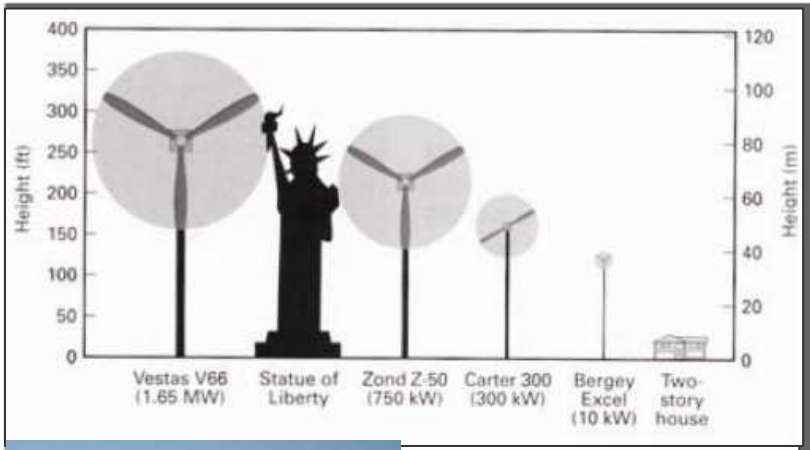
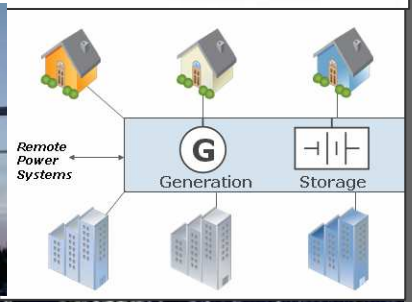




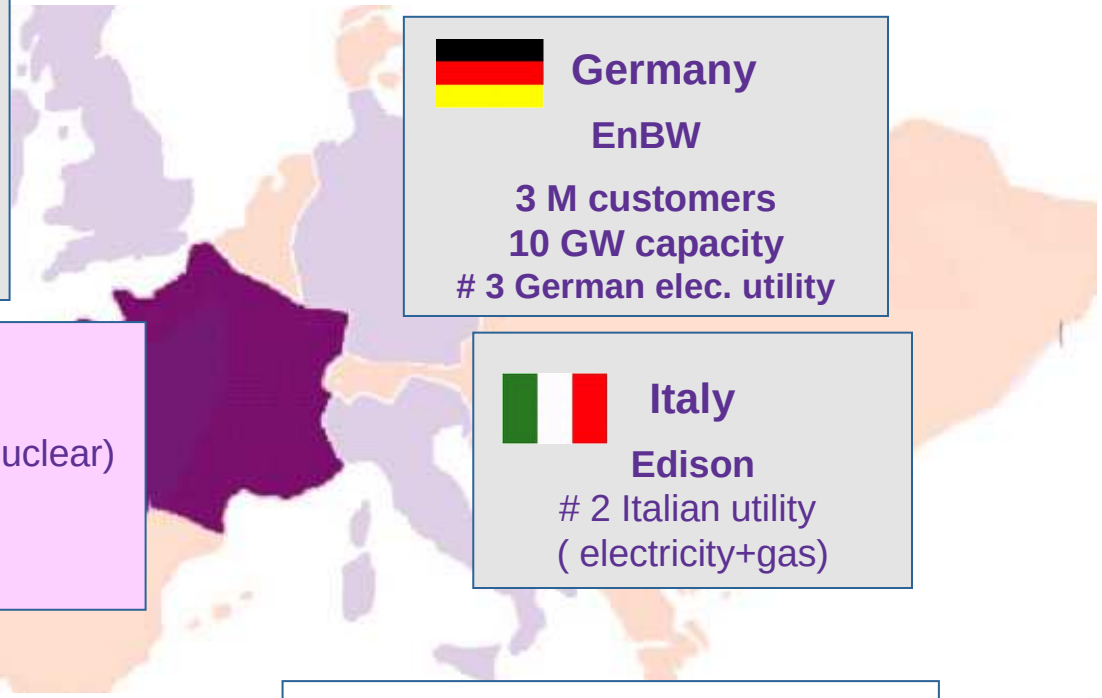
IEEE Distribution Automation Working Group

Tuesday 26 June
Tampa, Florida

EDF Distribution system of the future and DA roadmap

EDF R&D

EDF Group at a glance



United Kingdom
EDF Energy
8 M customers
16 GW capacity
1 distributor

Germany
EnBW
3 M customers
10 GW capacity
 # 3 German elec. utility

France
Capacity: 101 GW (63 GW nuclear)
Customers : 28m
Networks: 1 340 000 km
Gas: 3 bcm

Italy
Edison
2 Italian utility
(electricity+gas)

