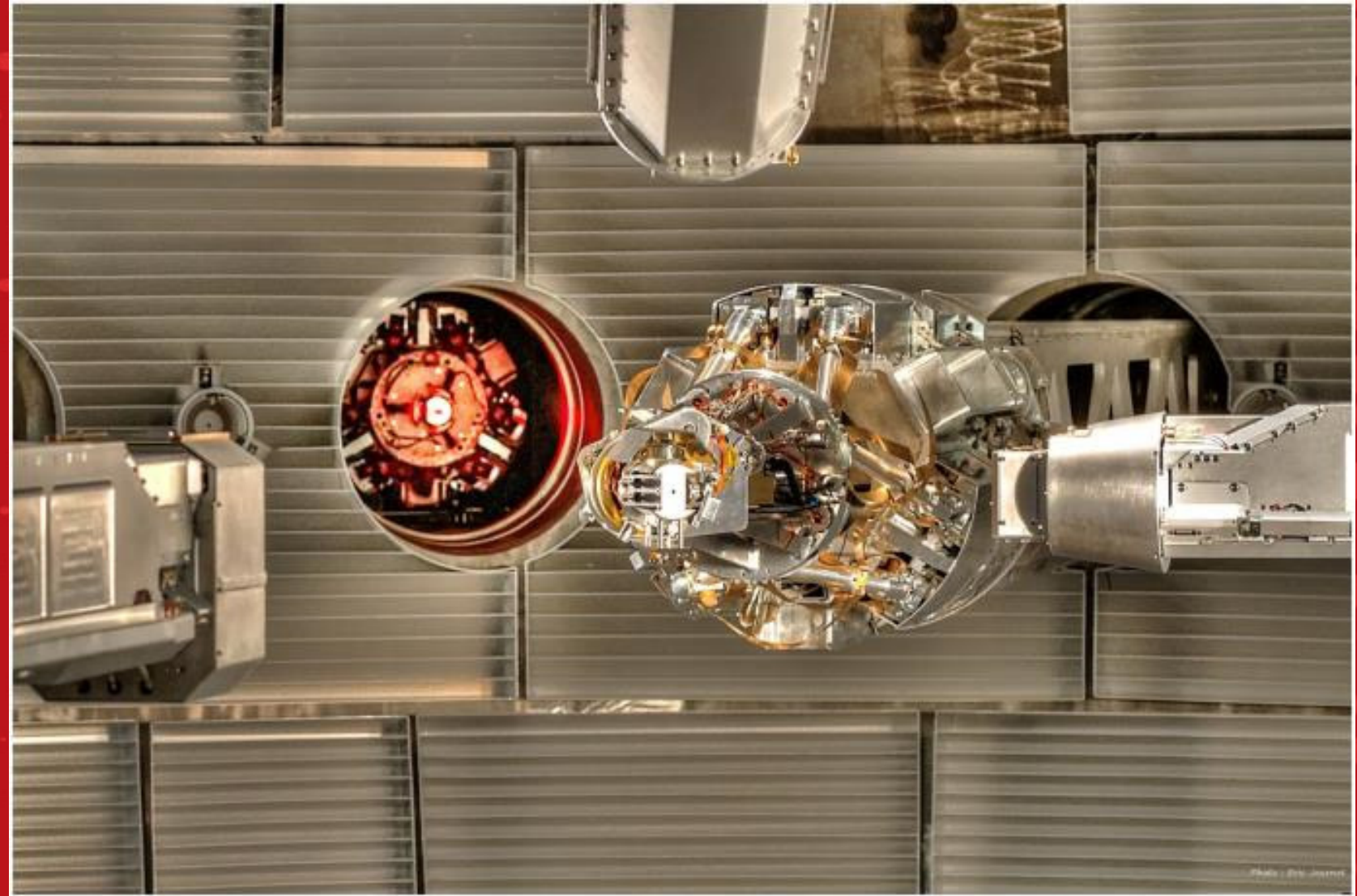
DE LA RECHERCHE À L'INDUSTRIE

# LMJ Target Diagnostics Integration

October 8th, 2019

S. TRANQUILLE-MARQUES , CEA/CESTA

e-mail: [sandrine.tranquille-marques@cea.fr](mailto:sandrine.tranquille-marques@cea.fr)





## What is LMJ, What are Target Diagnostics ?



**What is LMJ, What are Target Diagnostics ?**

**Target Diagnostics (TD) Control Command Architecture**

**What is LMJ, What are Target Diagnostics ?**

**Target Diagnostics (TD) Control Command Architecture**

**Target Diagnostic Life Cycle**

**What is LMJ, What are Target Diagnostics ?**

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**Target Diagnostics Integration Process**

**What is LMJ, What are Target Diagnostics ?**

**Target Diagnostics (TD) Control Command Architecture**

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**Target Diagnostics Integration Process**

**Target Diagnostic in Shot Sequence**

**Conclusion**

LMJ offers unique capabilities to study **High Energy Density Physics** and **Basic Science** (*equation of State, atomic data, nuclear data ..*)

## A large panel of experiments will be done:

- Temperatures: 100 eV up to 100 keV
- Pressures: several thousands of Mbars
- Ignition is the most exciting challenge



## Building

- 300 meters (~984 feet) long;
- 100 meters (~328 feet) wide;
- 50 meters (~164 feet) high
- 140,000 m<sup>2</sup> of floor space

## 4 Laser bays

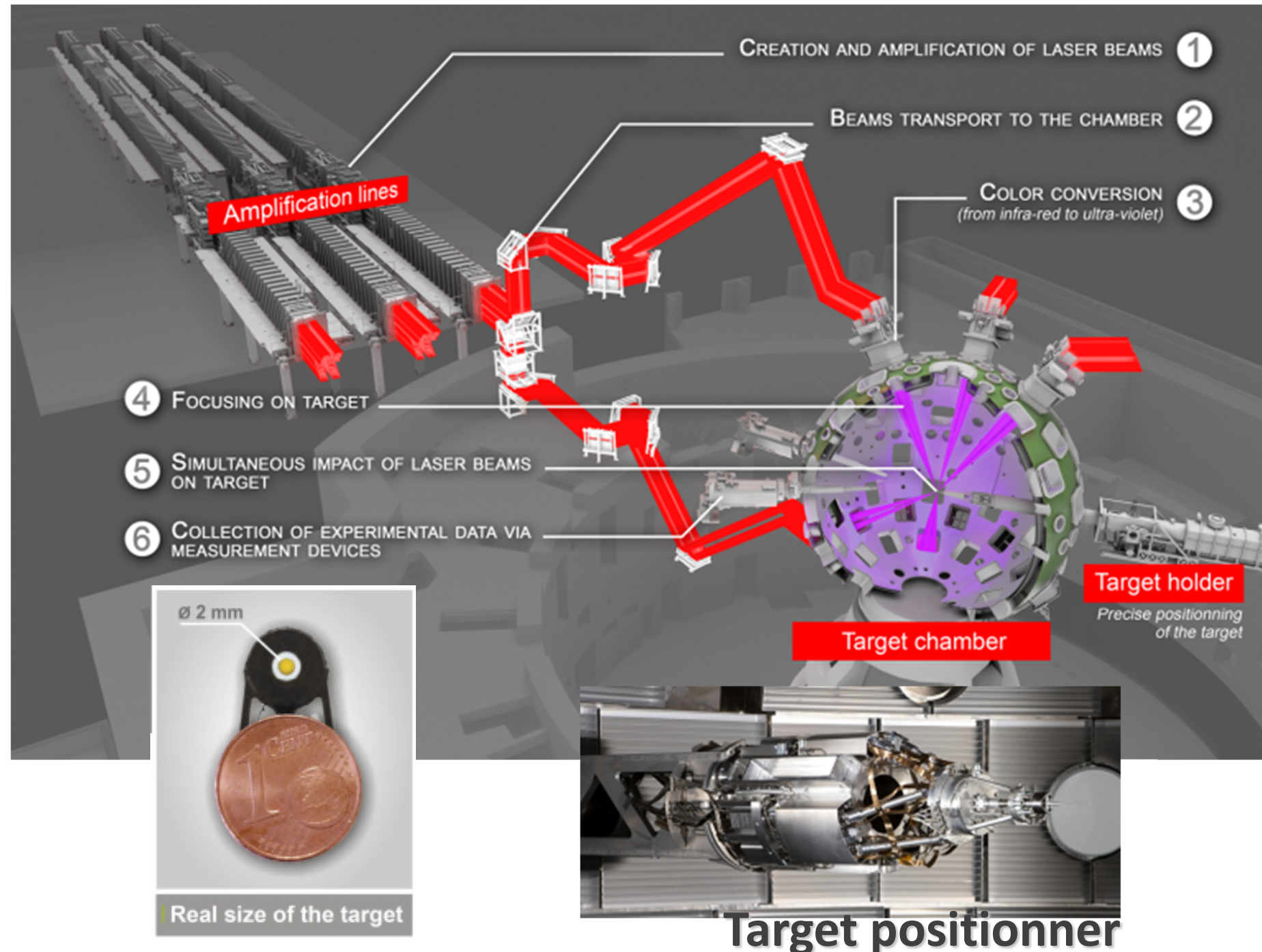
- 22 bundles of 8 beams (176 beams)
- 10,000 optical devices
- 10,000 motors
- 2,000 cameras
- 2 metric tons of single crystals
- 300 metric tons of glass

## Experiment Room

- ∅ 60 m (~197 feet) / 50 m (~164 feet) High

## Experiment Chamber ∅ 10 m (~33 feet)

## Target ∅ 2mm



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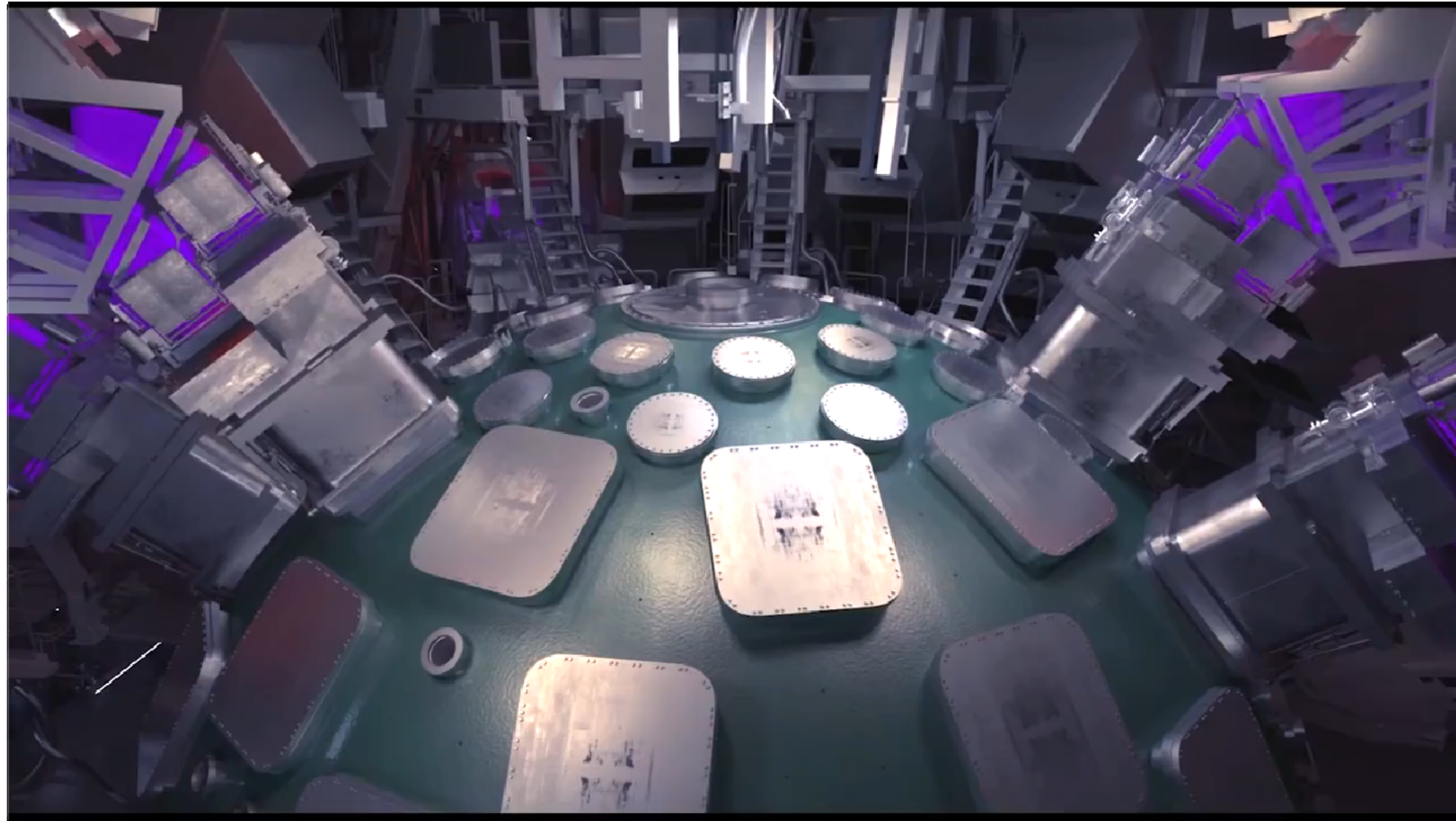
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## ● Target Ø 2mm



LMJ/TD

C/C Architecture

TD Life Cycle

TD Integration

TD Shot Sequence

Conclusion

**Laser/Plasma Interaction**

- ✓ Backscattering
- ✓ Laser propagation
- ✓ Laser entrance hole

**Cavity Physics**

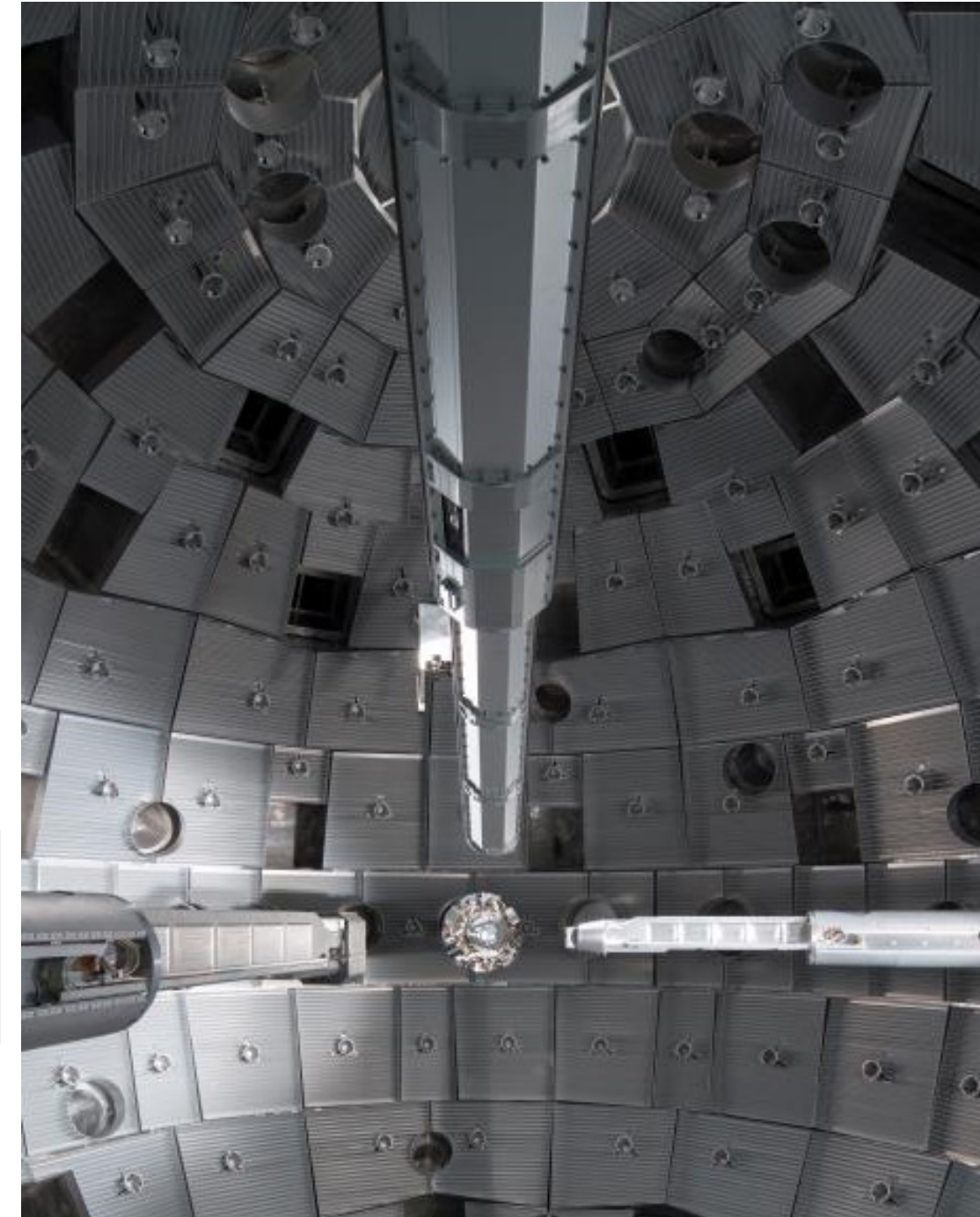
- ✓ X-ray Conversion
- ✓ Radiative temperature
- ✓ ...

**Core implosion**

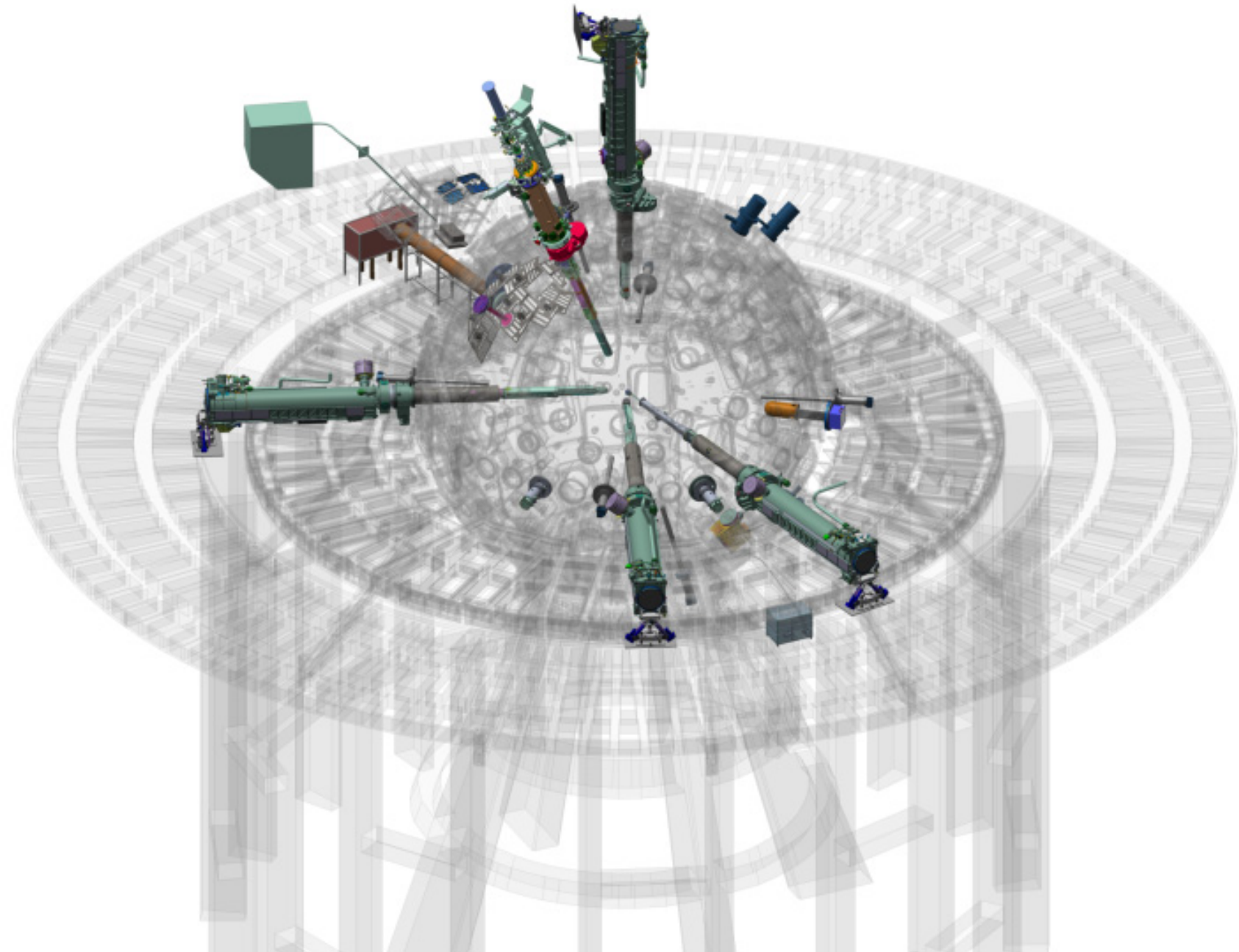
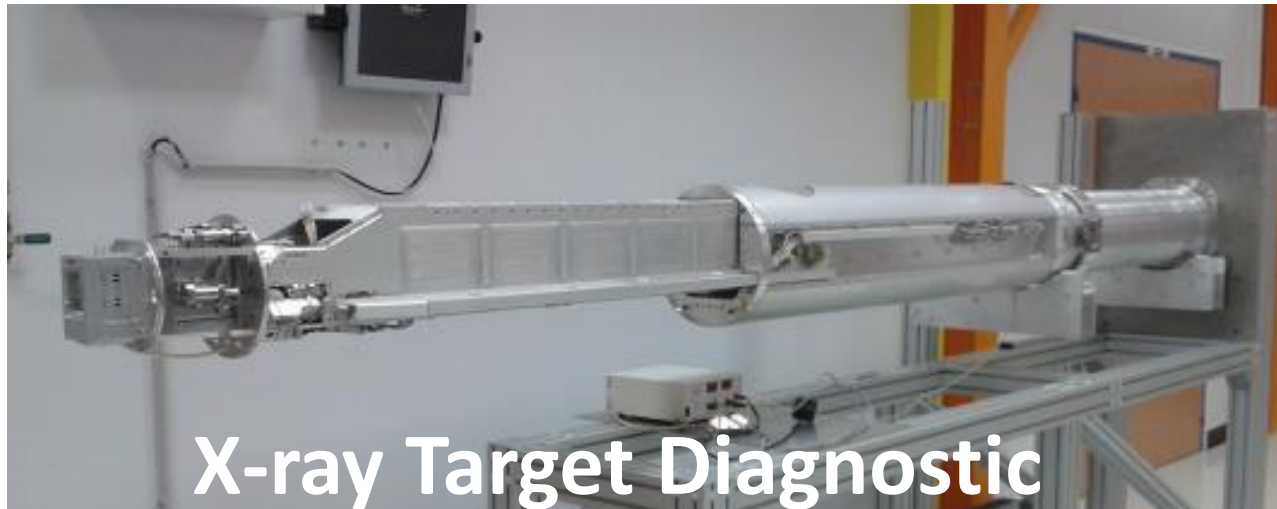
- ✓ Density measurement
- ✓ Hot spot shape and diameter
- ✓ Velocity

**Capsule physics**

- ✓ Shocks chronometry
- ✓ Hydrodynamic instabilities
- ✓ Implosion symmetry



Target Diagnostics are classified in 5 families :