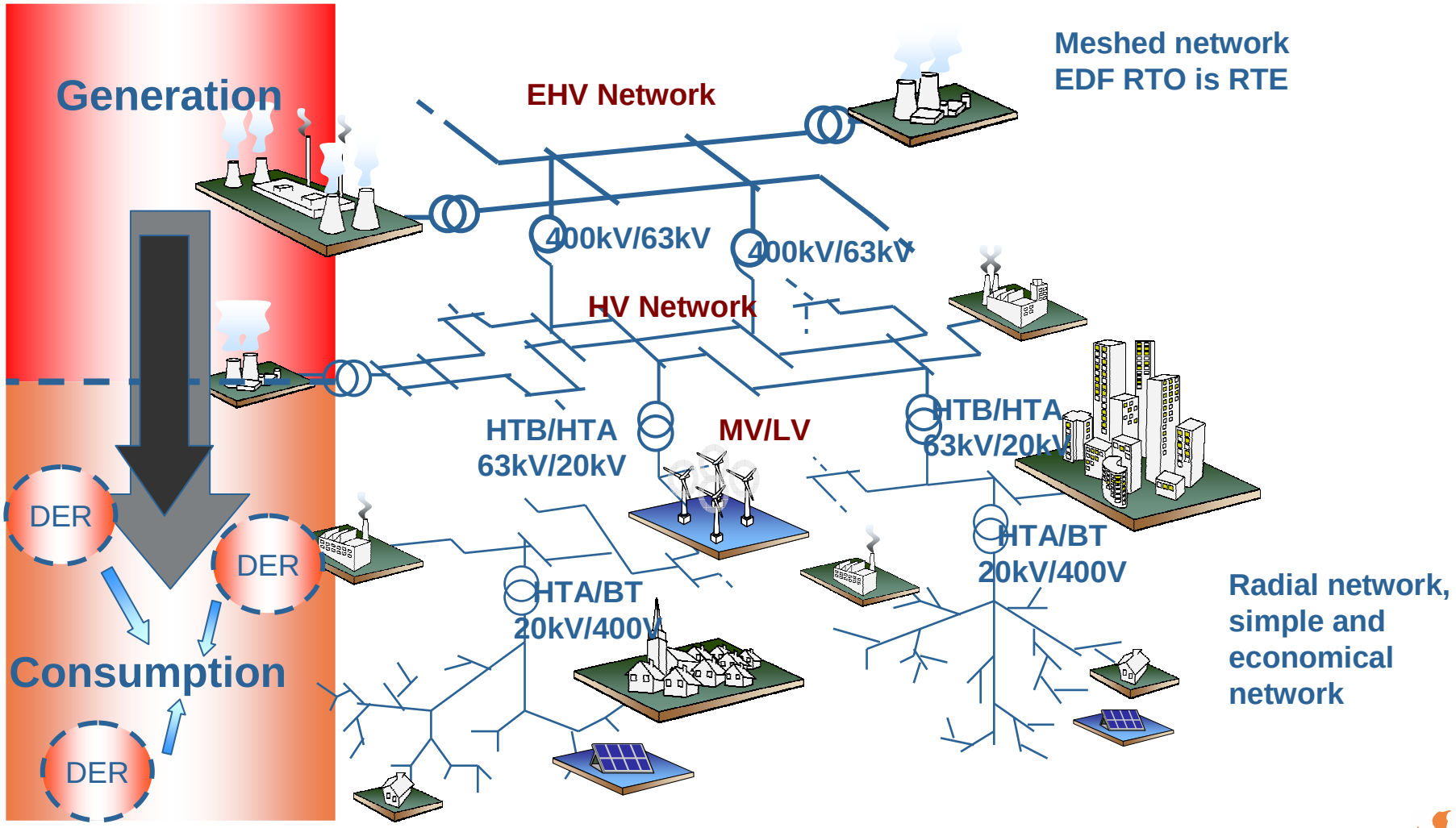
Revenues : € 51 billion*
EBITDA : € 13 billion*
Customers in the world : 40.2 million*
Employees in the world : 161.560*
Generation : 131.000 MWe* (installated capacity)
640.000 GWh* (generation)

* consolidated figures

EDF Trading

Volumes handled: electricity (745 TWh)
Gas (116 bcm)
Coal (237 Mt)
Oil (141 Mb)

EDF Distribution network in France



- 2.200 distribution substations, MV network : 570.000 km (35% underground)
- 650.000 MV/LV sub-stations (350.000 pole mounted, 300.000 in cabin, 200.000 w CB)
- LV grid: 630.000 km (40% underground) -29 million customers

State of the art for French network automation

Typical urban grid architecture:

- Double feeder for each MV/LV substation in Paris
- Ring Main Unit in other urban areas
- radial in rural areas

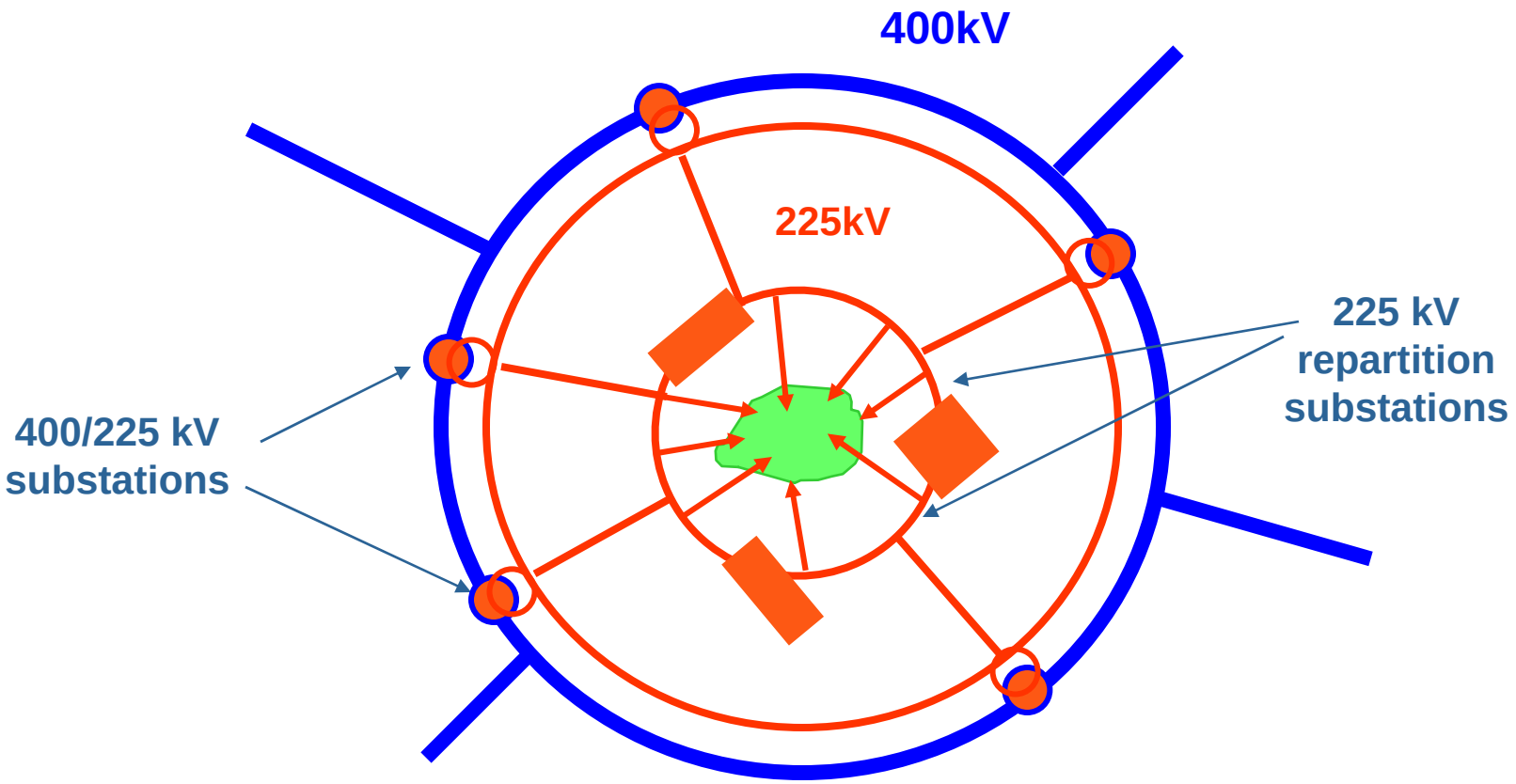
MV equipment used for grid automation:

- Remotely controlled switches: 93 000 (3.7 per feeder), usually equipped with a fault indicator,
- A few reclosers and a few sectionalizers