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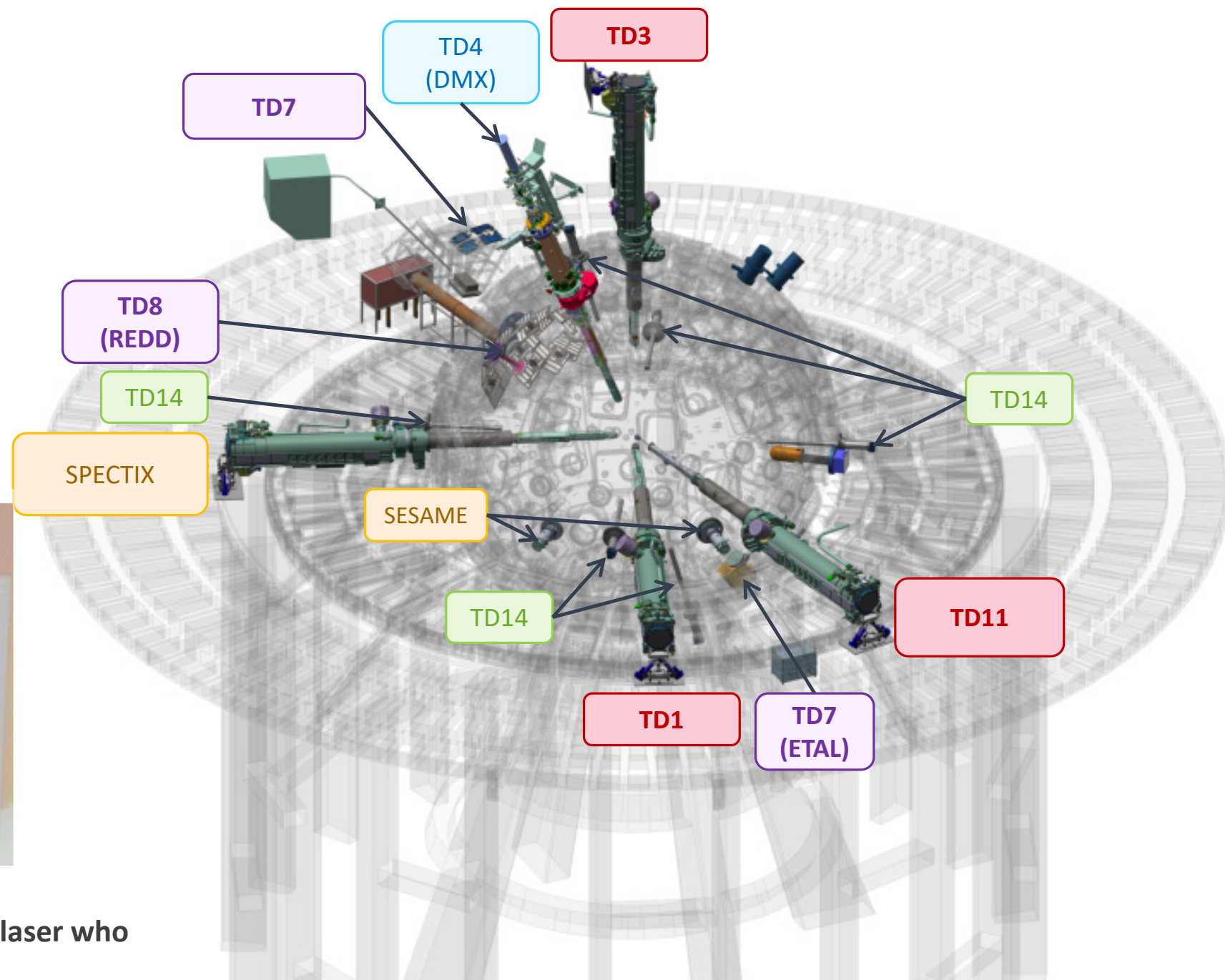
Insertable TD

Specific mechanical TD

Visible /UV TD

Neutronics TD

PETAL+ TD \*



\* PETAL uses one beam on LMJ and is a high energy multi-PetaWatt laser who needs specific target diagnostics

LMJ/TD

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L3 Facility Planning and Operations

GMAO

PARC

GTIR

ADM

L2 System Supervisory

SVP

GCI

L1 SubSystem Control

Installation network

L0 Equipment Control

equipments



**\* IQT: Integration and qualification Tool**



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Interfacing Devices

Driver Devices

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Driver Devices

Alignment

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Tango Database

equipments



\* **IQT: Integration and qualification Tool**



Shared Reference

**L3 Facility Planning and Operations**

GMAO

PARC

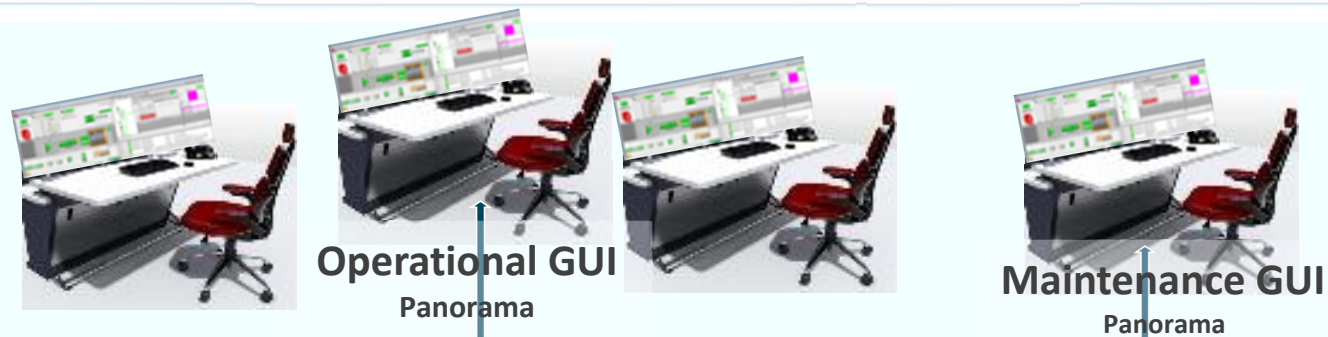
GTIR

ADM

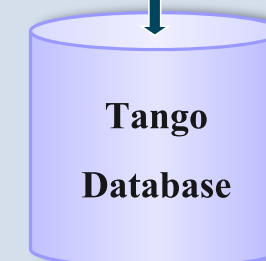
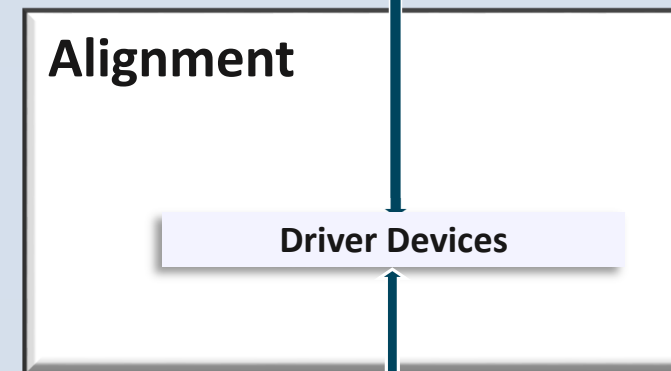
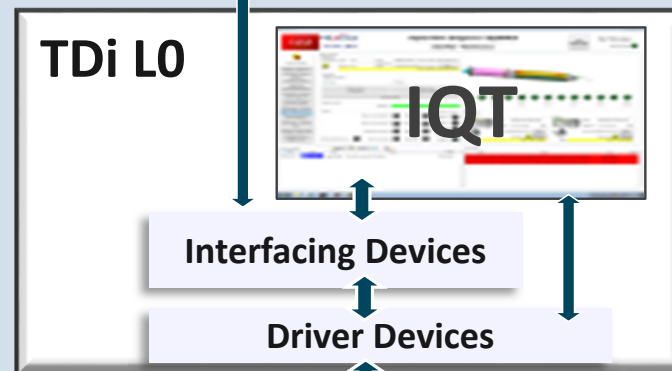
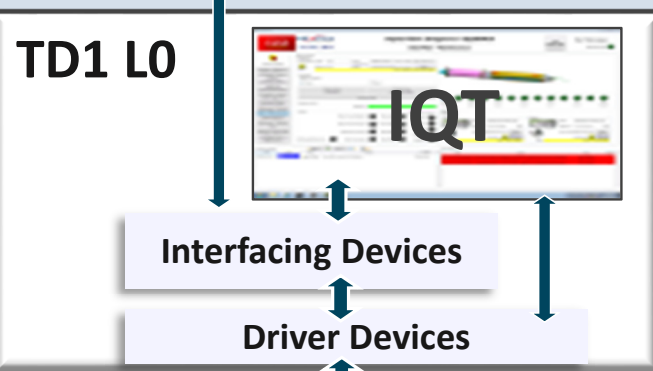
**L2 System Supervisory**