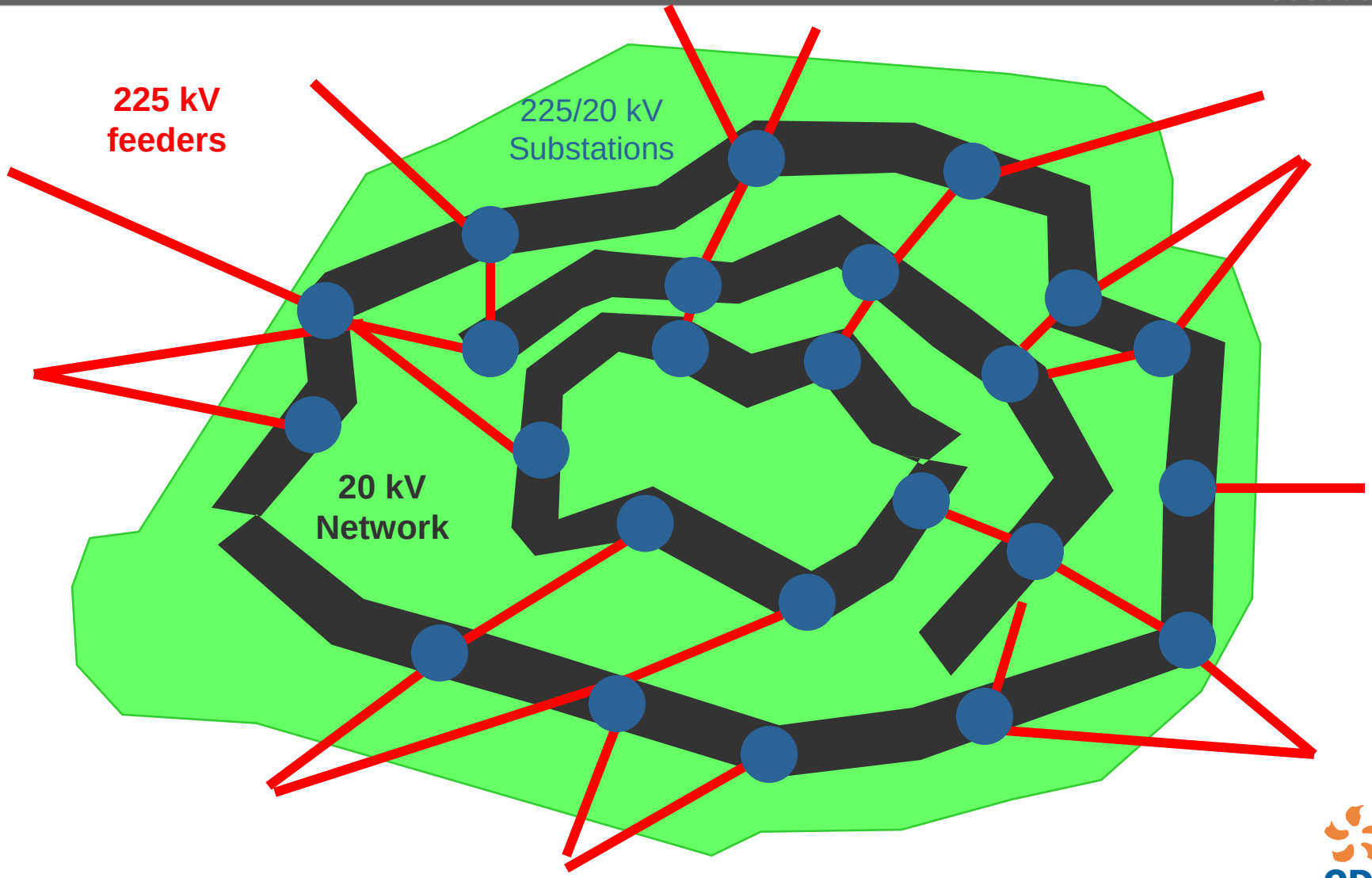
Experimentation of 3 new automation functions assisting the operator in:

- Synthesize alarms coming form sub-stations (20 alarms are summarized in one line)
- Automated localization functions (calls up fault indicators and localises the faulted segment)
- Identifies the remote actions to reconfigure (algorithm can adapt to any grid situation)

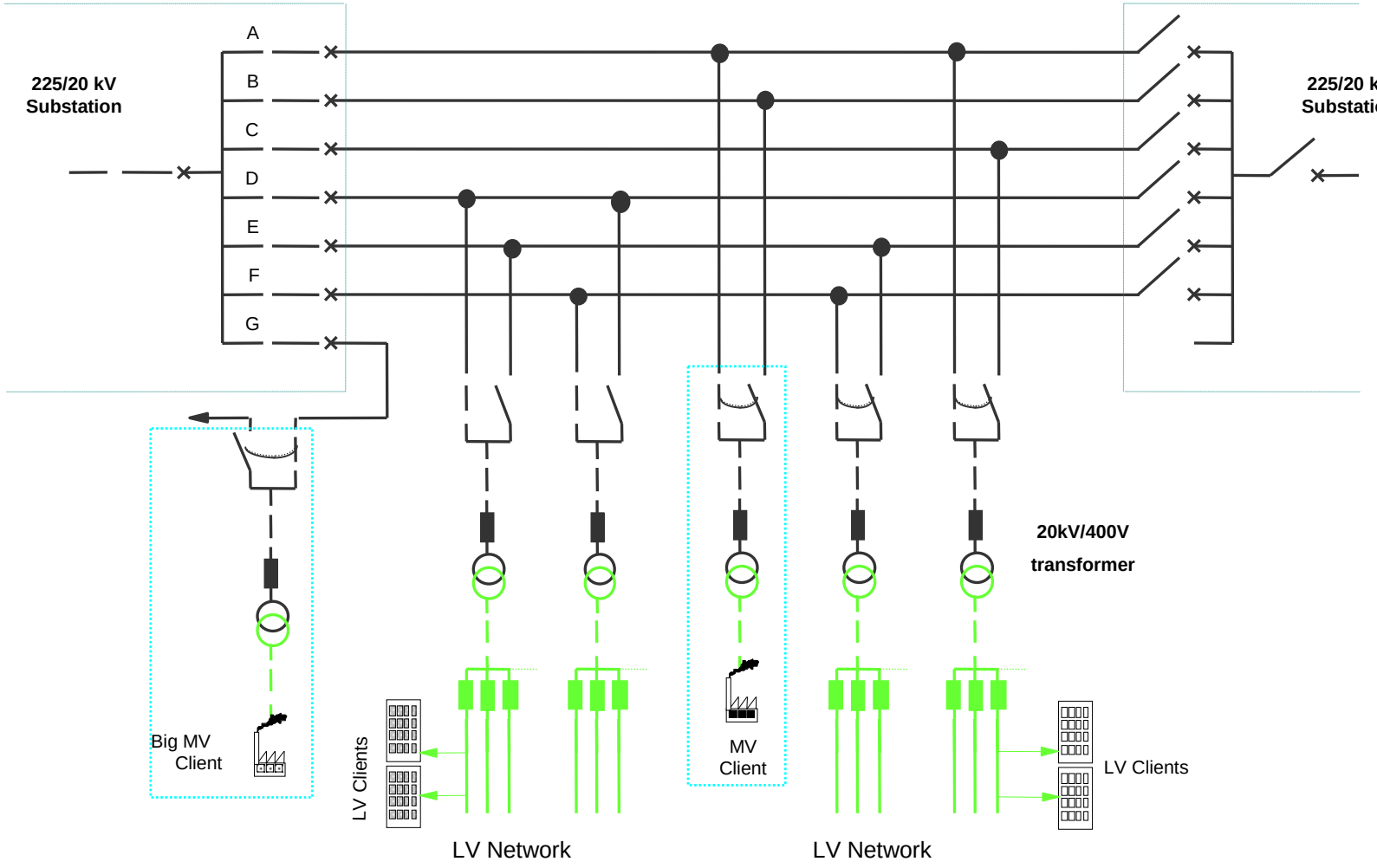
Paris region Transmission Grid



Paris 20 kV Rings network



Paris Distribution Design: 20 kV artery supplies 50 MV/LV substations



Drivers of evolutions of future distribution systems

Crisis and contingencies management

- Summer peak situations more common – maintenance windows are reducing,
- Impact of climate change on network performance,
- Rules of Network design : N-1 may not always be enough,
- Customers need accurate up-to-date information,

New constraints

- Renewable and dispersed generation (DER & RES) is growing (7GW, 3GW of planned installations),
- Hybrid vehicles and new transportation means,
- Aging infrastructure

Increased economic performance and industrial intelligence

- Be one of the best distribution operator
- New performance metrics under scrutiny of regulators
- Competitiveness: ouverture des metiers avec un metier du distributeur plus a l'interface.

Distribution systems need for more flexibility
Distribution 2015 Challenge prepare this evolution

Optimization of energy resources

Reduction of Gas Emissions

Optimization of assets (aging assets, integration of DERs)

Higher constraints. Maintain or enhance quality of supply

Poor flexibility of network assets

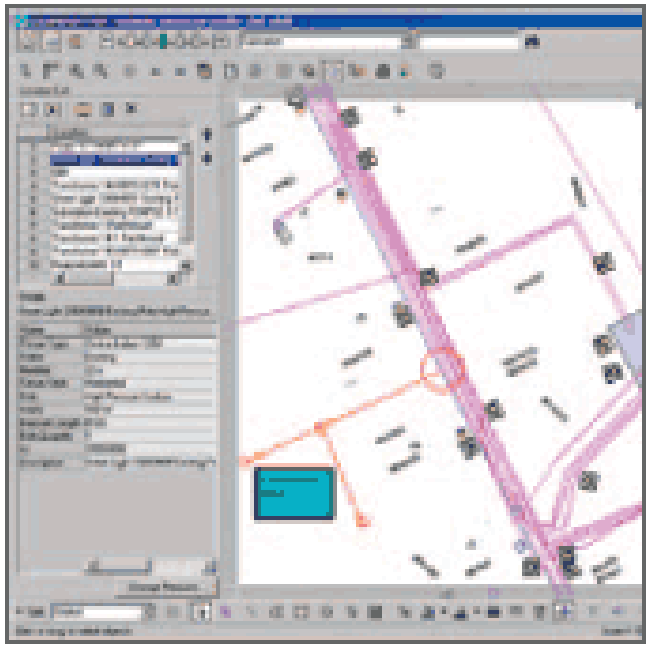
1) Preparation of advanced
distribution management systems tools;
2) Strengthen our knowledge of aging assets to optimize lifetime
3) Distribution energy resources on distribution networks: towards active distribution systems
4) Information technologies applied to distribution systems:
(r)evolution for increased performance