SVP

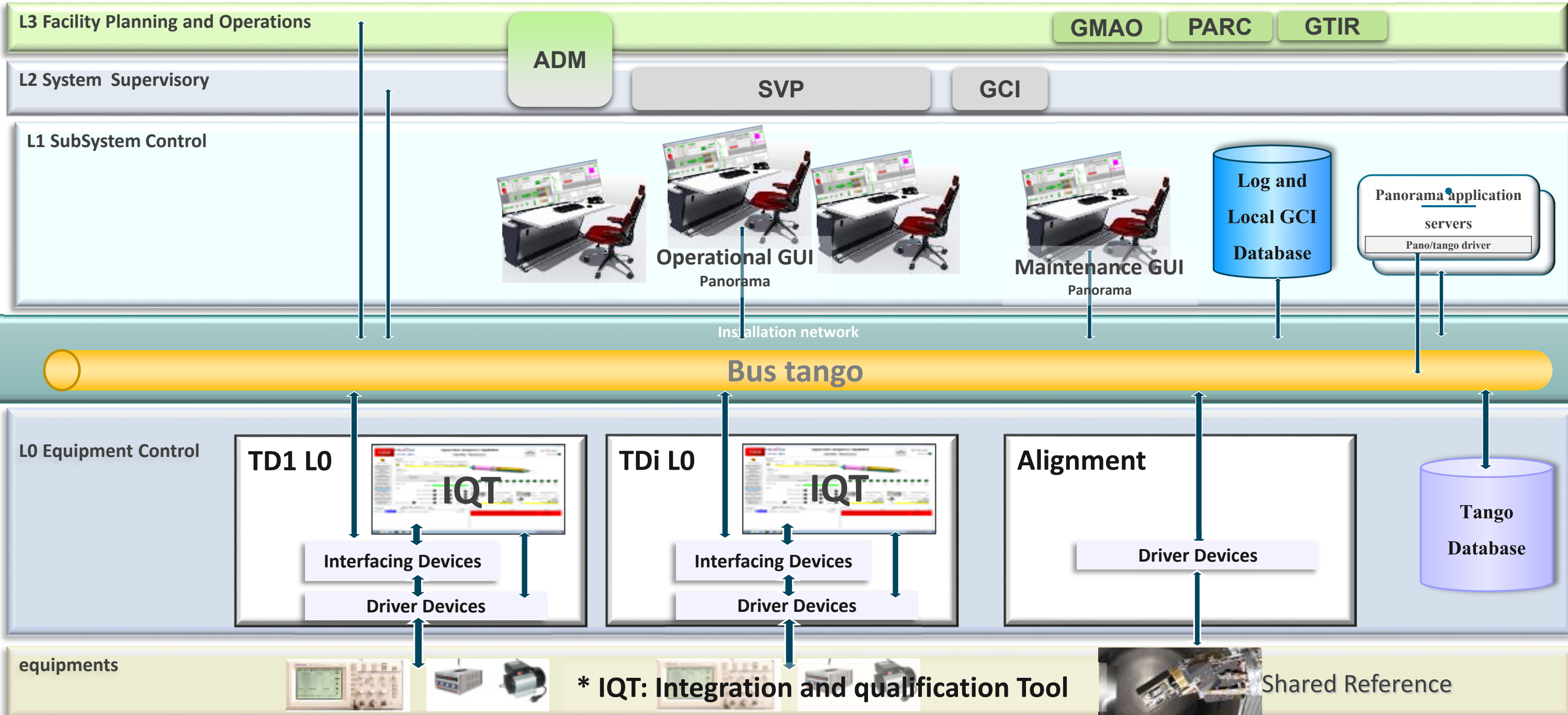
GCI

**L1 SubSystem Control**

Installation network

**Bus tango****L0 Equipment Control****equipments****\* IQT: Integration and qualification Tool**

Shared Reference



\* IQT: Integration and qualification Tool

Shared Reference

LMJ/TD

C/C Architecture

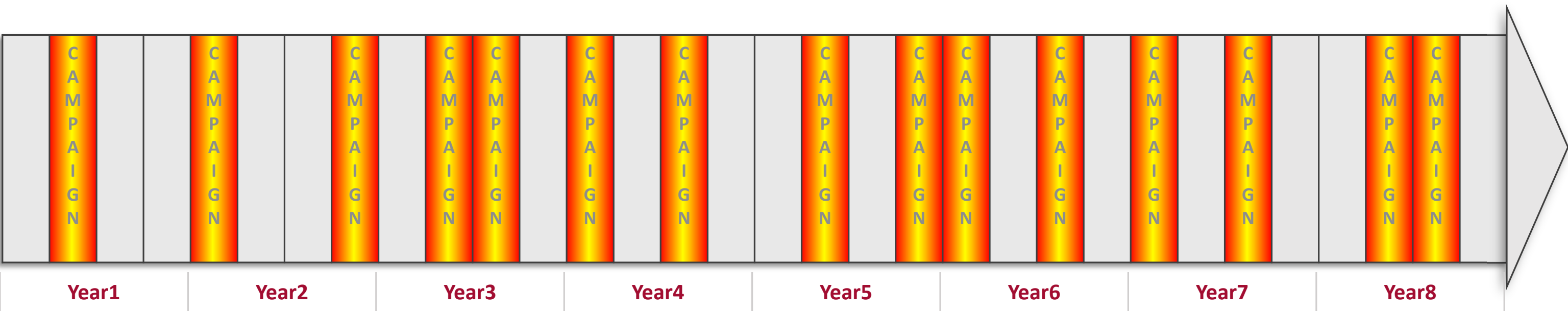
**TD Life Cycle**

TD Integration

TD Shot Sequence

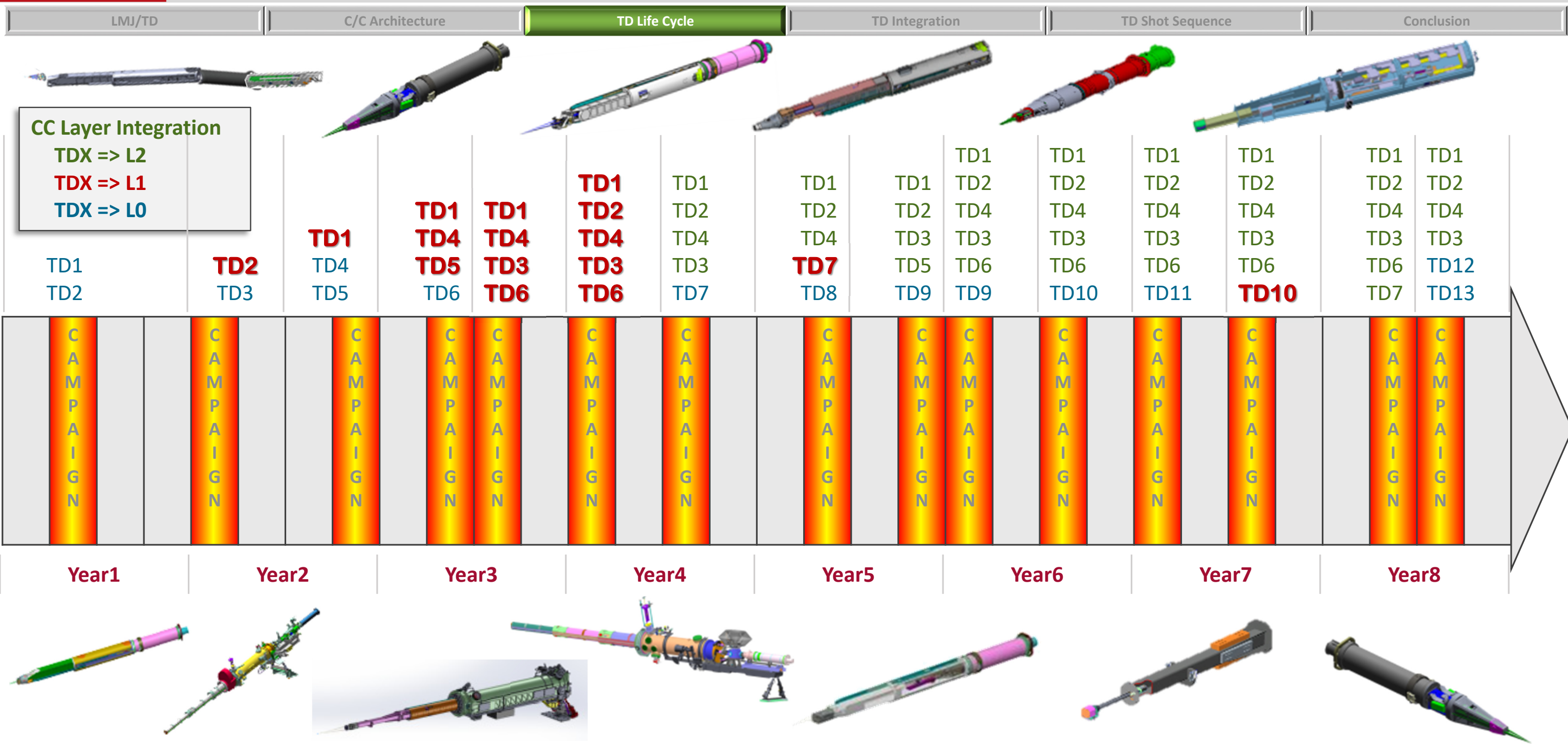
Conclusion

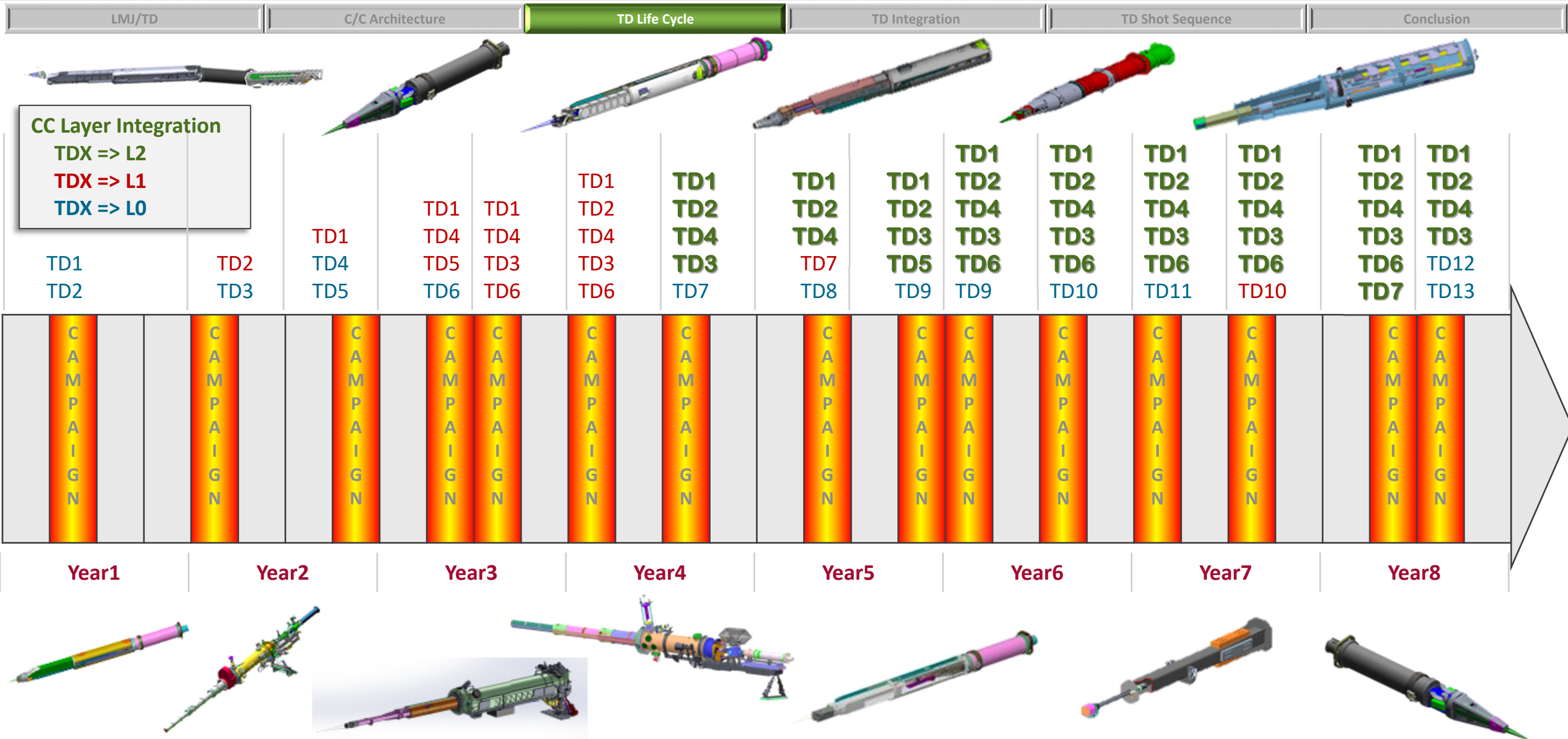
**TDX : New TD**



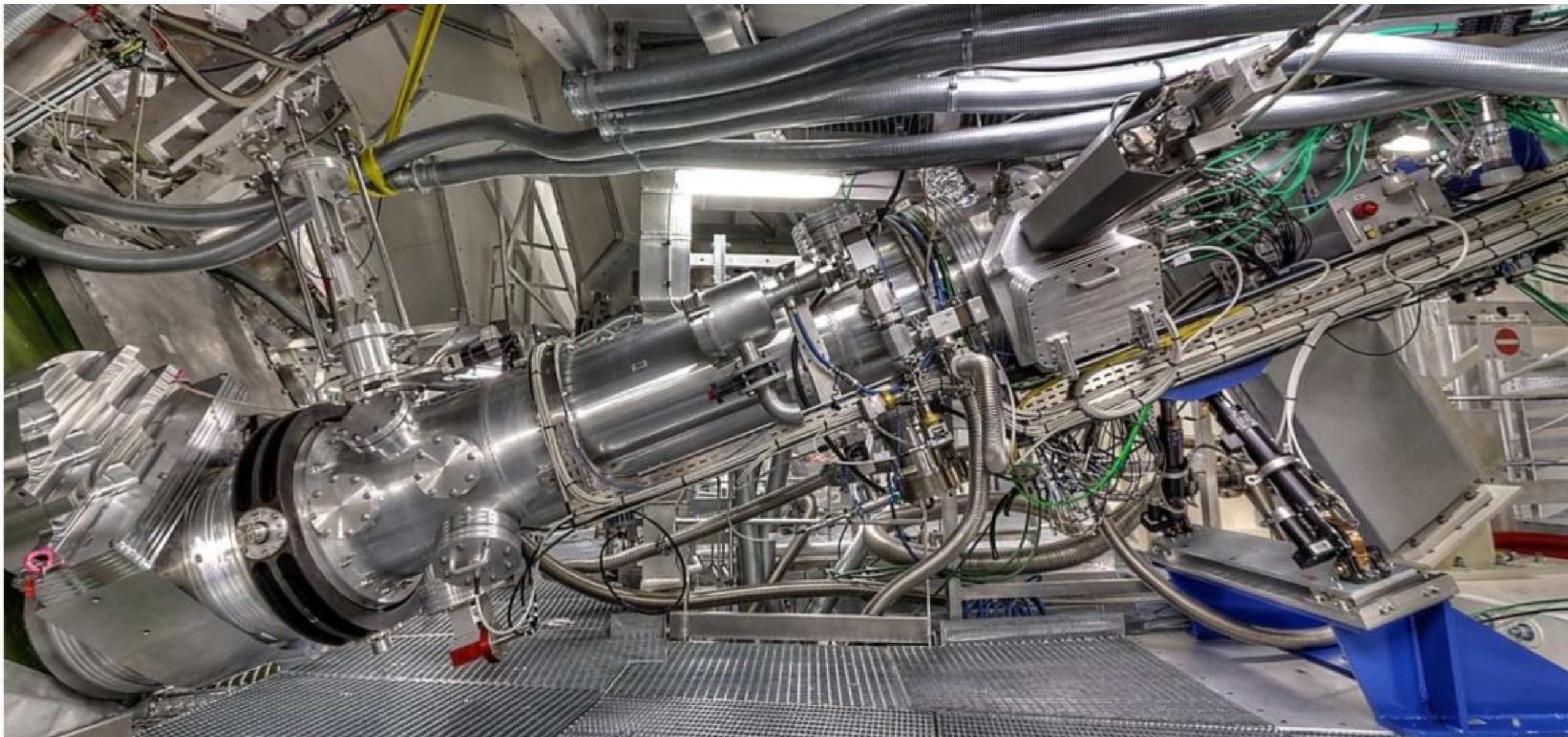




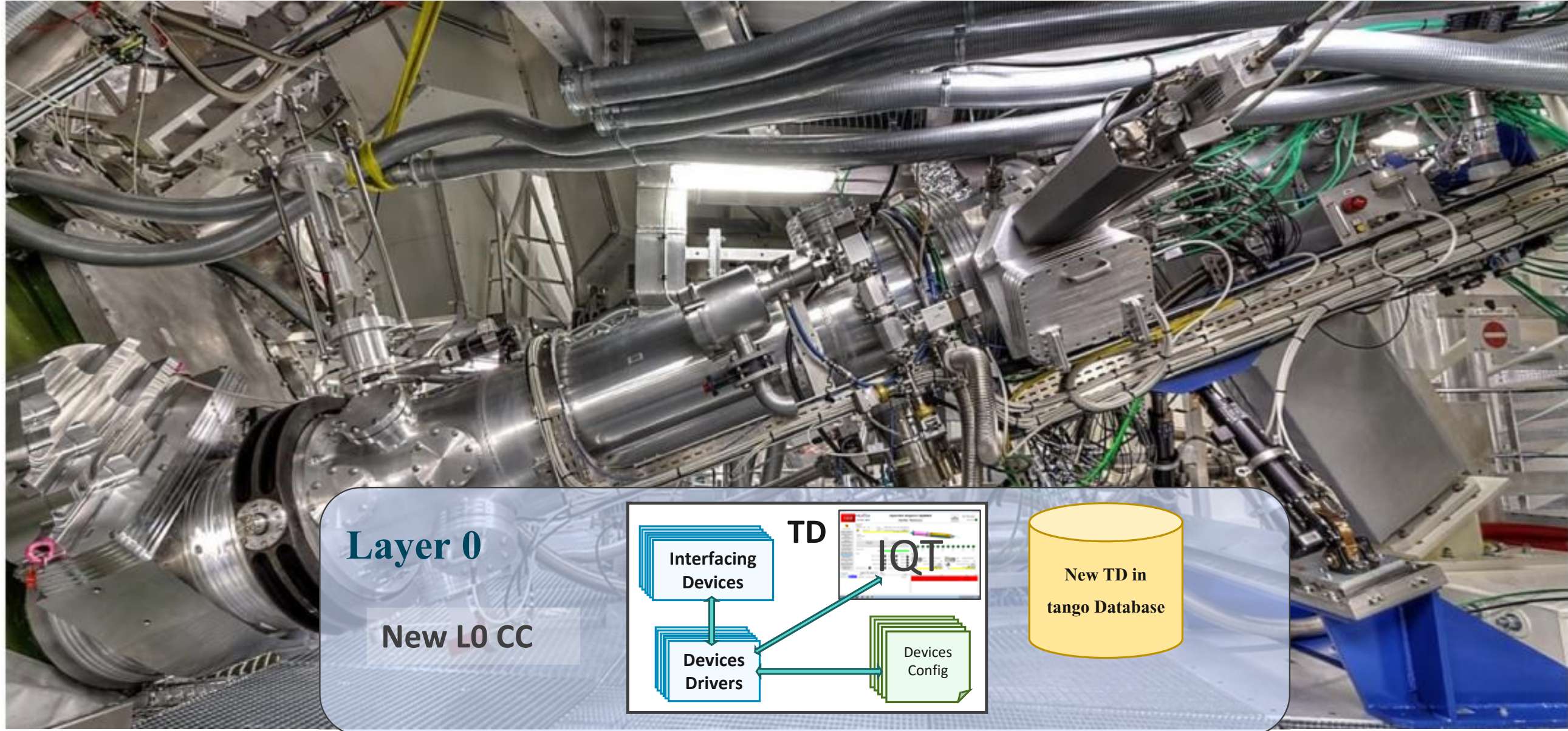




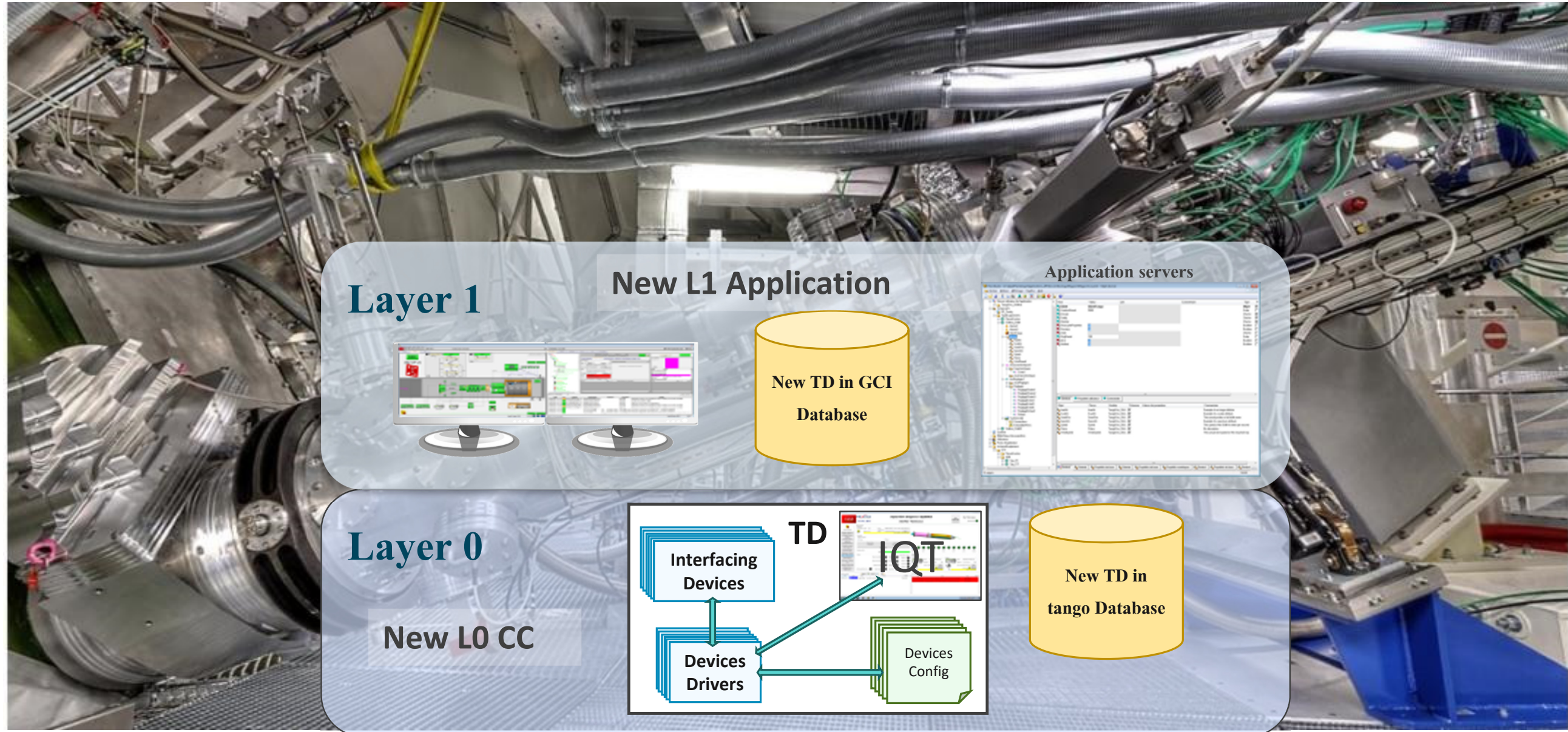
## New Target Diagnostic in LMJ



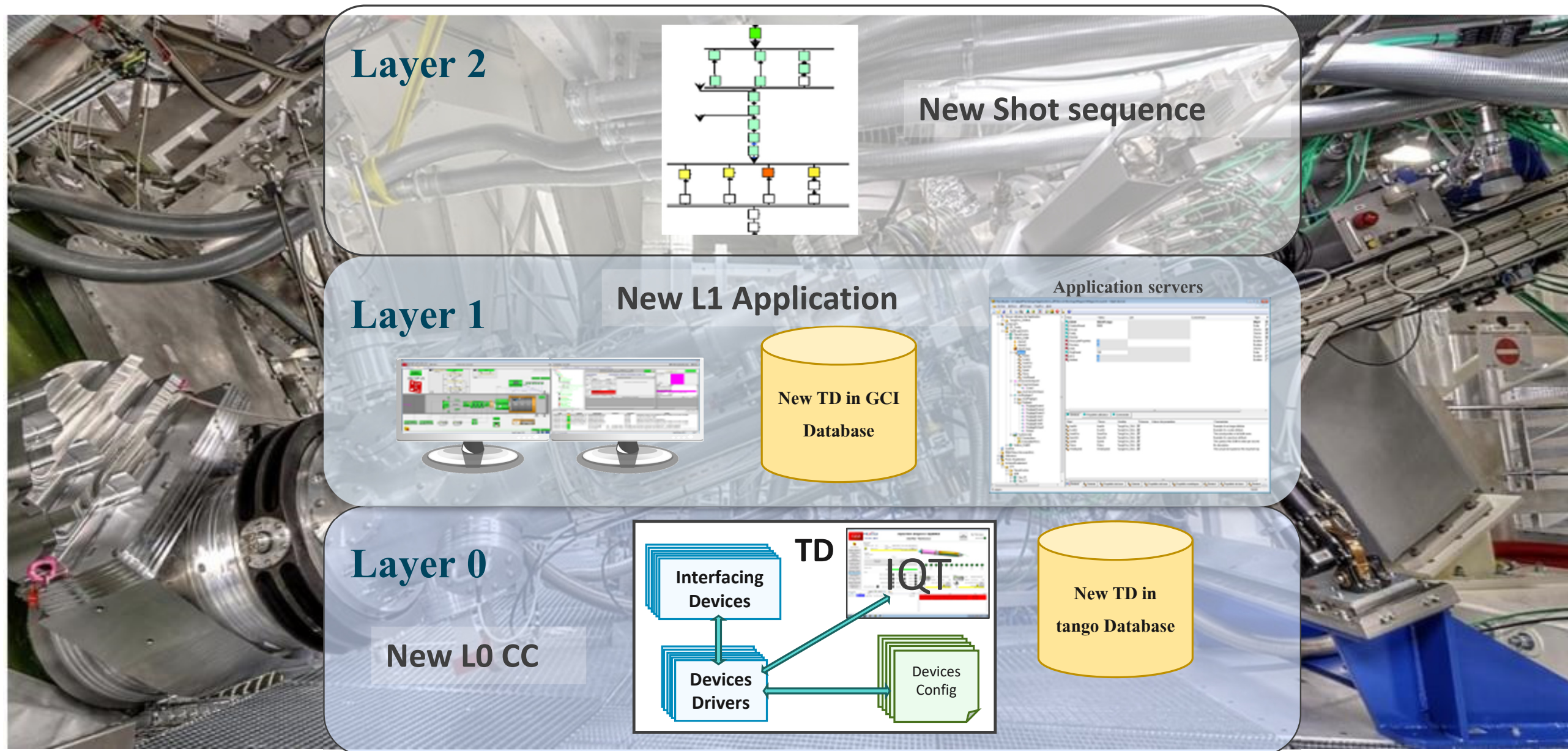
## New Target Diagnostic in LMJ



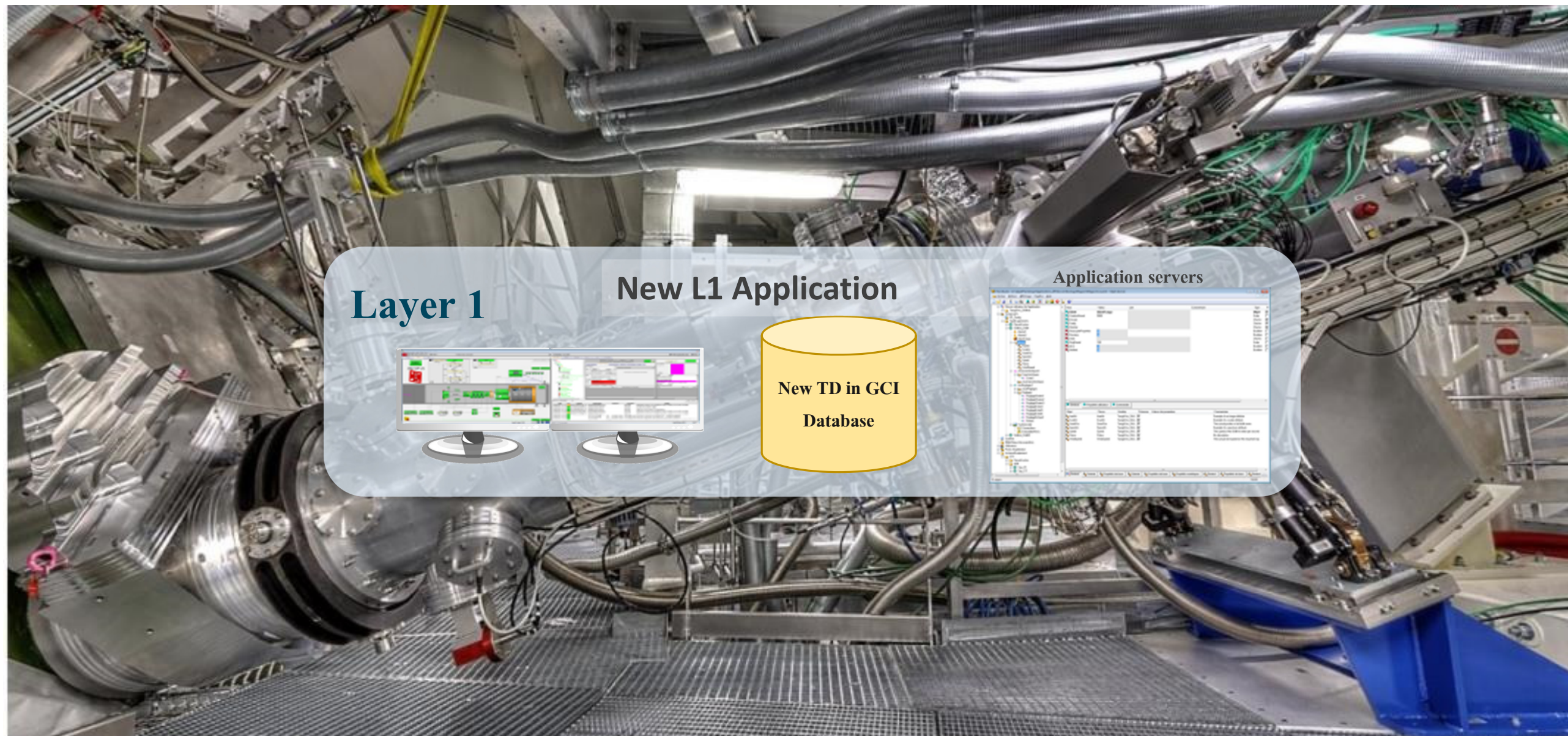
## New Target Diagnostic in LMJ

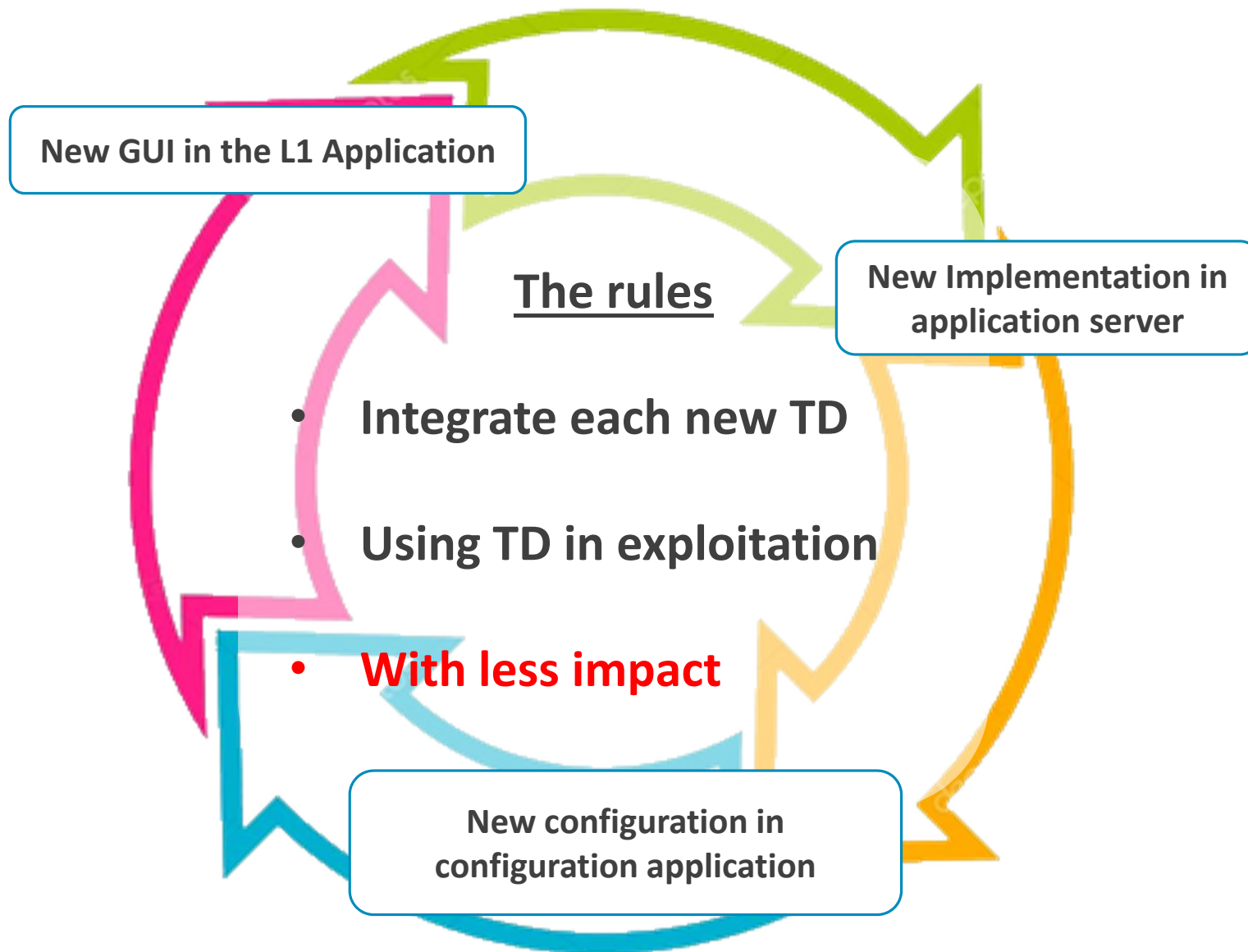


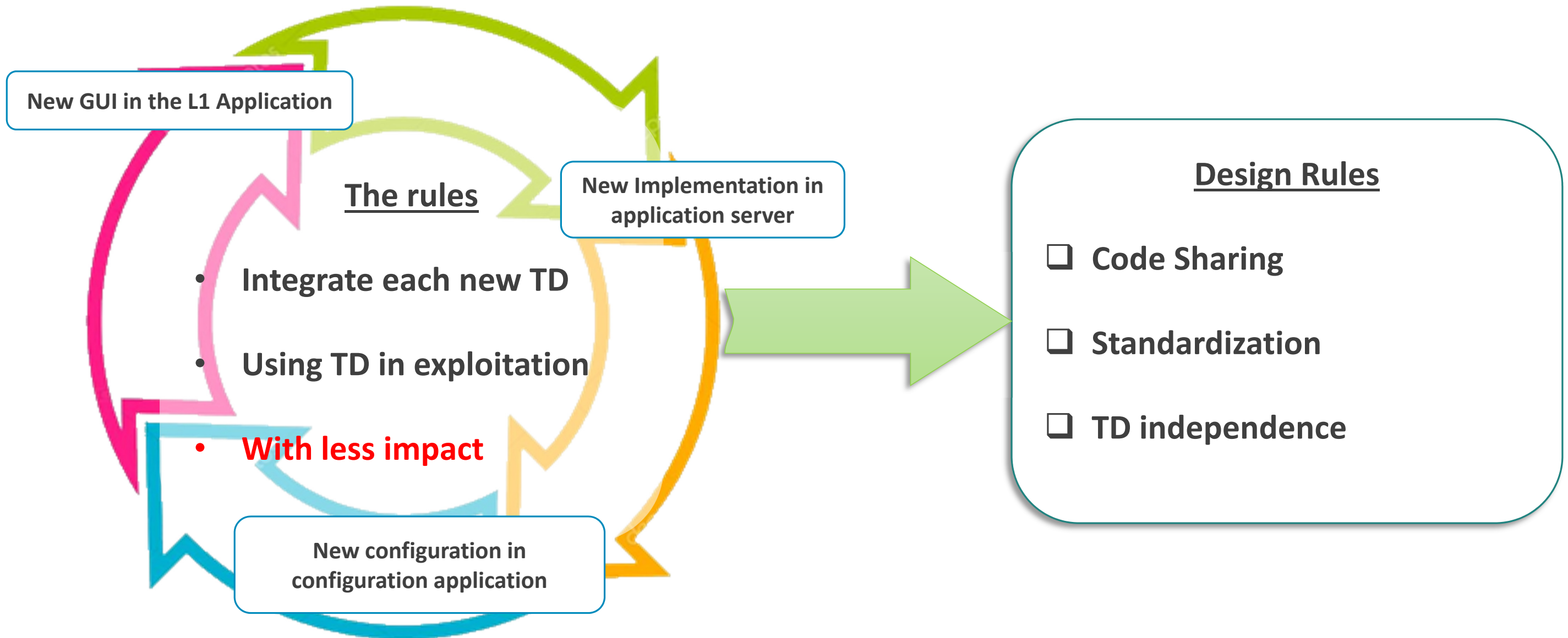
## New Target Diagnostic in LMJ



## New Target Diagnostic in LMJ







LMJ/TD

C/C Architecture

TD Life Cycle

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Editeur de superviseurs de DP, Version 1.0.0.1

Magasin | Superviseur | Deploiement

### Gestionnaire de Magasins

| Version Magasin                  | Dernière édition    |
|----------------------------------|---------------------|
| 25112013_04                      | 25/11/2013 15:51:47 |
| 25112013_05                      | 27/11/2013 14:22:38 |
| 25112013_06                      | 27/11/2013 14:08:57 |
| ✓ VersionCorrigeeNovembre2013    | 25/11/2013 15:30:16 |
| VersionInitialeBaseTangoComplete | 25/11/2013 15:30:16 |