Distribution 2015 Challenge: Preparing new distribution management systems tools

In 2009 to have proven technical and economic feasibility of new functions toward advanced distribution management systems

- Opportunities of a new advanced metering infrastructure
- Projection of increased distribution generation penetration

Preparation of new advanced functions for centralized control centers tools



Average size DMS France

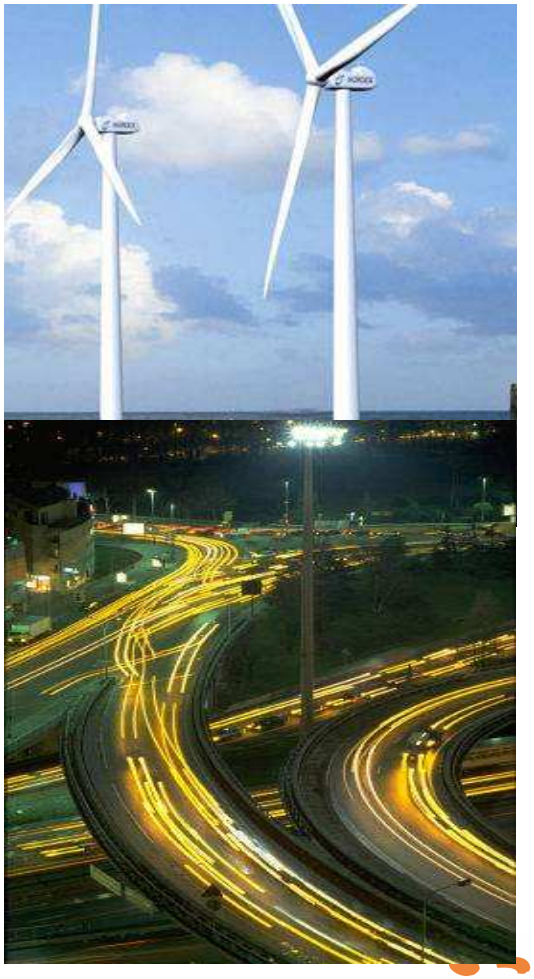
- 100 primary substations (up to 120)
- 3000 remote controlled devices (up to 8000)
- 10000-20000 remote-controled actions
- 10000 manual circuit-breakers, …
- 60000 lines (corresponding to Nîmes area)

Distribution 2015 Challenge: DER and active distribution systems

The objectives are to identify:

-The main issues of the distribution systems with the development of high penetration of DGs and demand-side management solutions

- Possible evolutions of stakeholders in the case of a very active distribution network



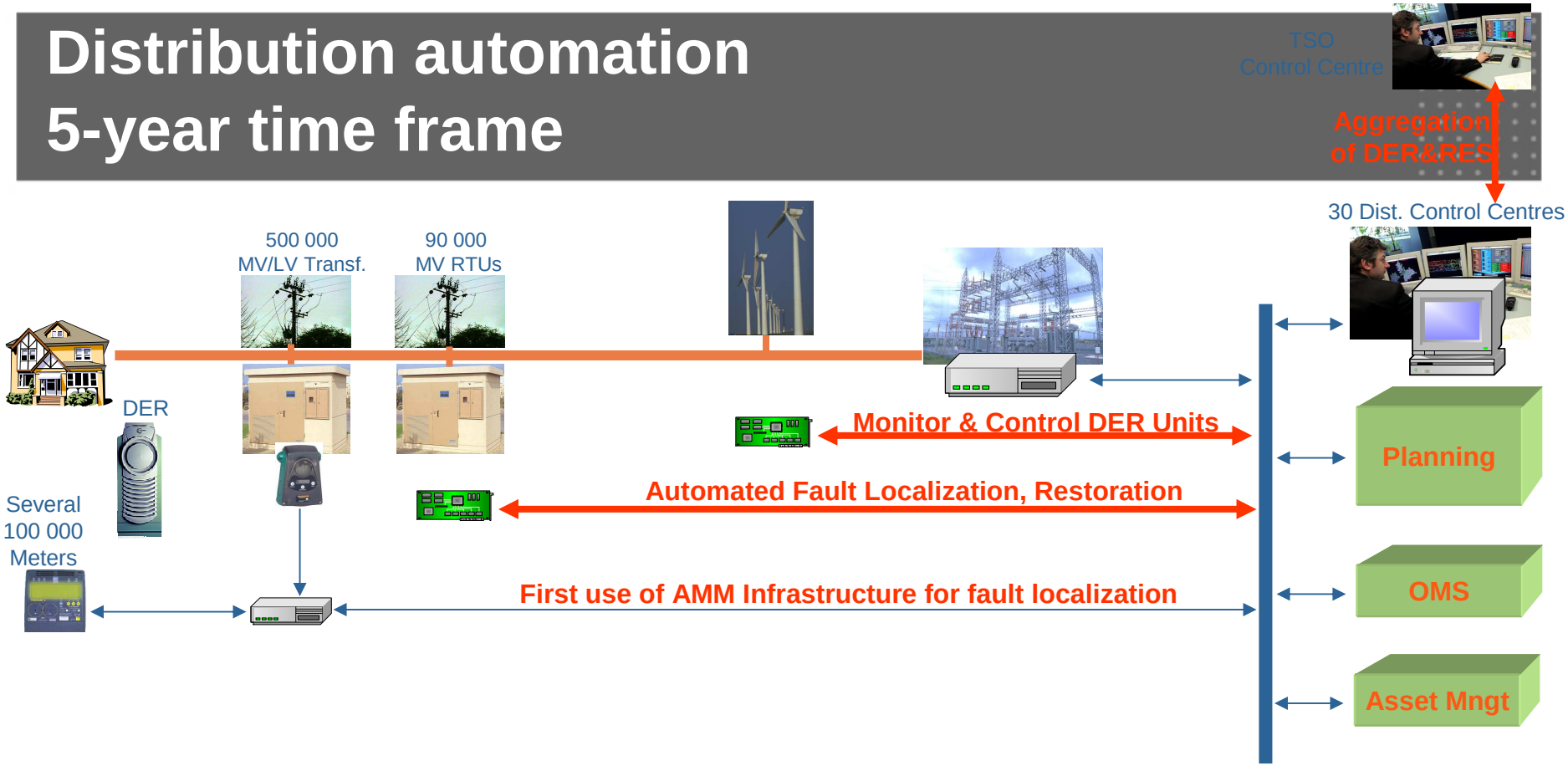
Distribution 2015 Challenge: IT applied to distribution: (r)evolution for increased performance