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Renommer

Importer Magasin  
Exporter Magasin

Editer  
Rendre Actif

Magasin d'équipement actif : VersionCorrigeeNovembre2013

Editeur de superviseurs de DP, Version 1.0.0.1

Magasin | Superviseur | Deploiement

### Gestionnaire de superviseurs de DP

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| DP02 | 2511_07             | 27/11/2013 11:31:59 |
| DP03 | Novembre2013_Stable | 25/11/2013 15:57:40 |
| DP04 | ✓ test332_6565      | 27/11/2013 14:22:47 |

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Exporter Version

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Editer  
Contrôler cohérence  
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**Implementation**

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Rendre Actif

Magasin d'équipement actif : VersionCorrigeeNovembre2013

**Generation**

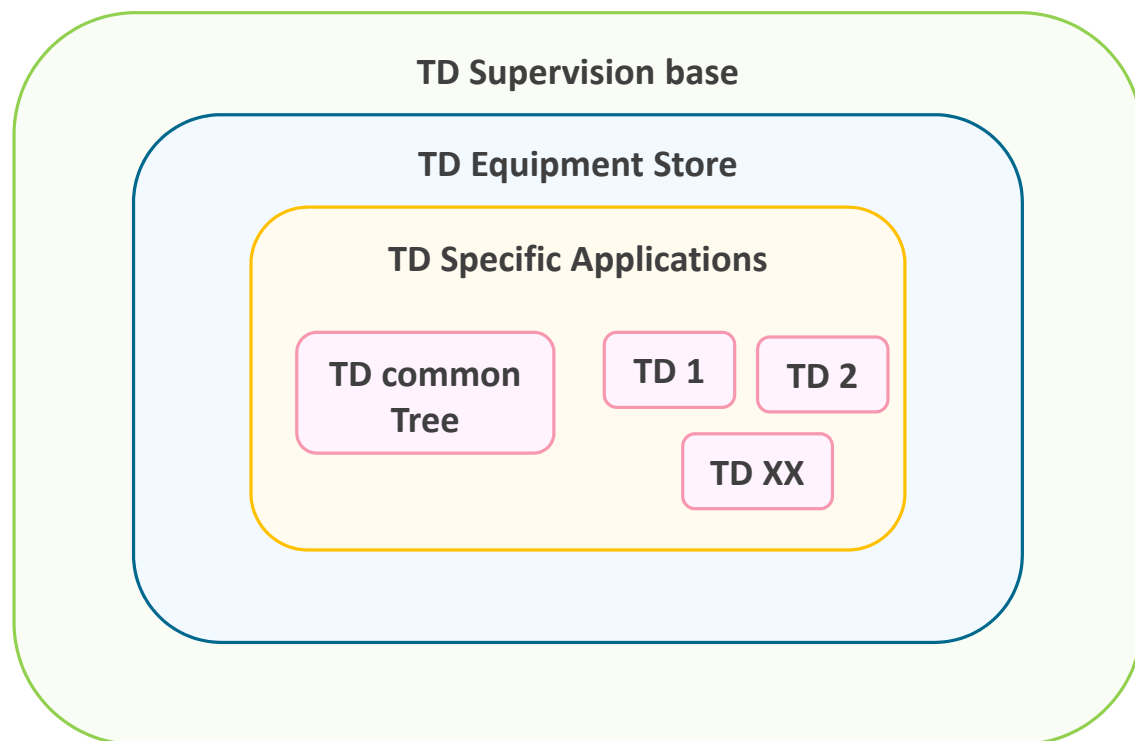


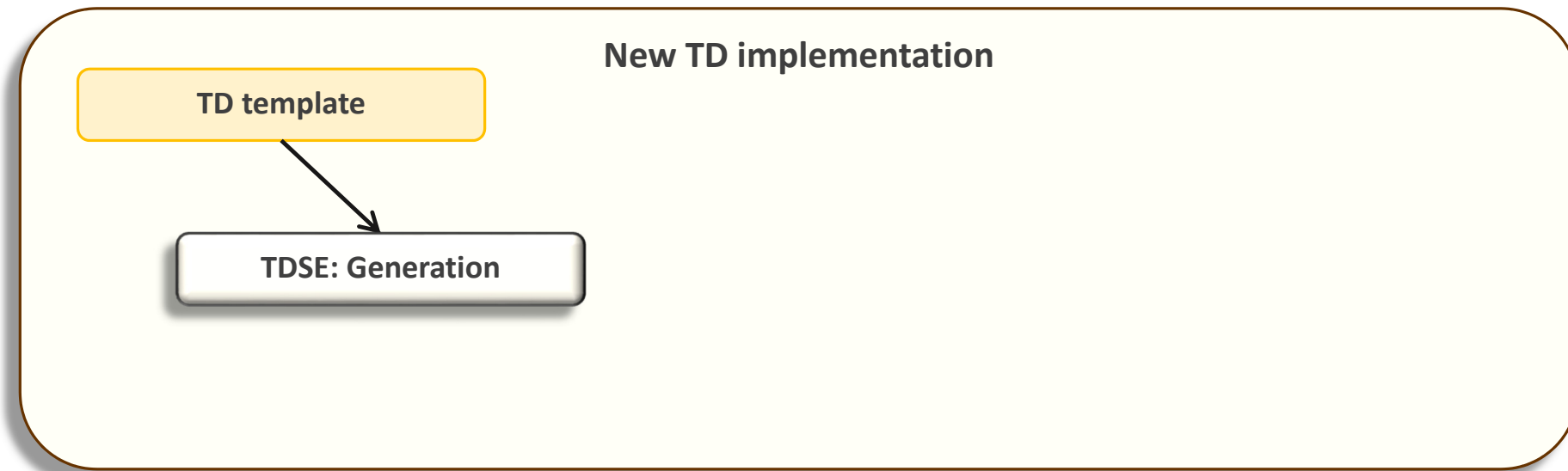
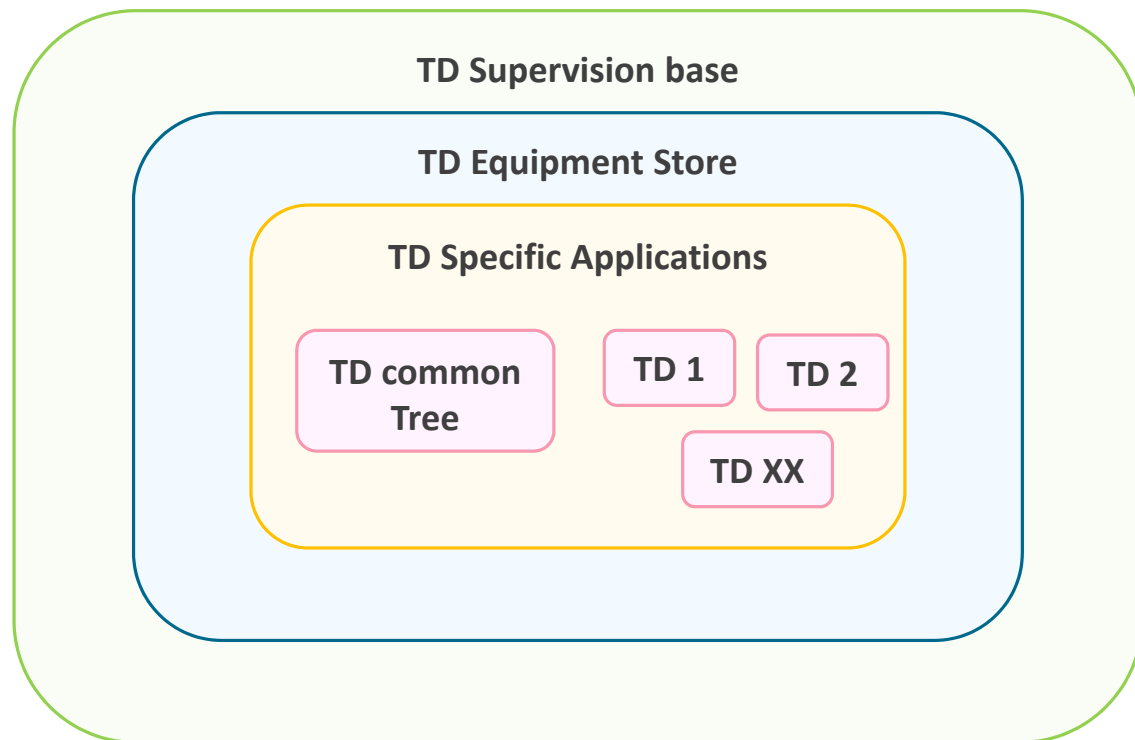
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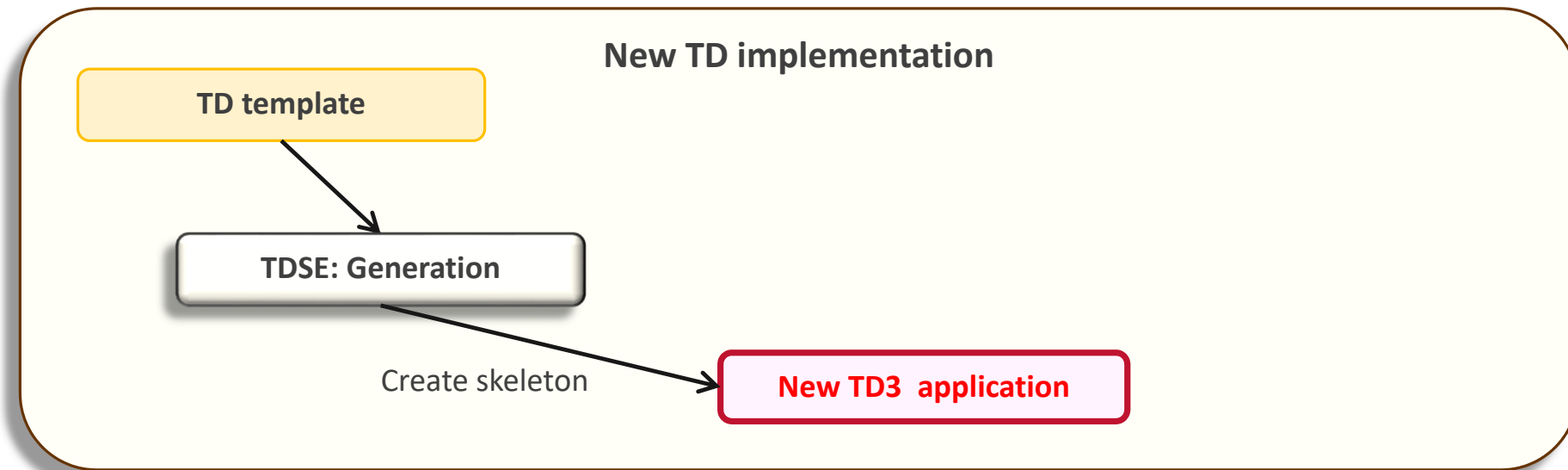
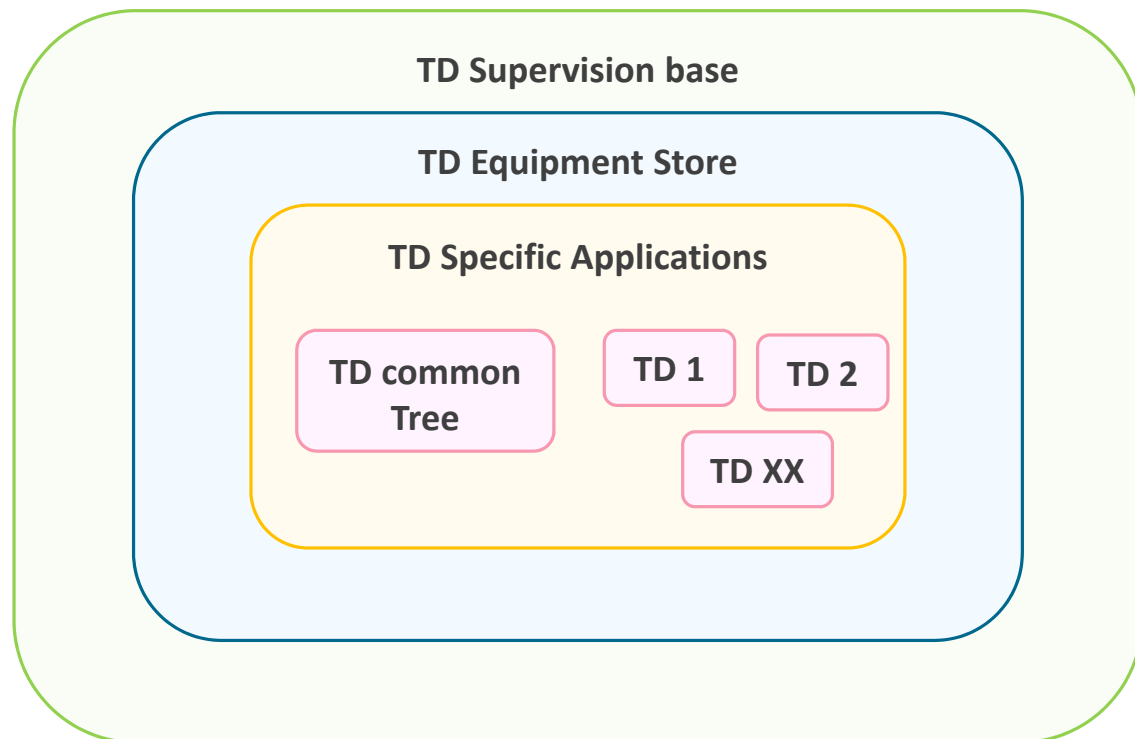
- Enumerates types
- Proxy
- Data Structure
- ...

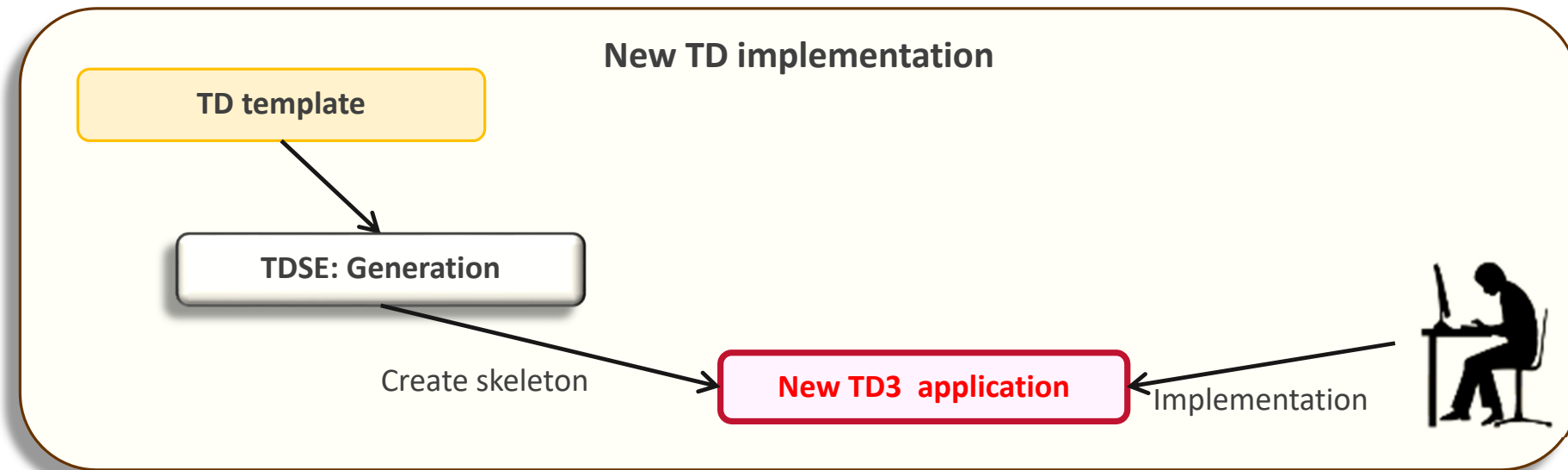
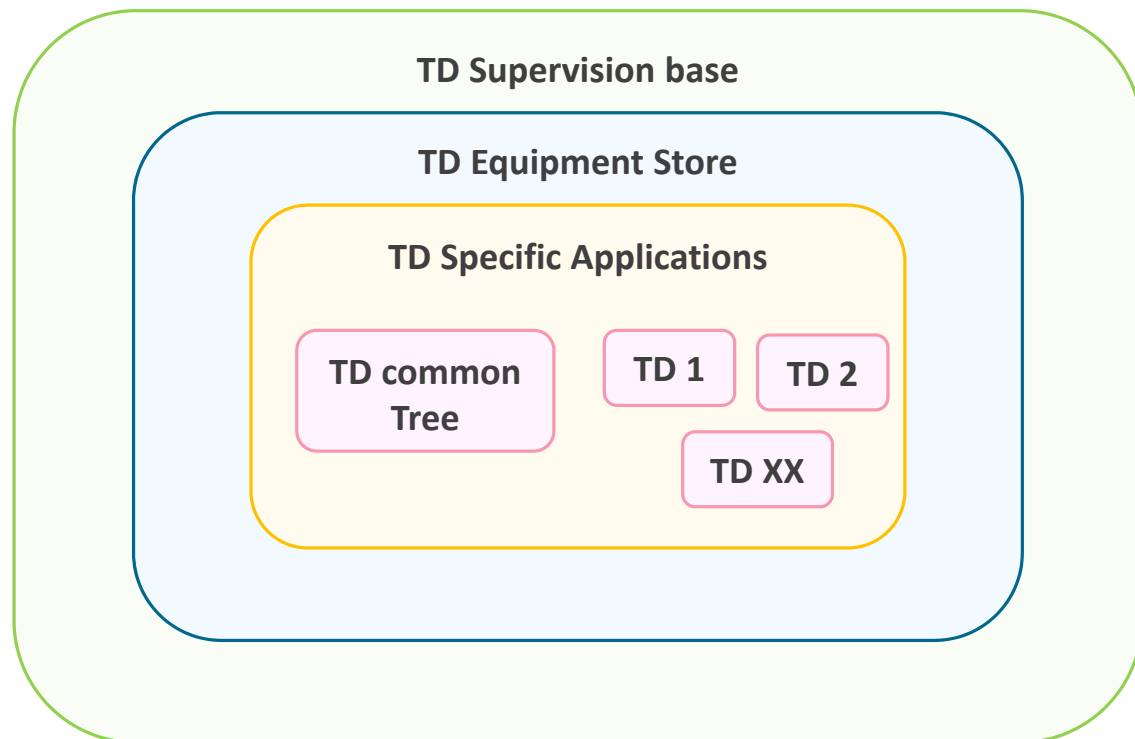
**TD Supervision base****TD Equipment Store****equipments**

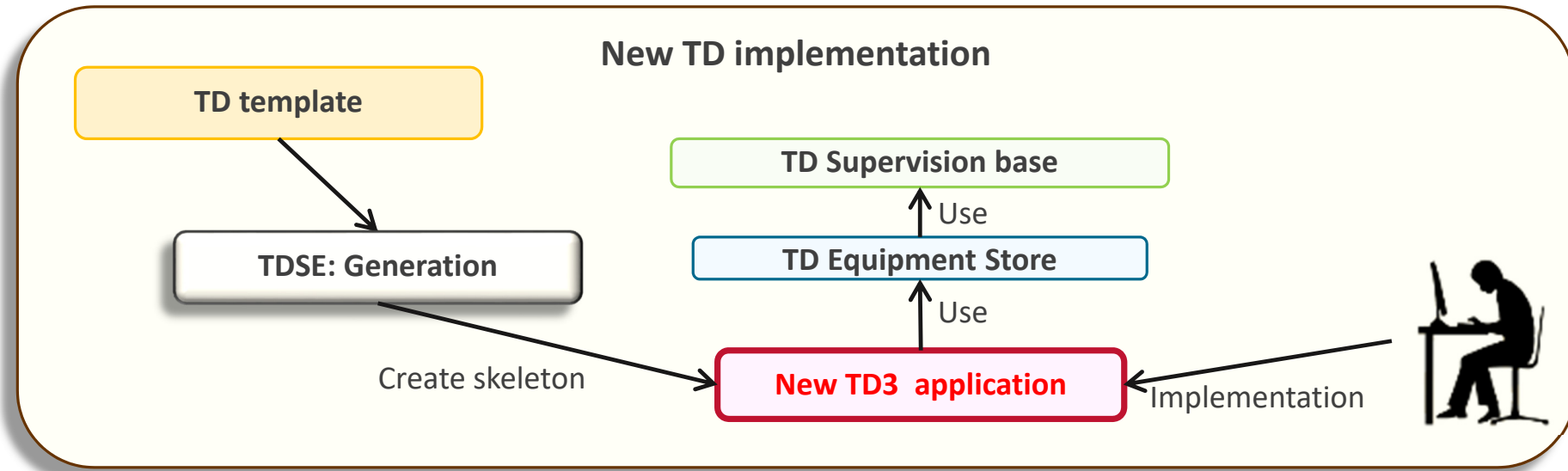
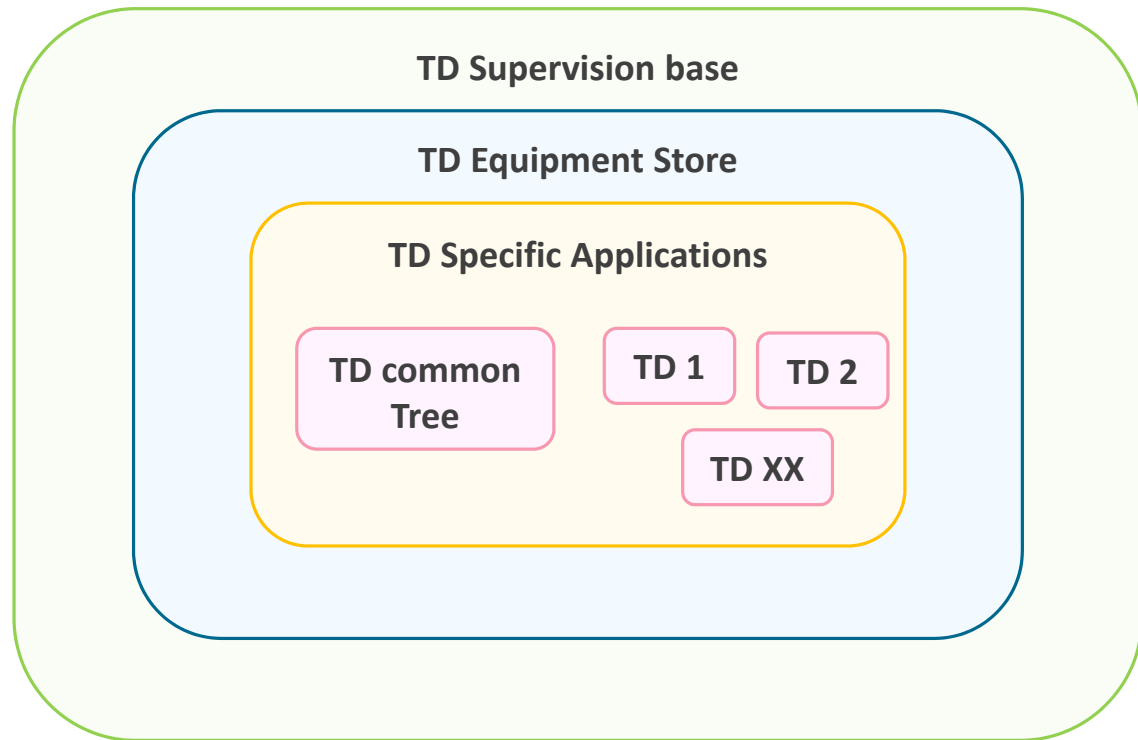
- **Functions**
- **Parameters**
- **Tango interface**