The objectives are to develop:

- Key technical innovations to support new applications for distribution network with high NPV

- Set up an integration platform DIGITAL to facilitate quick mock-up of new applications and test evolutions of the tools for distribution (integration benchtop) both to test technically and to prove economical viability

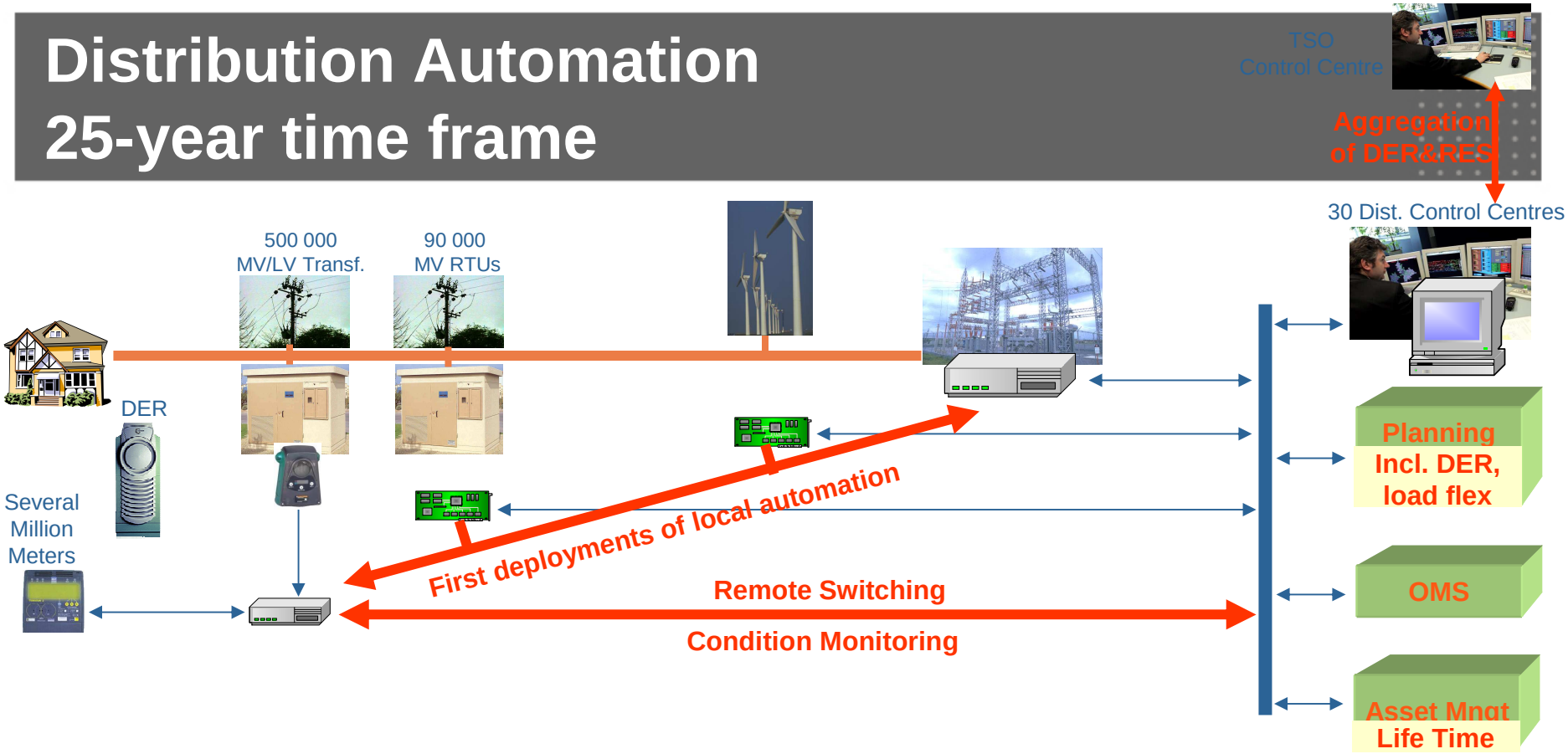
Distribution automation
5-year time frame