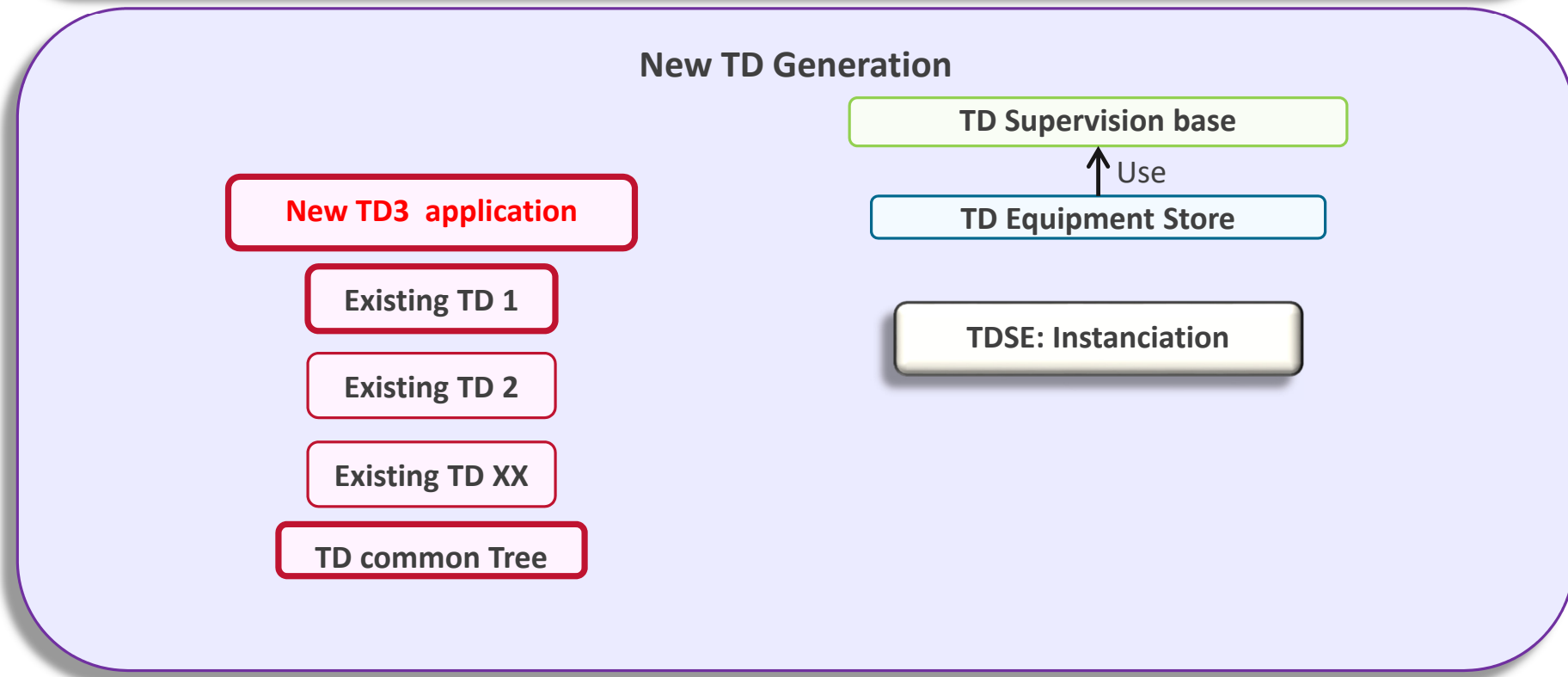
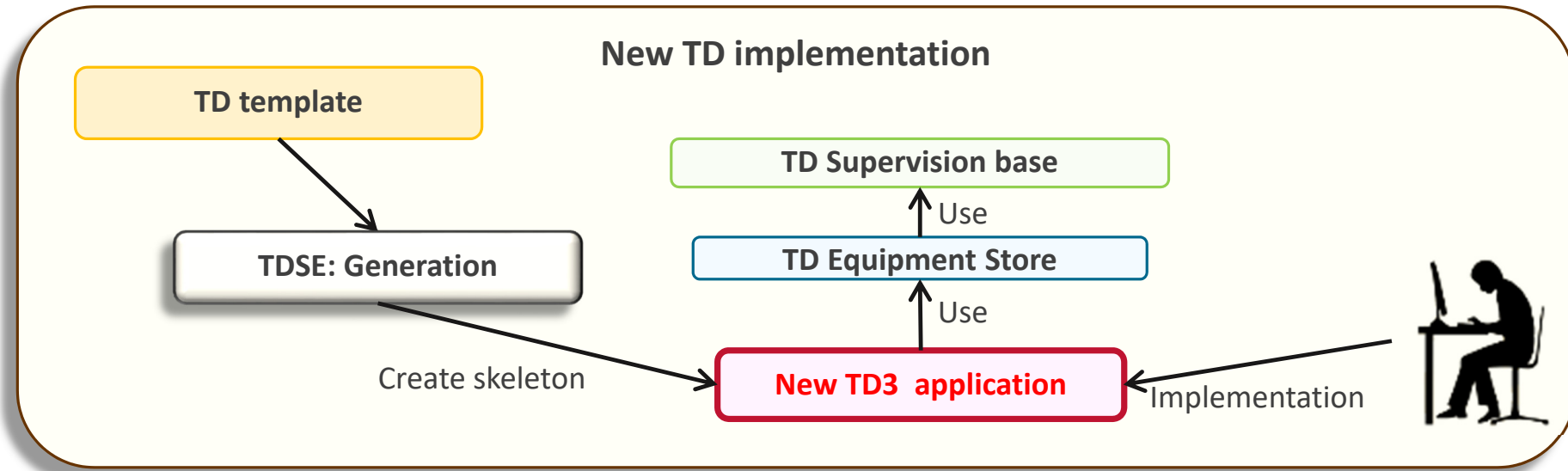
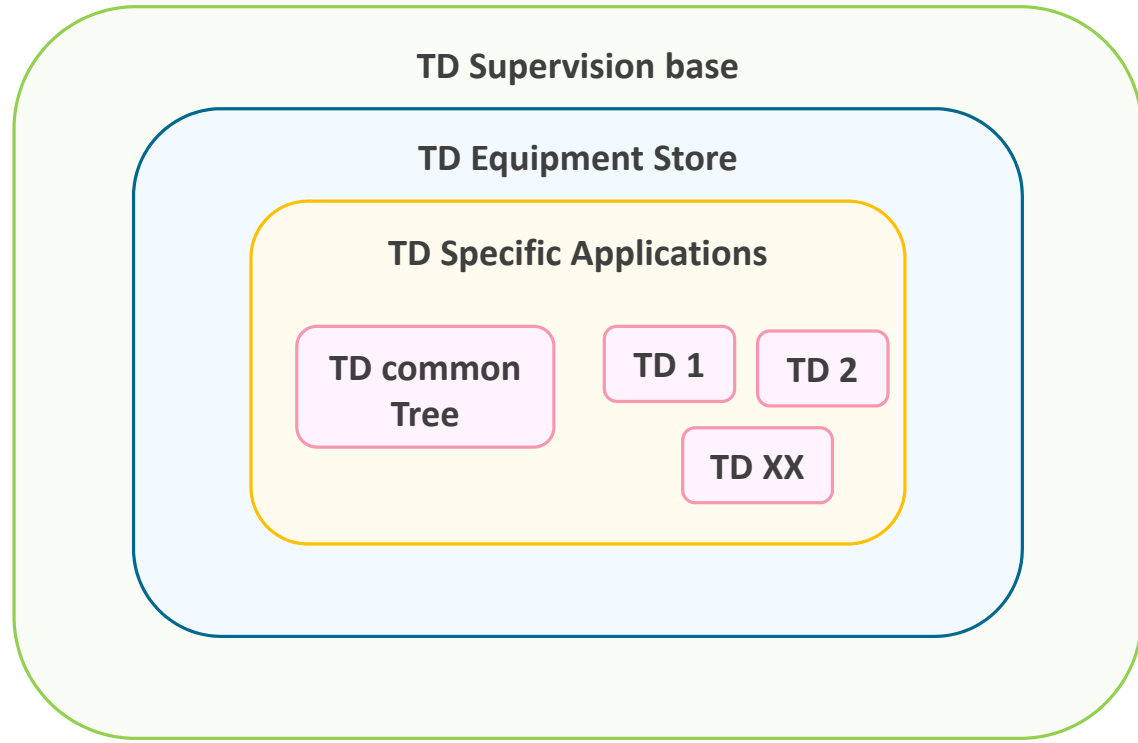


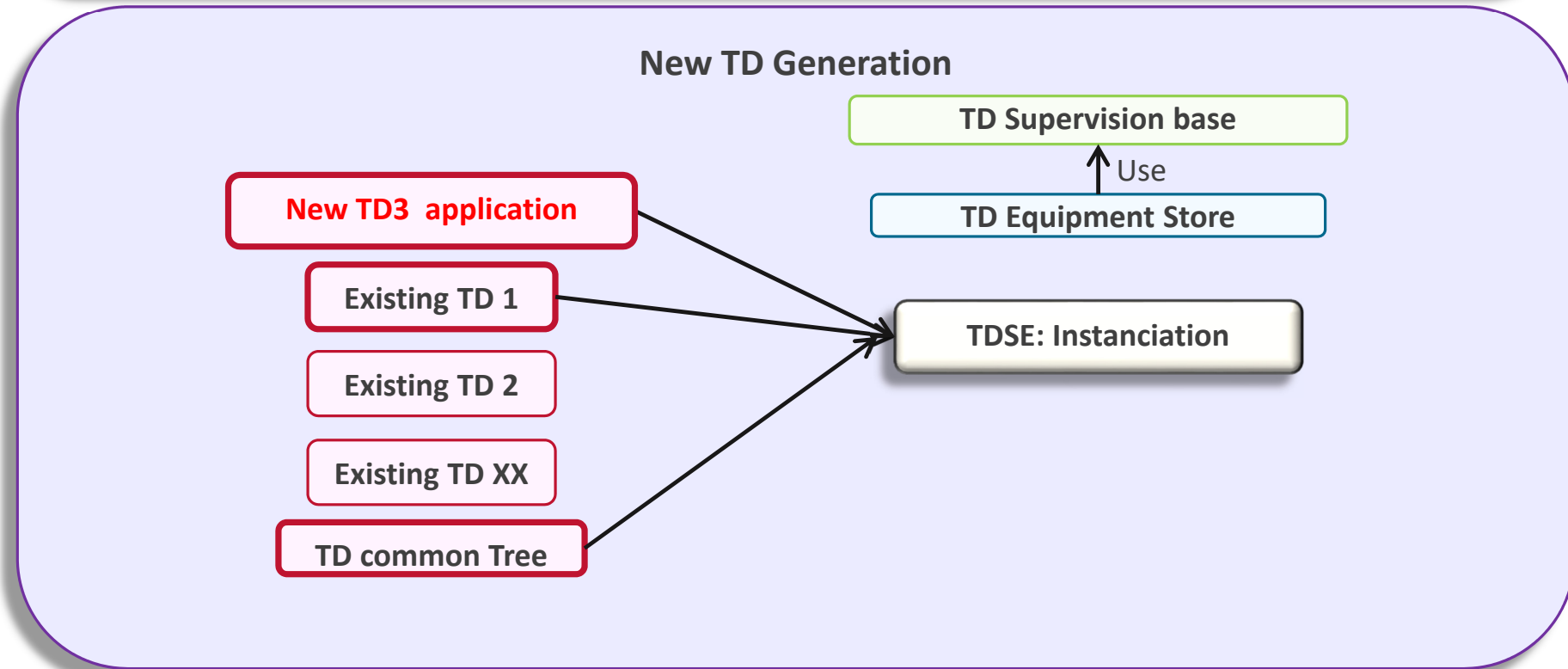
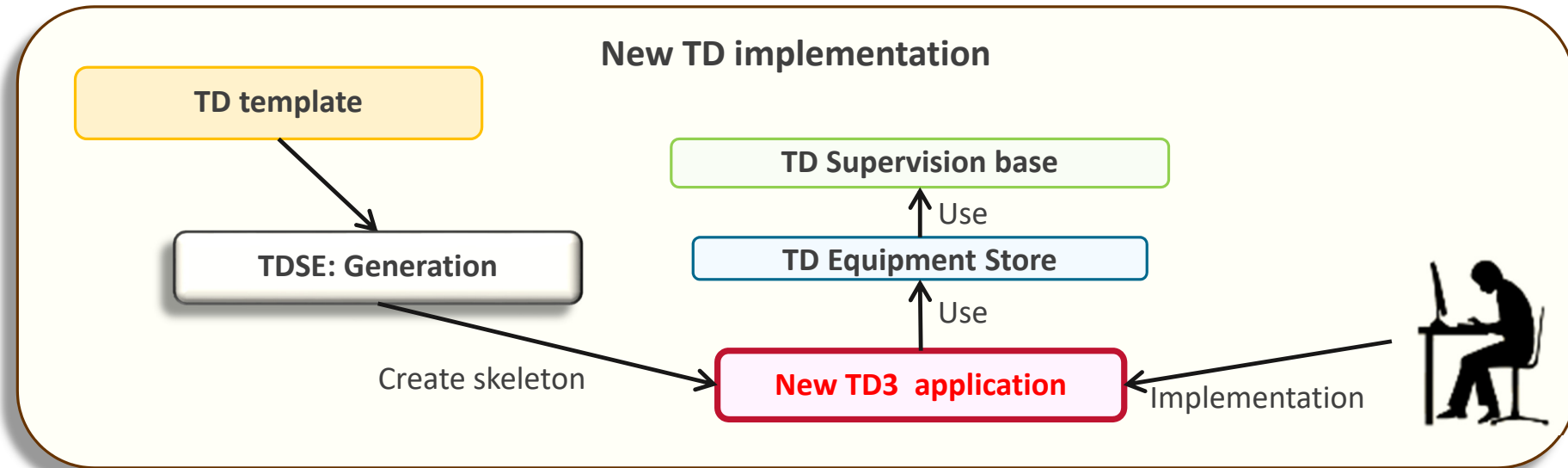
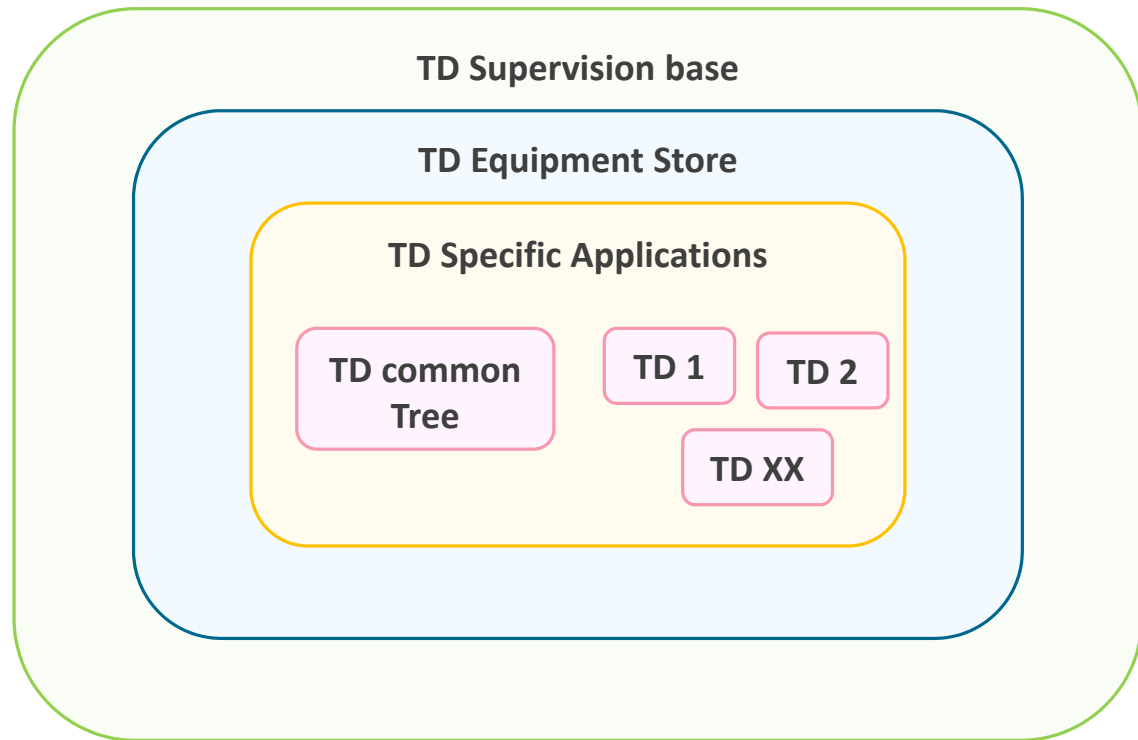


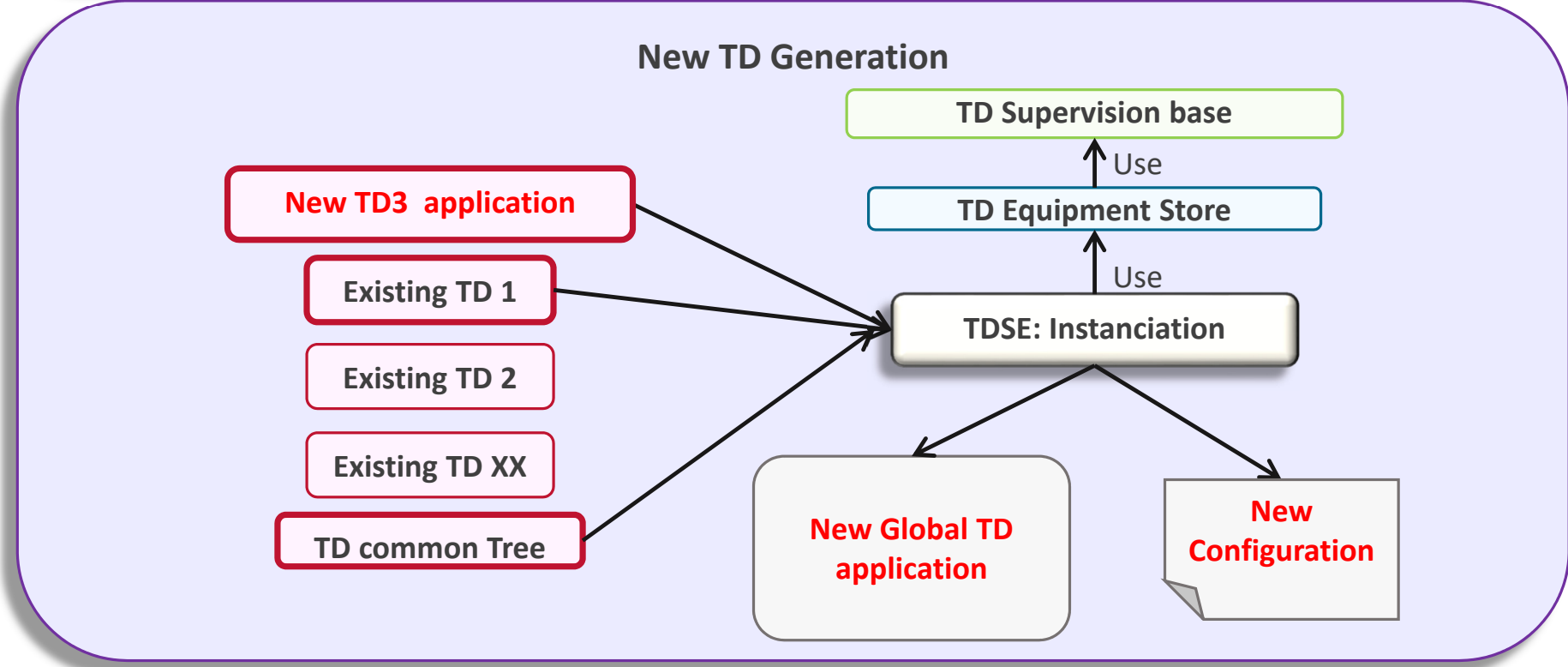
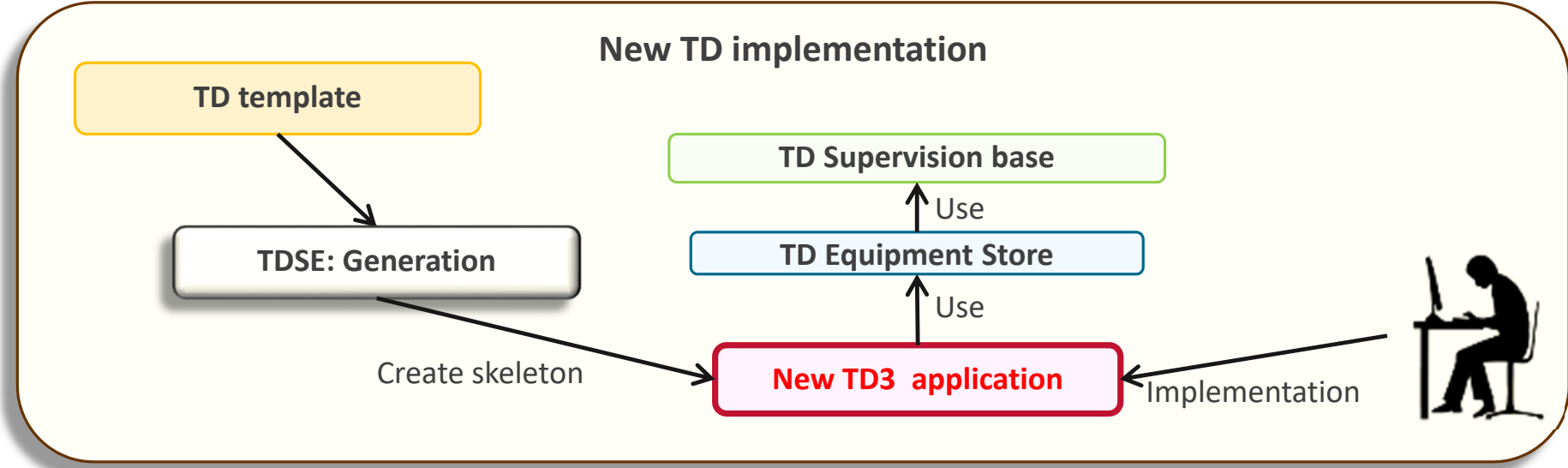
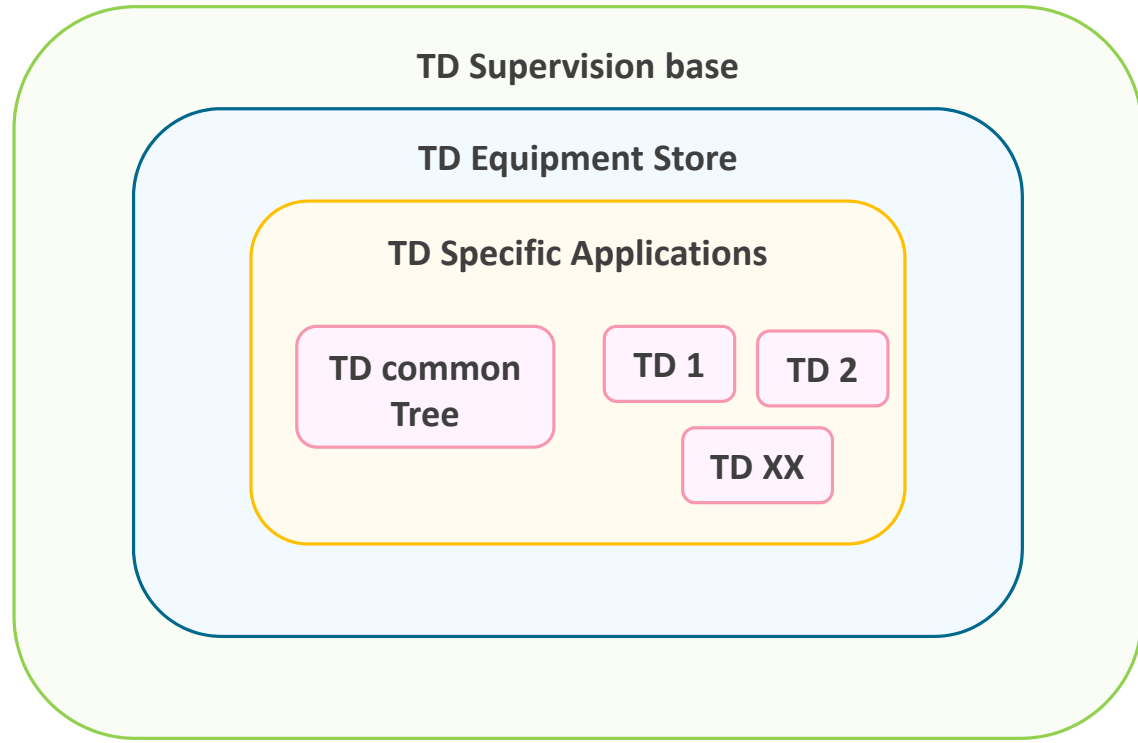


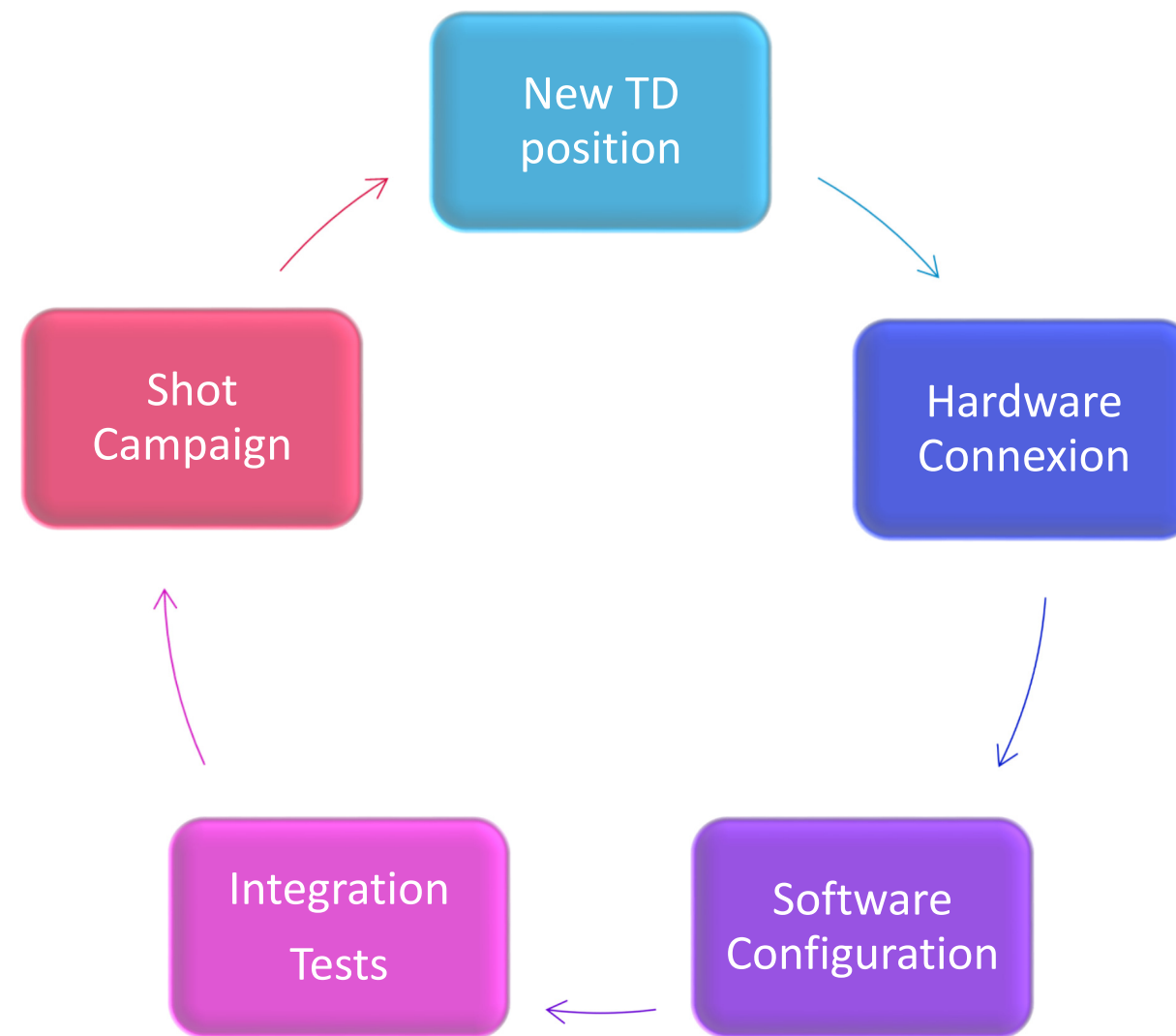
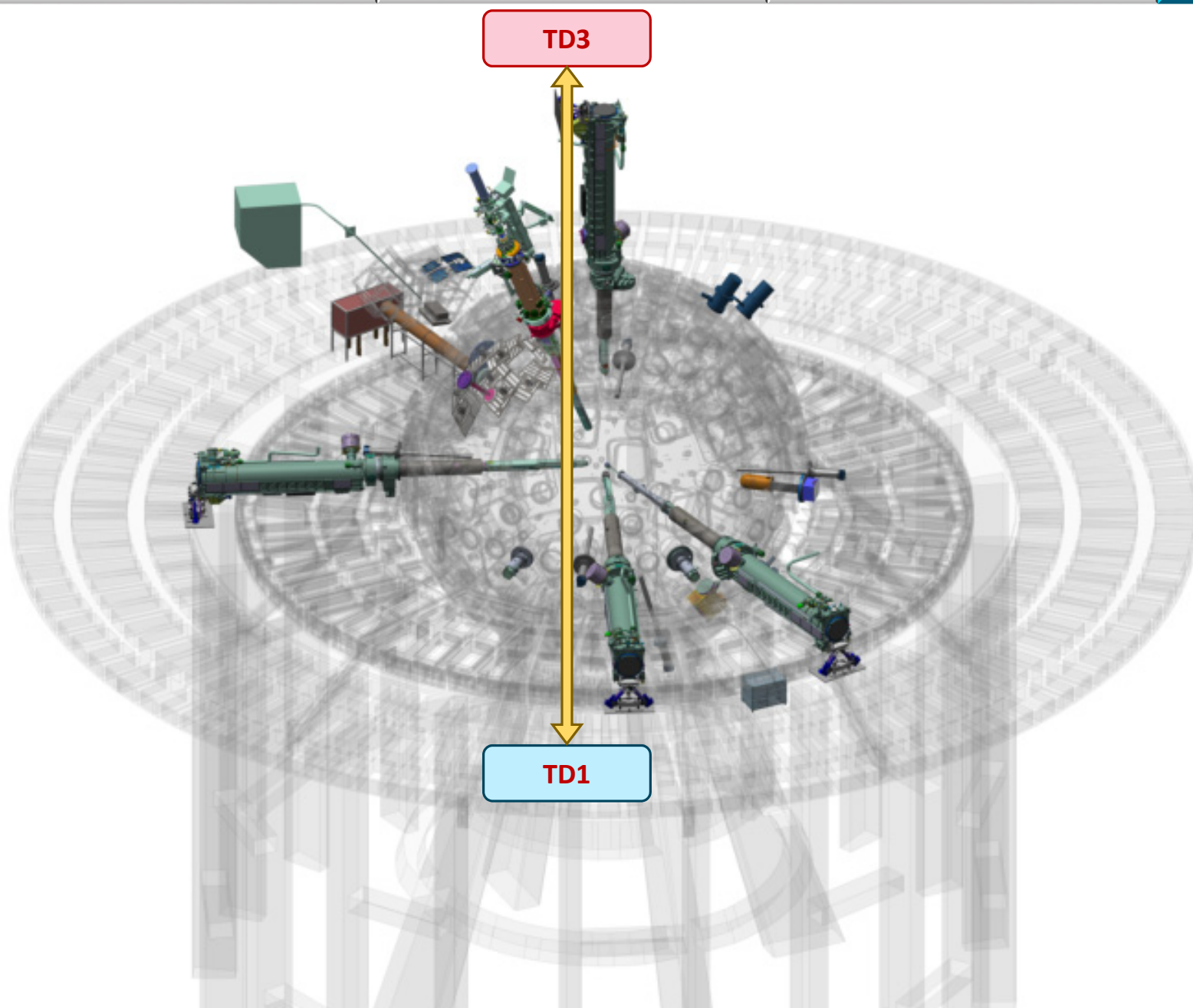


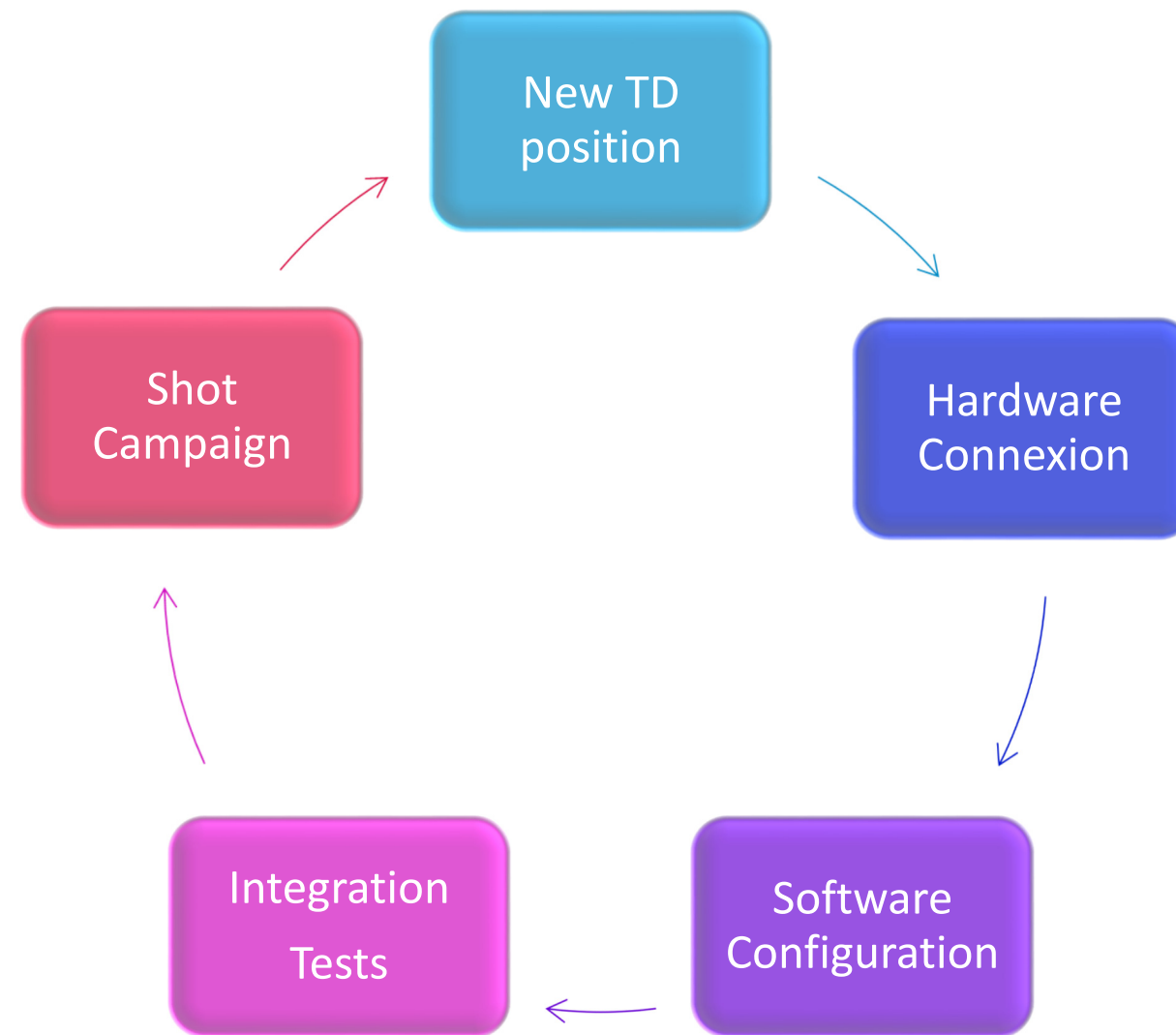
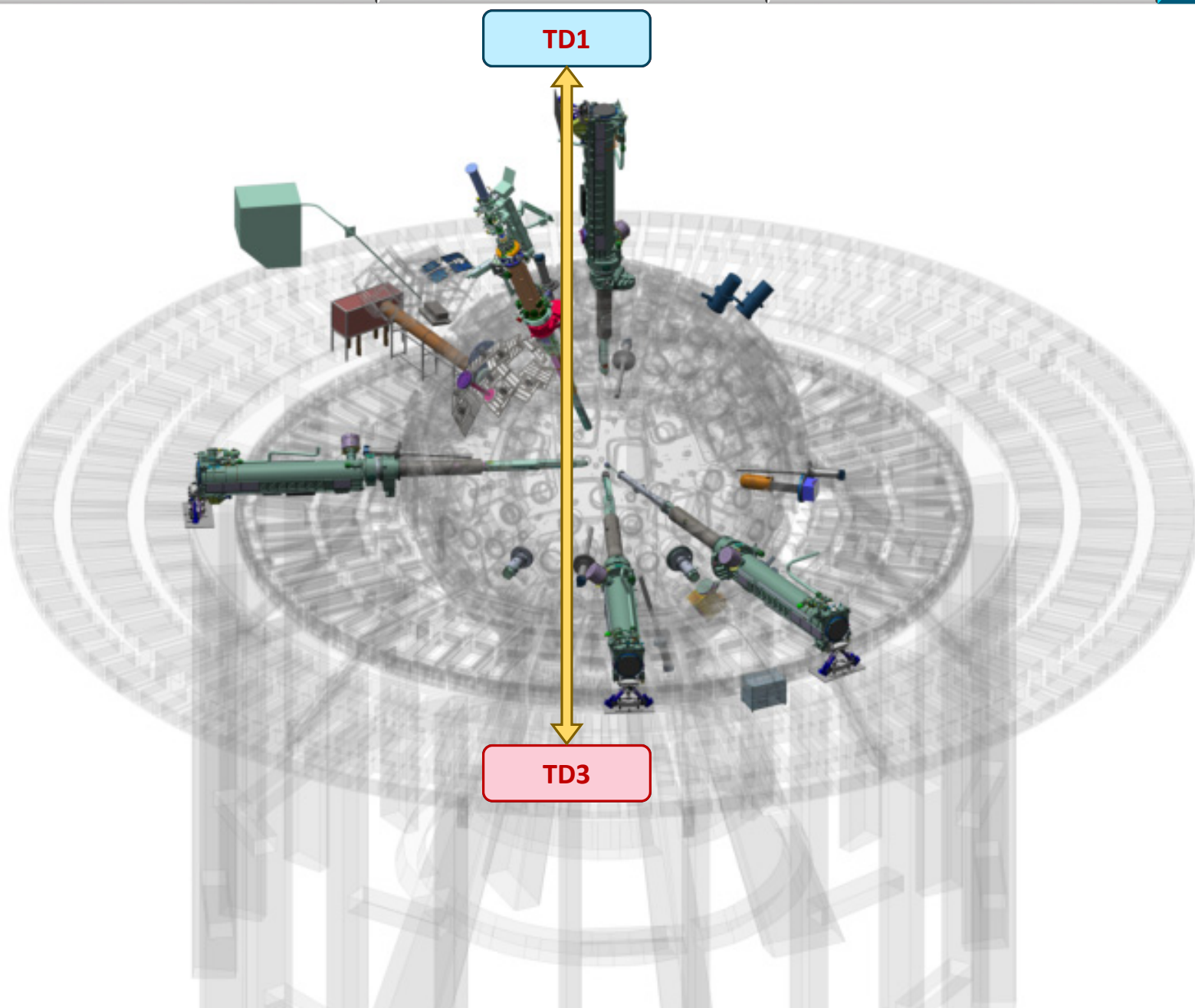