Centralized control :

- Create maximum value with available data,
- Automated functions (FLI, restoration). Expected gain on SAIDI : 5 to 10%,
- Incorporate DER units in control center functions (VVC, restoration),
- First synergies between AMM projects and network operation,
- Contribution to the aggregation of DER & RES.

Distribution Automation
25-year time frame



From a Reinforcement to a Decentralization of Control:

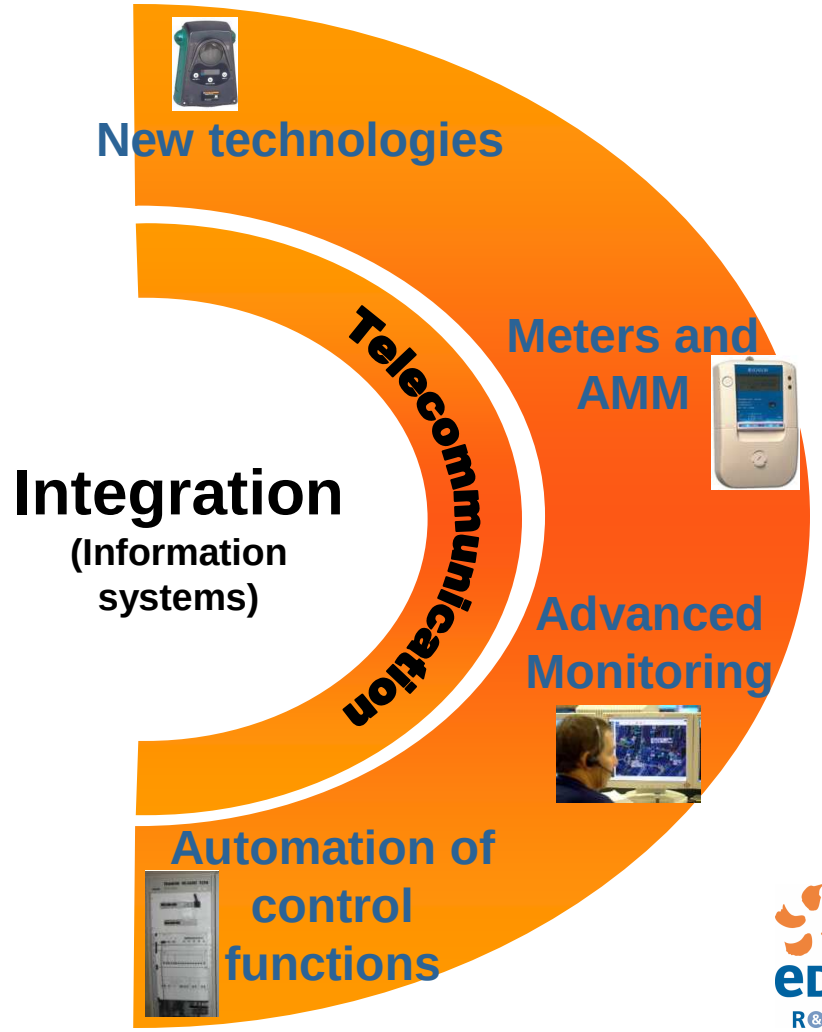
- Deploy. of synergies between AMM & network operation. Expected gain on SAIDI : up to 30%,
- Consolidation of control centres, Condition monitoring and asset managt,
- First decentralisation of automated control functions,
- First local coordinations of load & generation flexibilities.

Distribution Automation could not reach its maximum value without Integration

Applications

- Self healing power system (Fault location and restoration, congestion and voltage management)
- Distributed Generation integration (contribution to the ancillary services)
- Asset Management and Condition Monitoring
- Demand Response and Dynamic Pricing
- Participation in Energy Markets

Families of promising technologies



EDF Distribution system of the future

Questions?

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