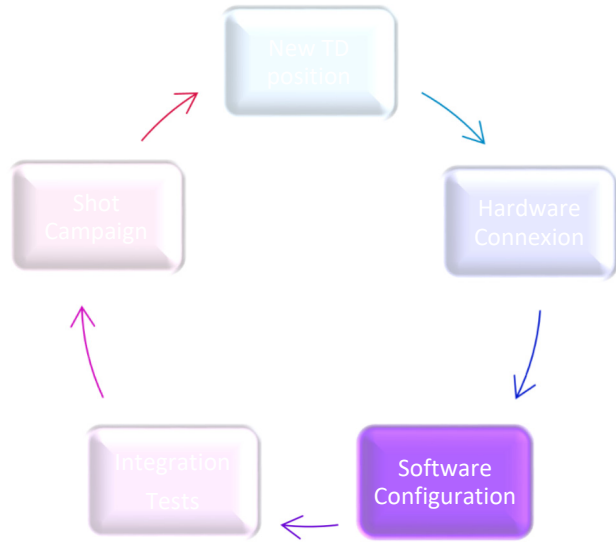


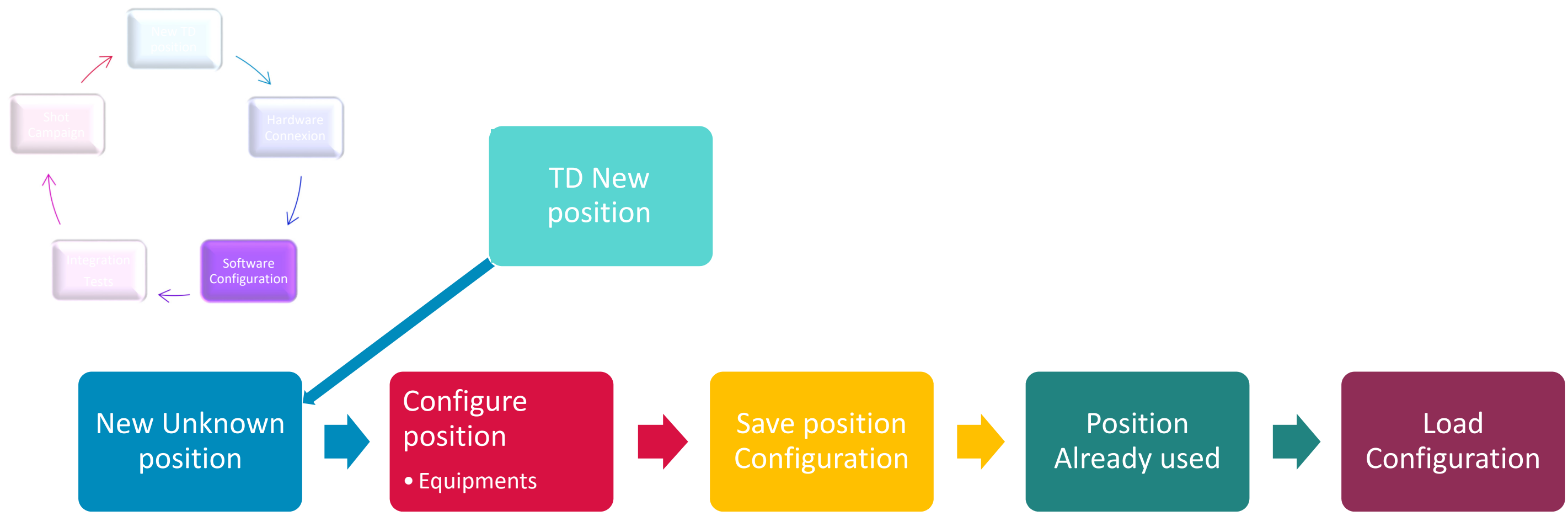


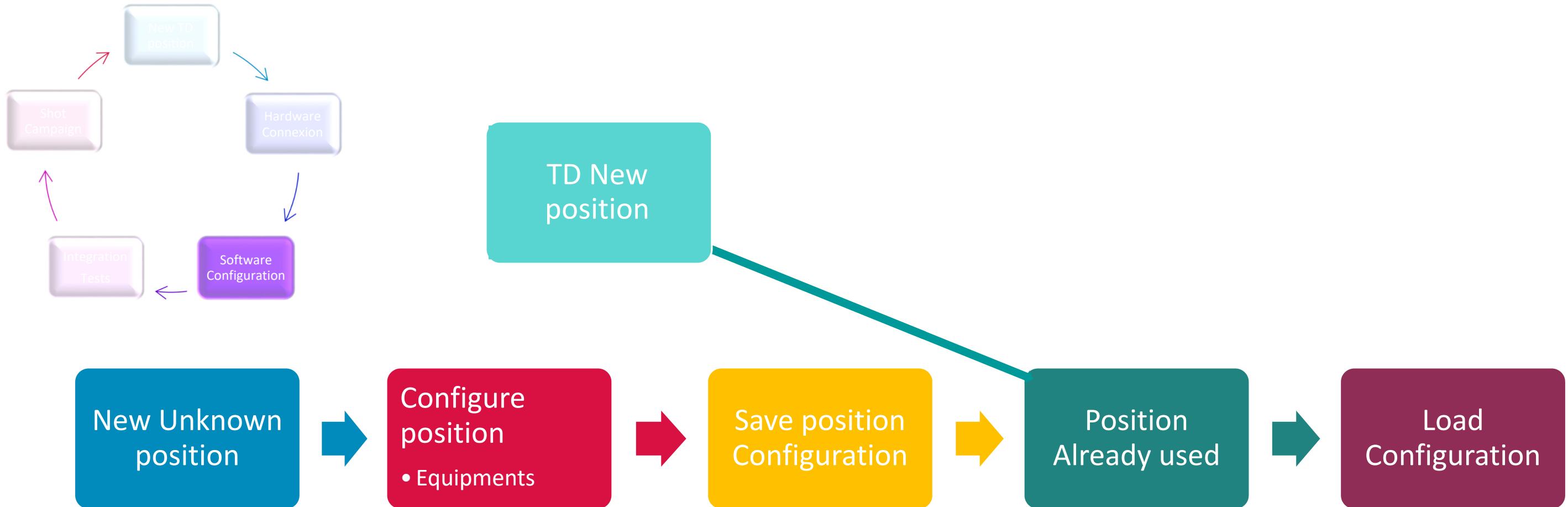


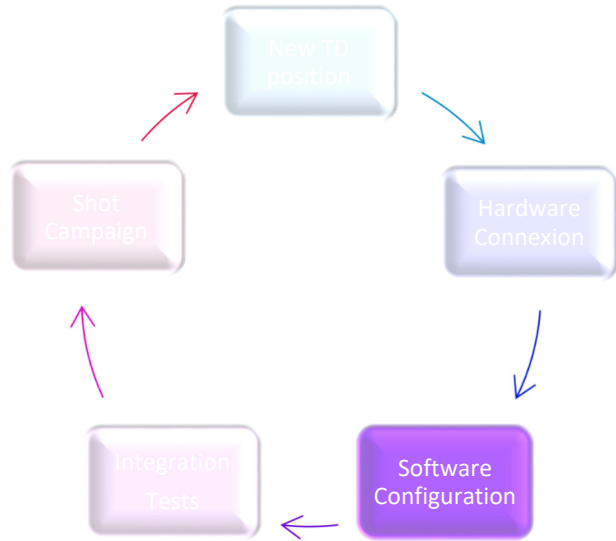












TD New position

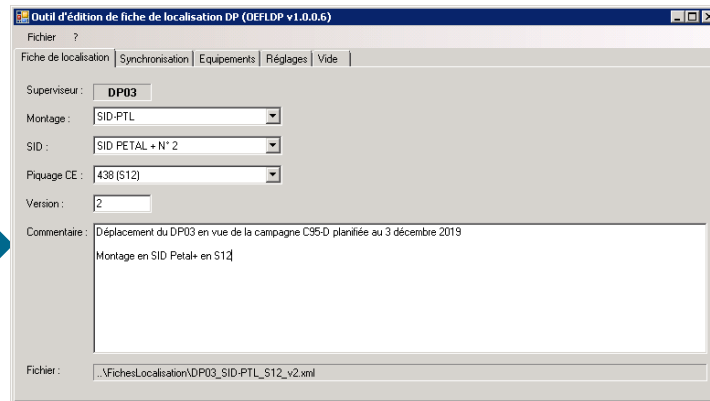
New Unknown position

Configure position  
• Equipments

Save position Configuration

Position Already used

Load Configuration



Configuration Files

GCI Facility Configuration



**Global Shot Sequence**



**TD Shot Sequence**



LMJ/TD

C/C Architecture

TD Life Cycle

TD Integration

TD Shot Sequence

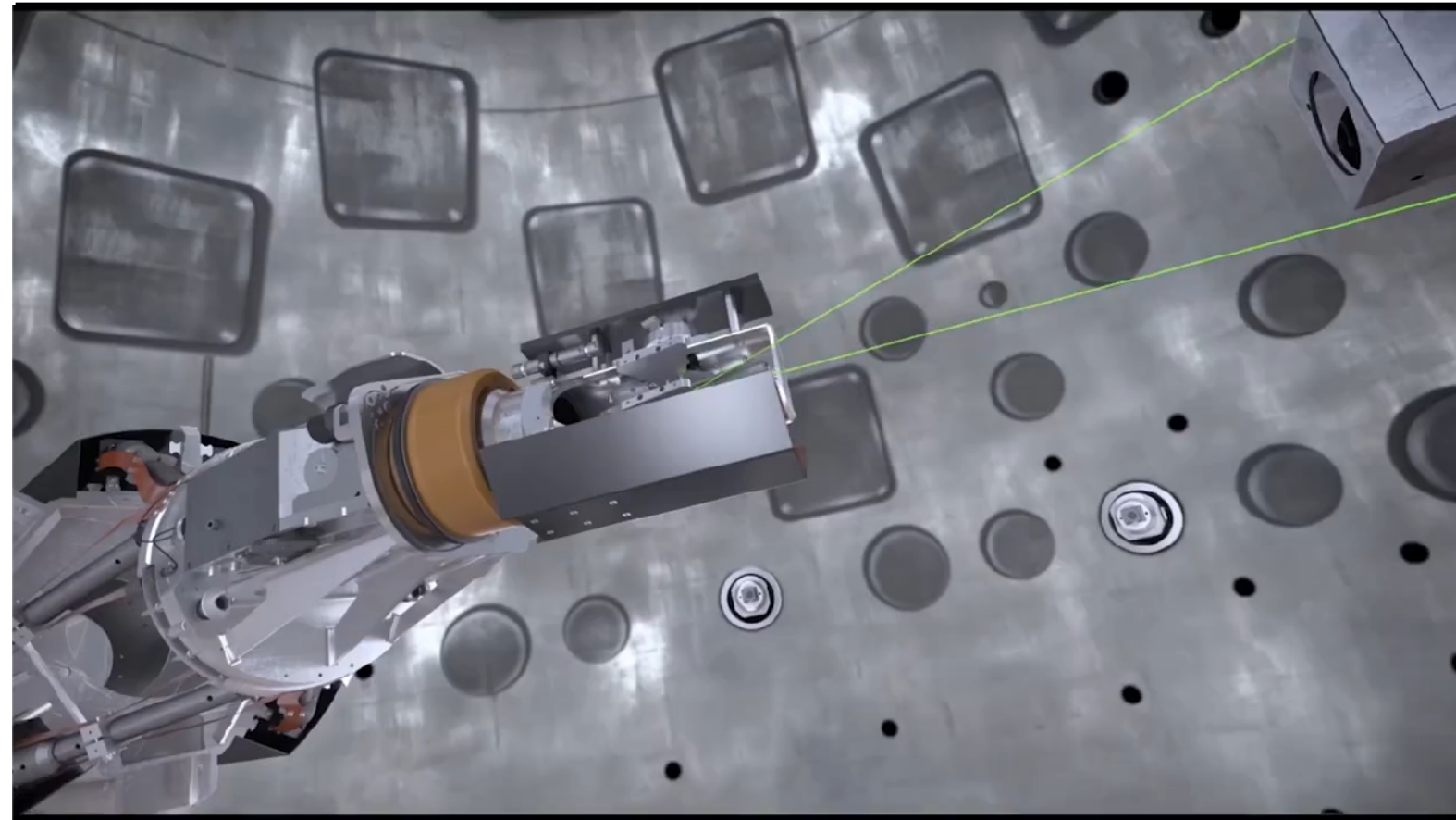
Conclusion

Global Shot Sequence

TD Shot Sequence

Shot Preparation

TD Alignment



## Global Shot Sequence

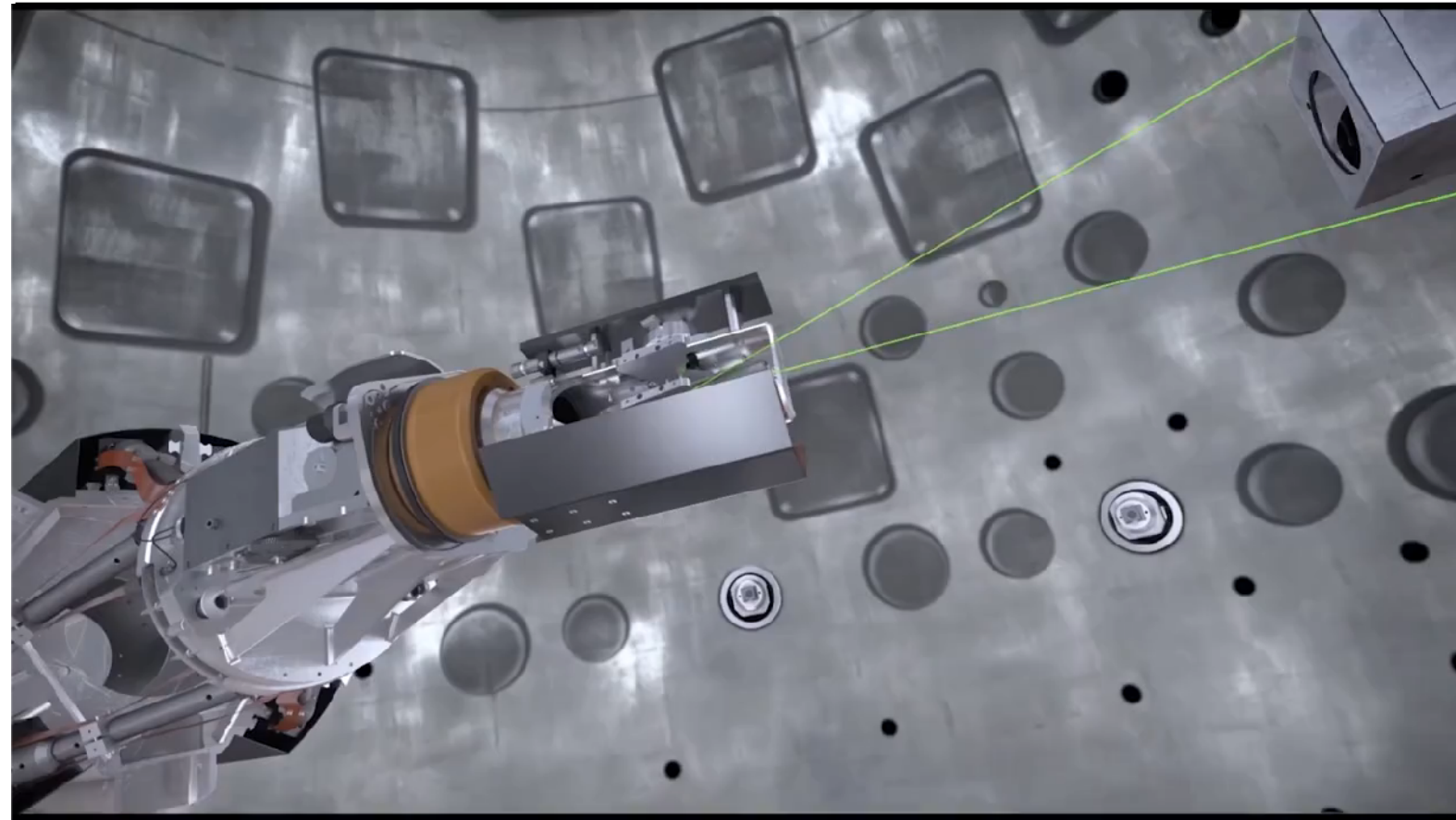
## TD Shot Sequence

Shot Preparation

TD Alignment

Shot Configuration

TD Configuration



LMJ/TD

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TD Life Cycle

TD Integration

TD Shot Sequence

Conclusion

## Global Shot Sequence

Shot Preparation

Shot Configuration

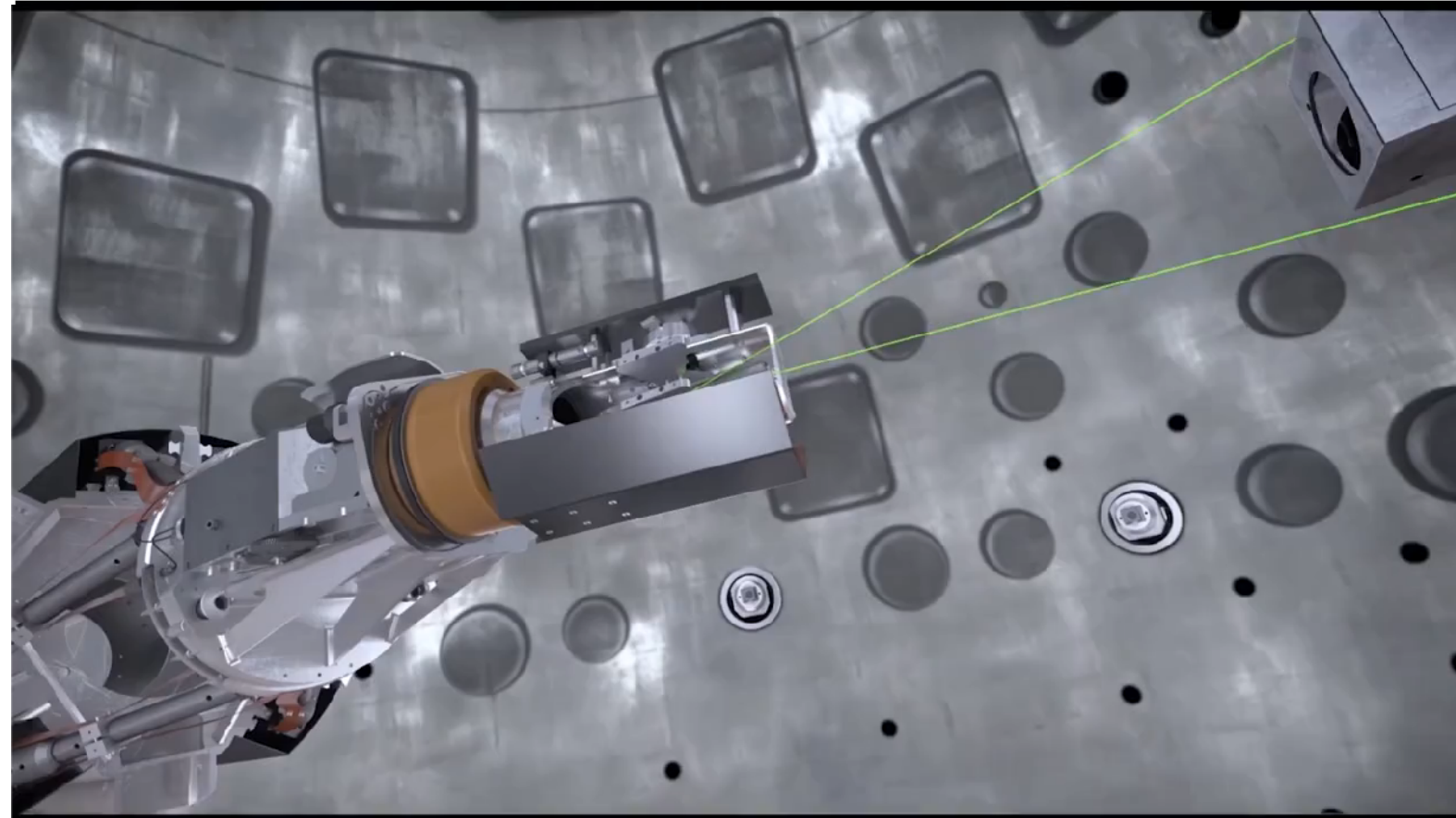
Shot Arming

## TD Shot Sequence

TD Alignment

TD Configuration

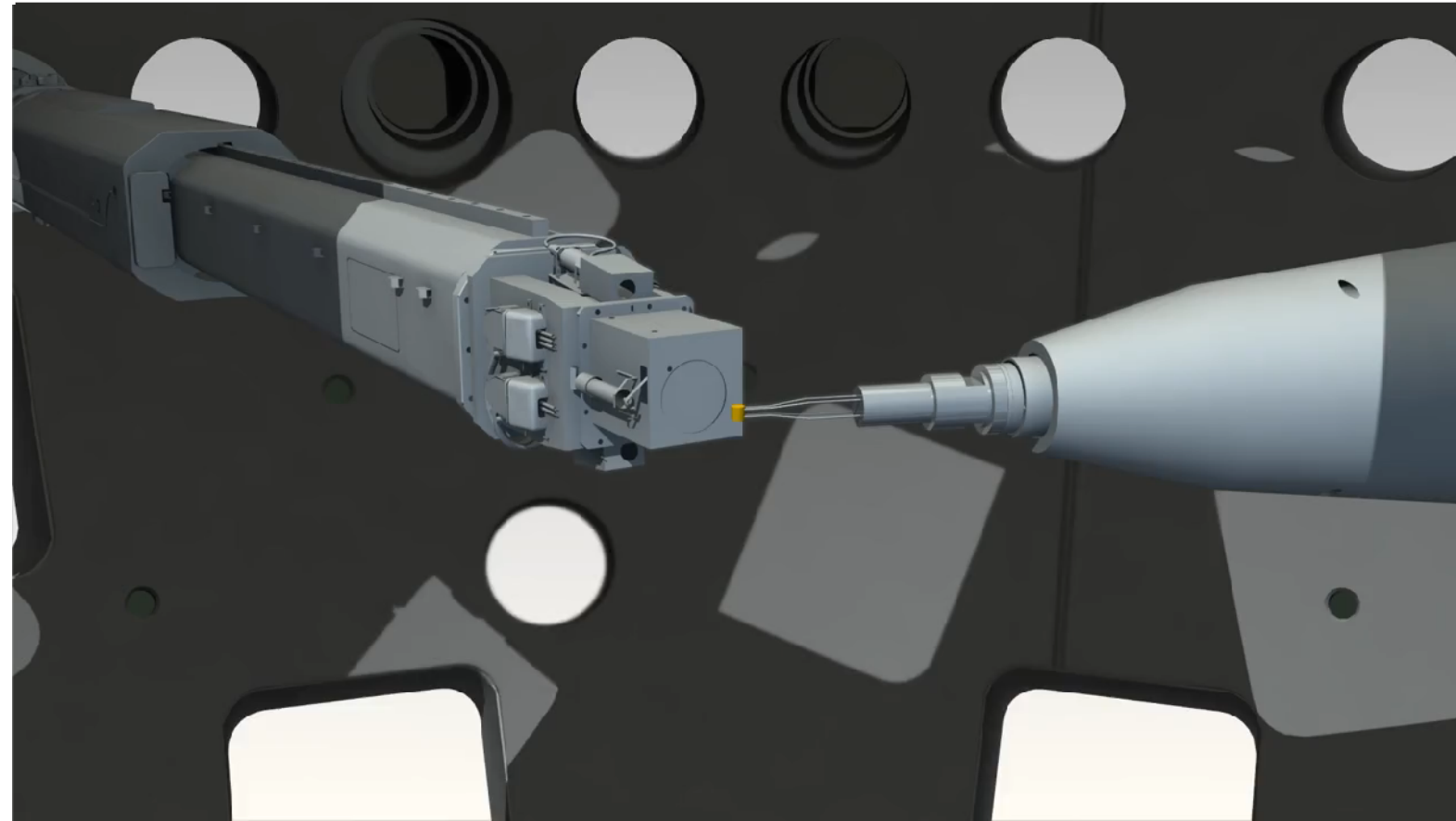
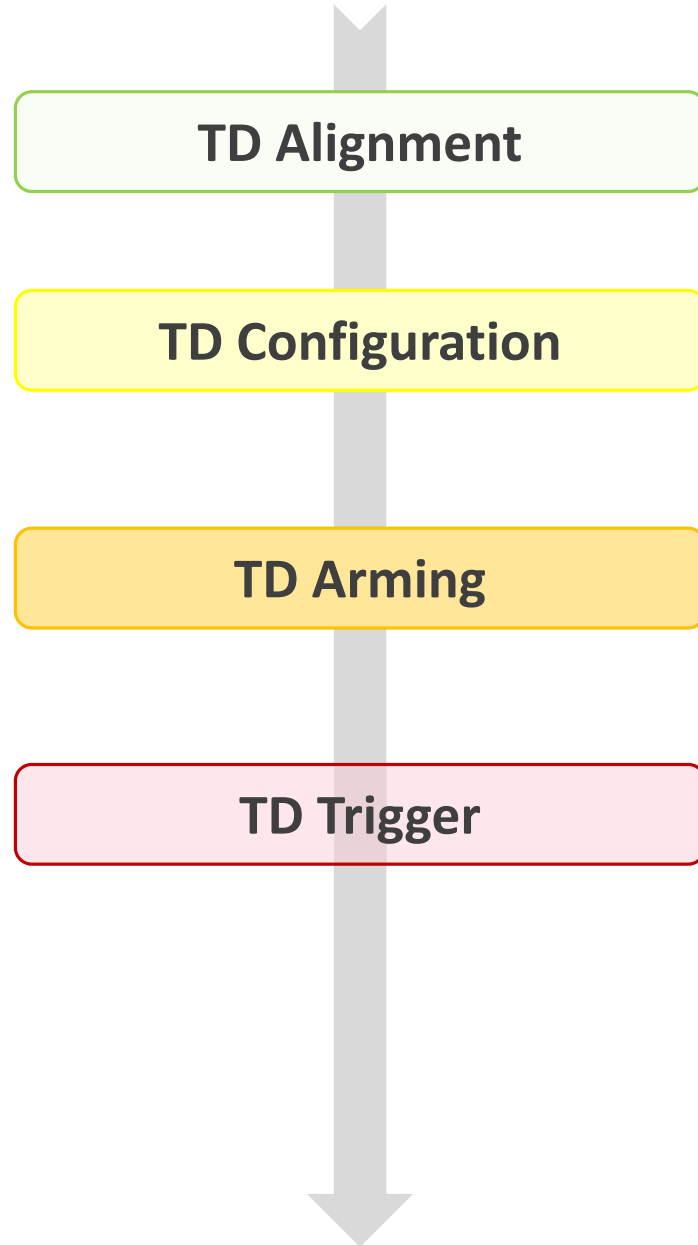
TD Arming



## Global Shot Sequence



## TD Shot Sequence



LMJ/TD

C/C Architecture

TD Life Cycle

TD Integration

TD Shot Sequence

Conclusion

## Global Shot Sequence

## TD Shot Sequence

Shot Preparation

Shot Configuration

Shot Arming

Shot

Shot Results  
Recovery

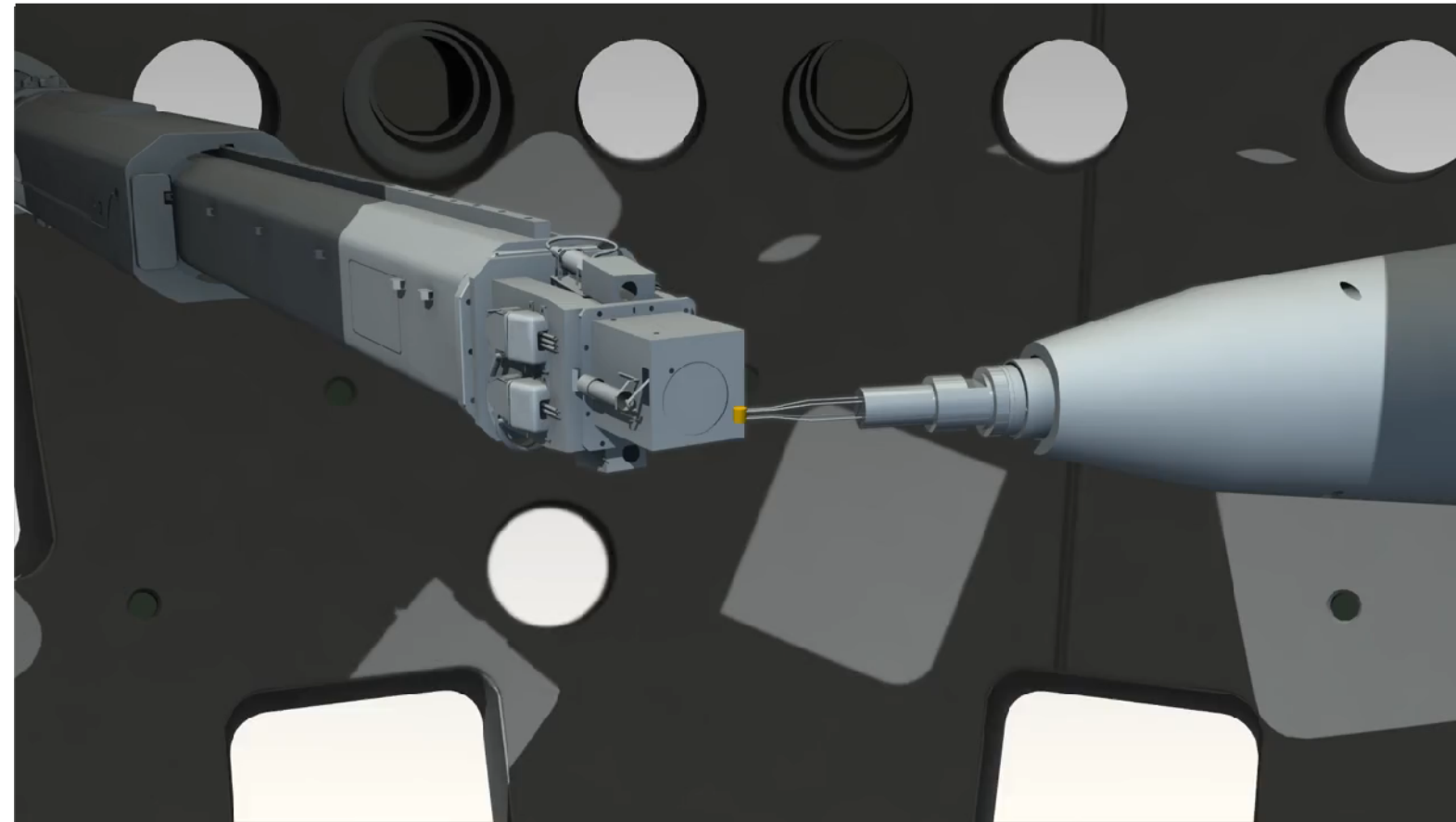
TD Alignment

TD Configuration

TD Arming

TD Trigger

TD Results Recovery



LMJ/TD

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## TD Campaign Configuration

## CC Layer Integration

TDX =&gt; L2

TDX =&gt; L1

TDX =&gt; L0

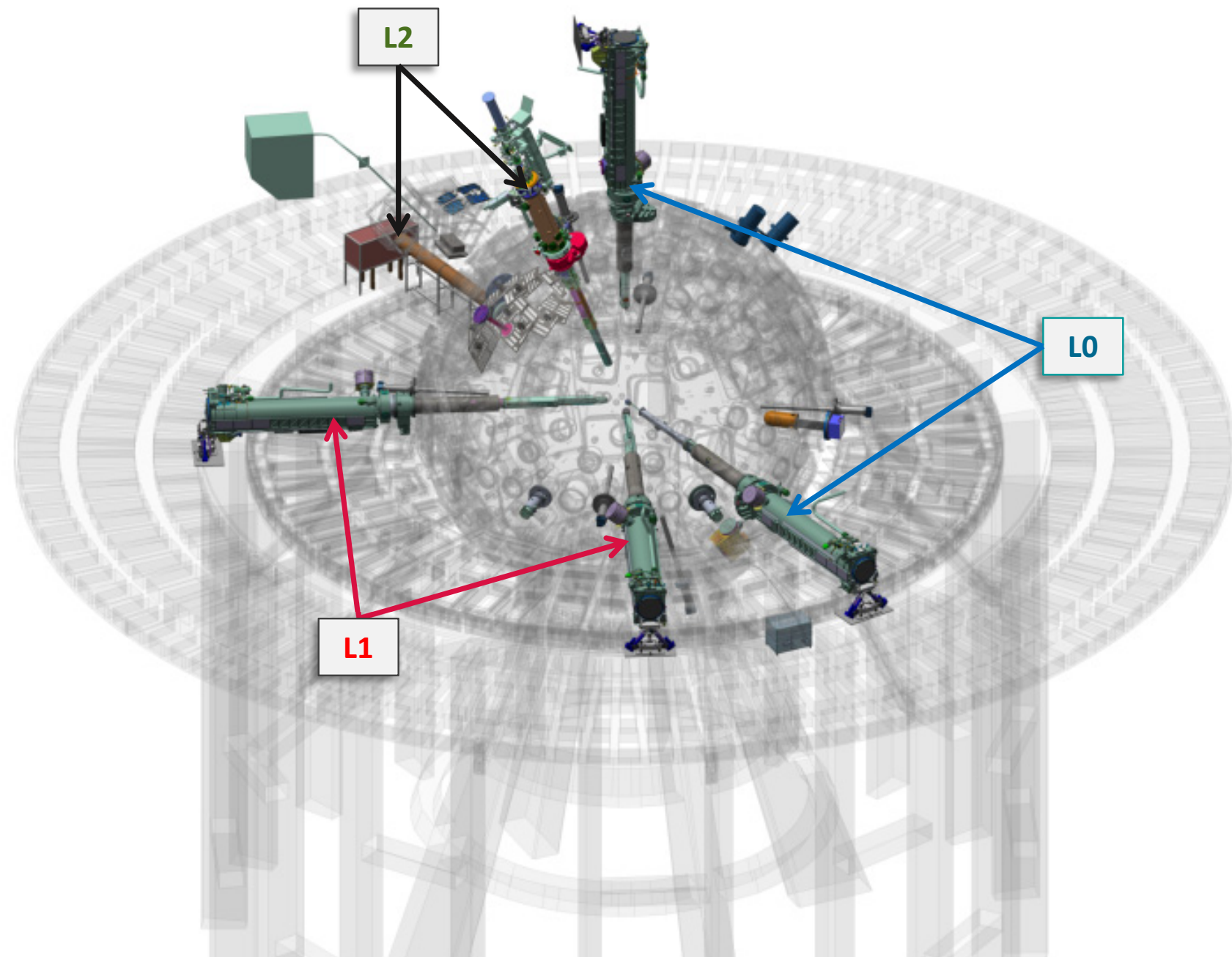
TD1

TD2

TD4

TD7

TD8

C  
A  
M  
P  
A  
I  
G  
N

## L2 System Supervisory

- Automatic Shot Sequence**
  - **Parameter Prediction**
  - **Automatic Transitions**
  - **Global Shot synchronization**
  - **Global result Recovery**



## L1 SubSystem Control

- Global Resource Management**
- Reservation**
- Operational state**
- Global Configuration Management**

## L0 Equipment Control

LMJ/TD

C/C Architecture

TD Life Cycle

TD Integration

TD Shot Sequence

Conclusion

## L2 System Supervisory

- Automatic Shot Sequence**
  - *Parameter Prediction*
  - *Automatic Transitions*
  - *Global Shot synchronization*
  - *Global result Recovery*
- Global Resource Management**
- Reservation**
- Operational state**
- Global Configuration Management**



## L1 SubSystem Control

- Shot Sequence Functions**
  - *Manual configuration*
- TD Resource Management**
  - *Reservation*



- Operational state**
- TD Configuration Management**
- Parameters backup**
- MultiTD driving**

## L0 Equipment Control

LMJ/TD

C/C Architecture

TD Life Cycle

TD Integration

TD Shot Sequence

Conclusion

## L2 System Supervisory

- Automatic Shot Sequence**
  - *Parameter Prediction*
  - *Automatic Transitions*
  - *Global Shot synchronization*
  - *Global result Recovery*
- Global Resource Management**
- Reservation**
- Operational state**
- Global Configuration Management**



## L1 SubSystem Control

- Shot Sequence Functions**
  - *Manual configuration*
- TD Resource Management**

- Low level Functions**
- Resource Management**

- *Megaphone*

- One Workstation ↔ One TD**

- Configuration Management**

- *Manual backup*
- *Several Files*



## L0 Equipment Control



LMJ/TD

C/C Architecture

TD Life Cycle

TD Integration

TD Shot Sequence

Conclusion

## L2 System Supervisory

- Automatic Shot Sequence**
  - **Parameter Prediction**
  - **Automatic Transitions**
  - **Global Shot synchronization**
  - **Global result Recovery**
- Global Resource Management**
- Reservation**
- Operational state**
- Global Configuration Management**



## L1 SubSystem Control

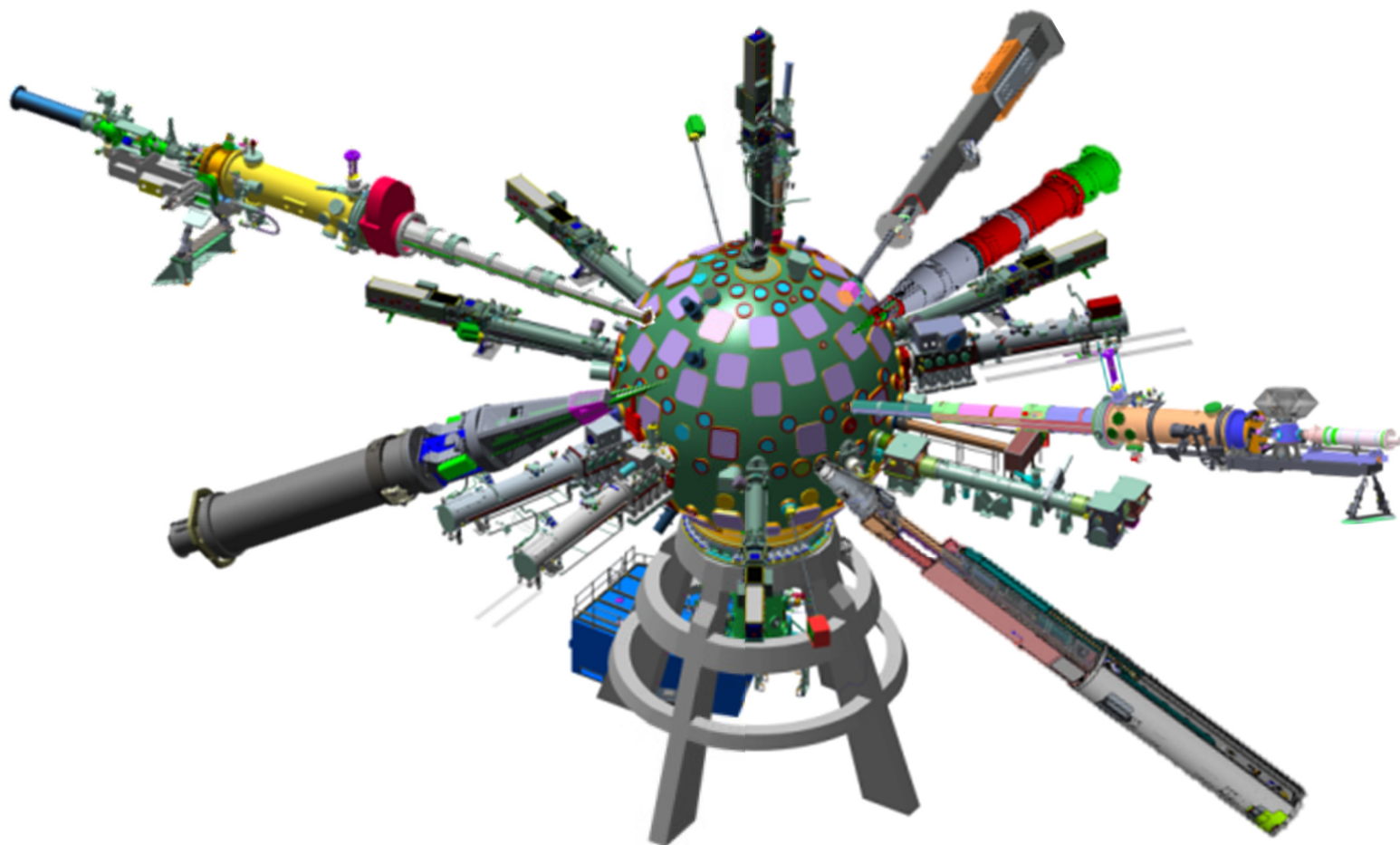
- Shot Sequence Functions**
  - **Manual configuration**
- TD Resource Management**
  - **Reservation**
- Operational state**
- TD Configuration Management**
- Parameters backup**
- MultiTD driving**



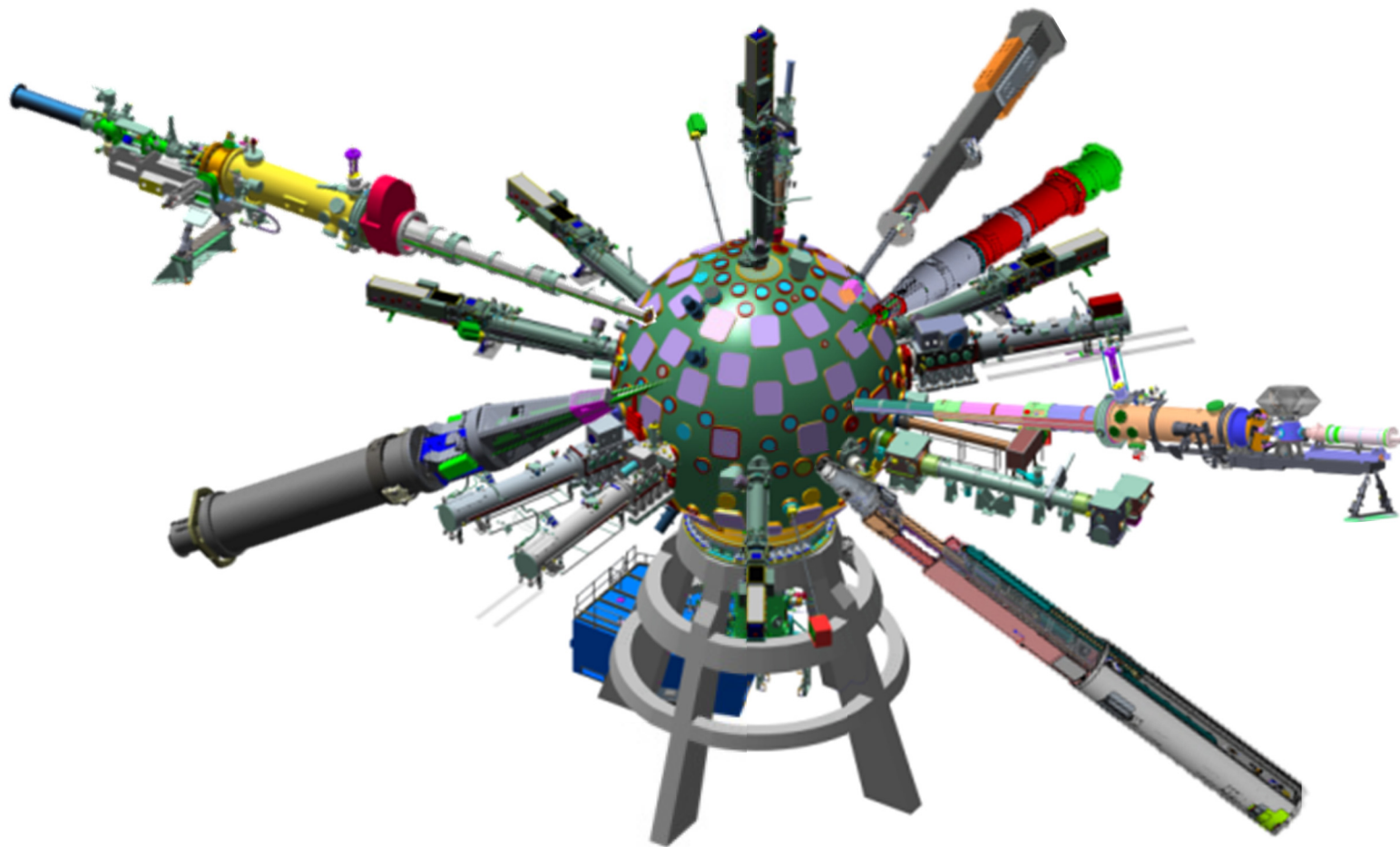
## L0 Equipment Control

- Low level Functions**
- Resource Management**
  - **Megaphone**
- One Workstation ↔ One TD**
- Configuration Management**
  - **Manual backup**
  - **Several Files**









LMJ/TD

C/C Architecture

TD Life Cycle

TD Integration

**TD Shot Sequence**

Conclusion

## L2 System Supervisory

## L1 SubSystem Control

## L0 Equipment Control

**Specific process**

**Manual Alignment**

TD configuration - Paper Shot Form  
Manual Configuration

Manual Arming

**Shot Results are locally saved**

LMJ/TD

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**TD Shot Sequence**

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## L2 System Supervisory

## L1 SubSystem Control

## L0 Equipment Control

**Specific process**

TD Ready!



**Manual Alignment**

TD configuration - Paper Shot Form  
Manual Configuration

Manual Arming

Shot Results are locally saved

LMJ/TD

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## L2 System Supervisory

**Exclude Resources controlled by layer**  
**Include all the triggers**  
 Global Alignment

TD configuration:  
 Global and Automatic Configuration

Global and Automatic Arming

Global Trigger

Shot Results are saved automatically

## L1 SubSystem Control



TD Ready!

Take off unused TD

Exclude L1 Triggers  
 Alignment one by one

TD configuration - **Paper Shot Form**  
 Configuration one by one

Arming one by one

Shot Results are saved

## L0 Equipment Control

Specific process



TD Ready!

Manual Alignment

TD configuration - Paper Shot Form  
 Manual Configuration

Manual Arming

Shot Results are locally saved

LMJ/TD

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## L2 System Supervisory

- Event logging
- Facility configuration management
- Reservation management
- Operational modes management
- Sequence
- Shot data management
- ....

**Exclude Resources controlled by layer**  
**Include all the triggers**  
 Global Alignment

TD configuration:  
 Global and Automatic Configuration

Global and Automatic Arming

Global Trigger

Shot Results are saved automatically

## Common framework

## L1 SubSystem Control

- Event logging
- Facility configuration management
- Reservation management
- Operational modes management
- ....

TD Ready!



Take off unused TD

**Exclude L1 Triggers**  
 Alignment one by one

TD configuration - **Paper Shot Form**  
 Configuration one by one

Arming one by one

Shot Results are saved

## L0 Equipment Control

### Specific process

TD Ready!



**Manual Alignment**

TD configuration - Paper Shot Form  
 Manual Configuration

Manual Arming

Shot Results are locally saved

## At least 2 new Target Diagnostic are integrated each Year in LMJ

- More than 15 Target Diagnostics are Under Construction

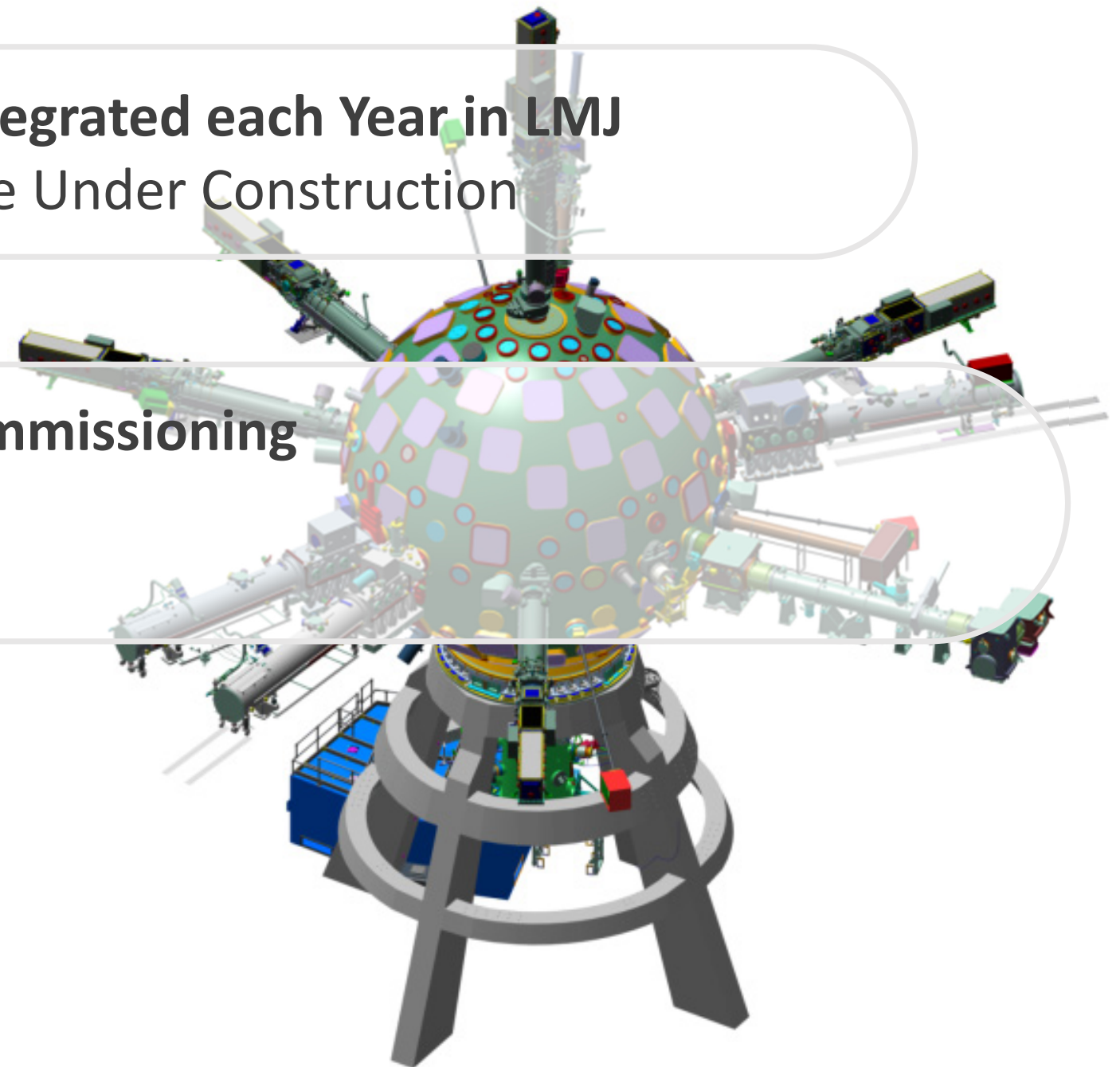


## At least 2 new Target Diagnostic are integrated each Year in LMJ

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## Progressive Integration Tools commissioning

- Application Integration
- Shot Sequence Integration



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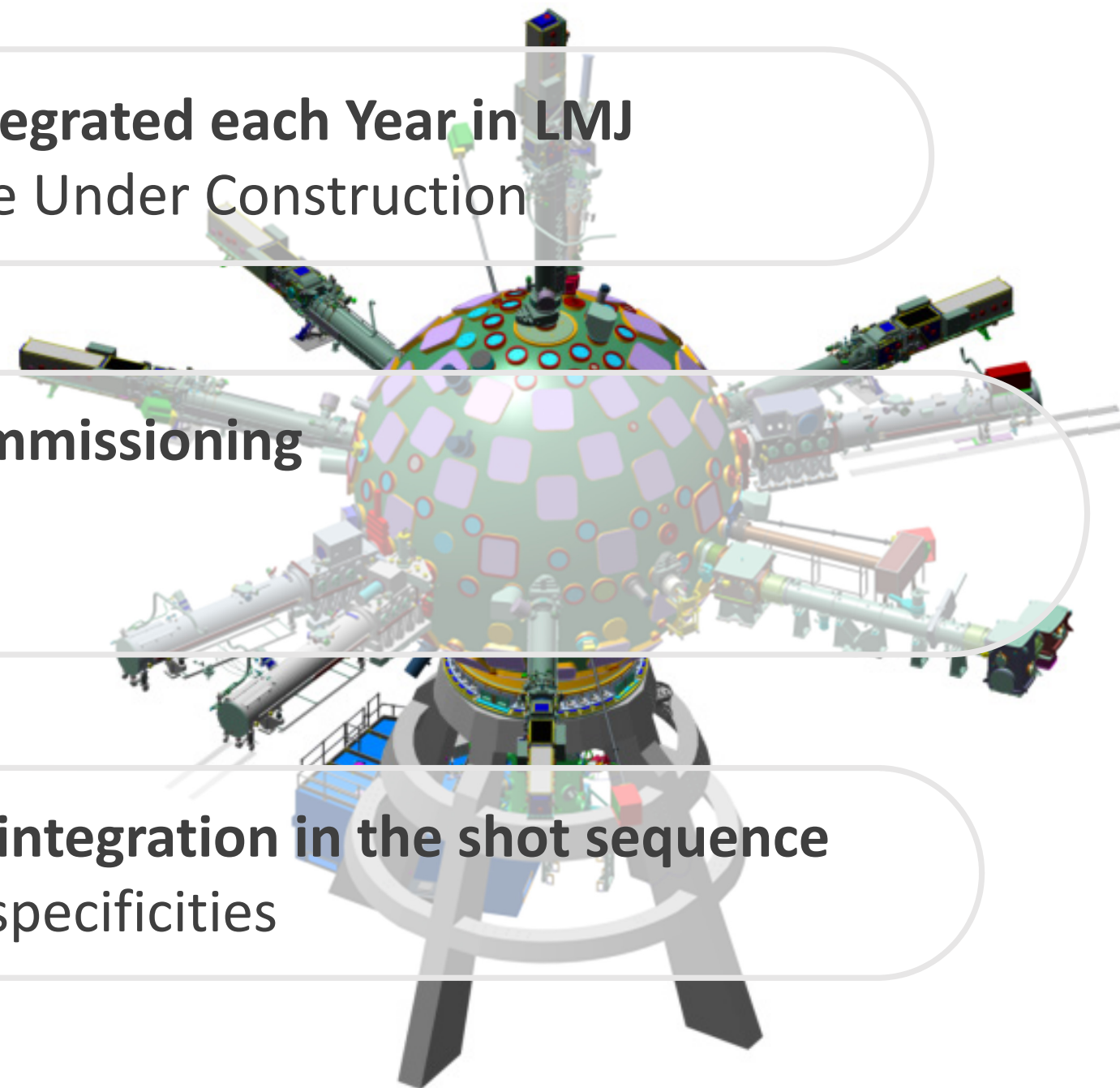
- More than 15 Target Diagnostics are Under Construction

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- Application Integration
- Shot Sequence Integration

## Now the Challenge is their complete integration in the shot sequence

- Integration of Target Diagnostics specificities



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- Application Integration
- Shot Sequence Integration

## Now the Challenge is their complete integration in the shot sequence

- Integration of Target Diagnostics specificities

to be continued...

