



Computing in a national research Institution: the INFN case

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TECH-FPA PhD Retreat 2025 – 17-21/2/2025 - LNGS

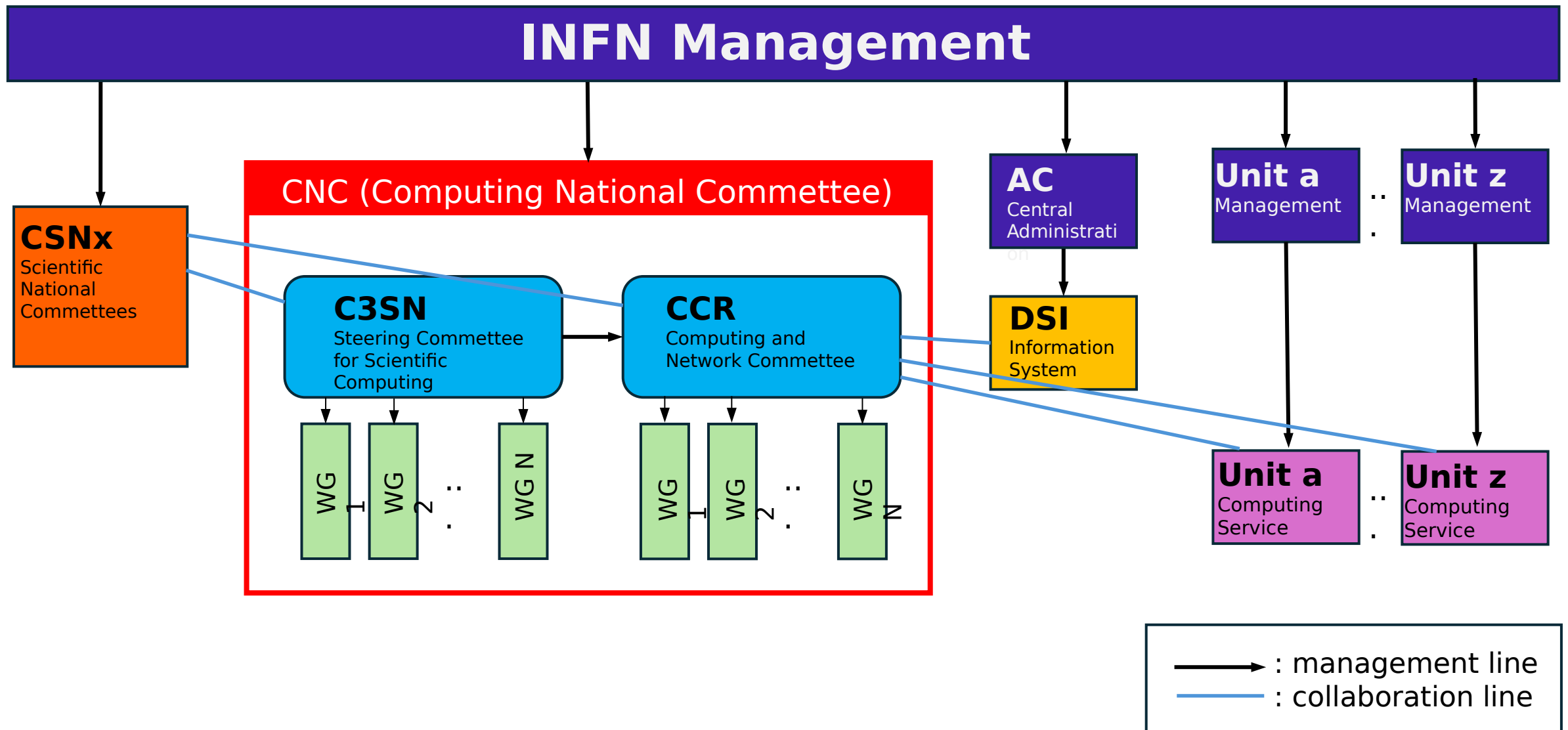
INFN: a distributed institution

- 4 National Laboratories
- 20 Divisions
- 6 Associated Groups
- 3 National Centers
- 1 International Consortium

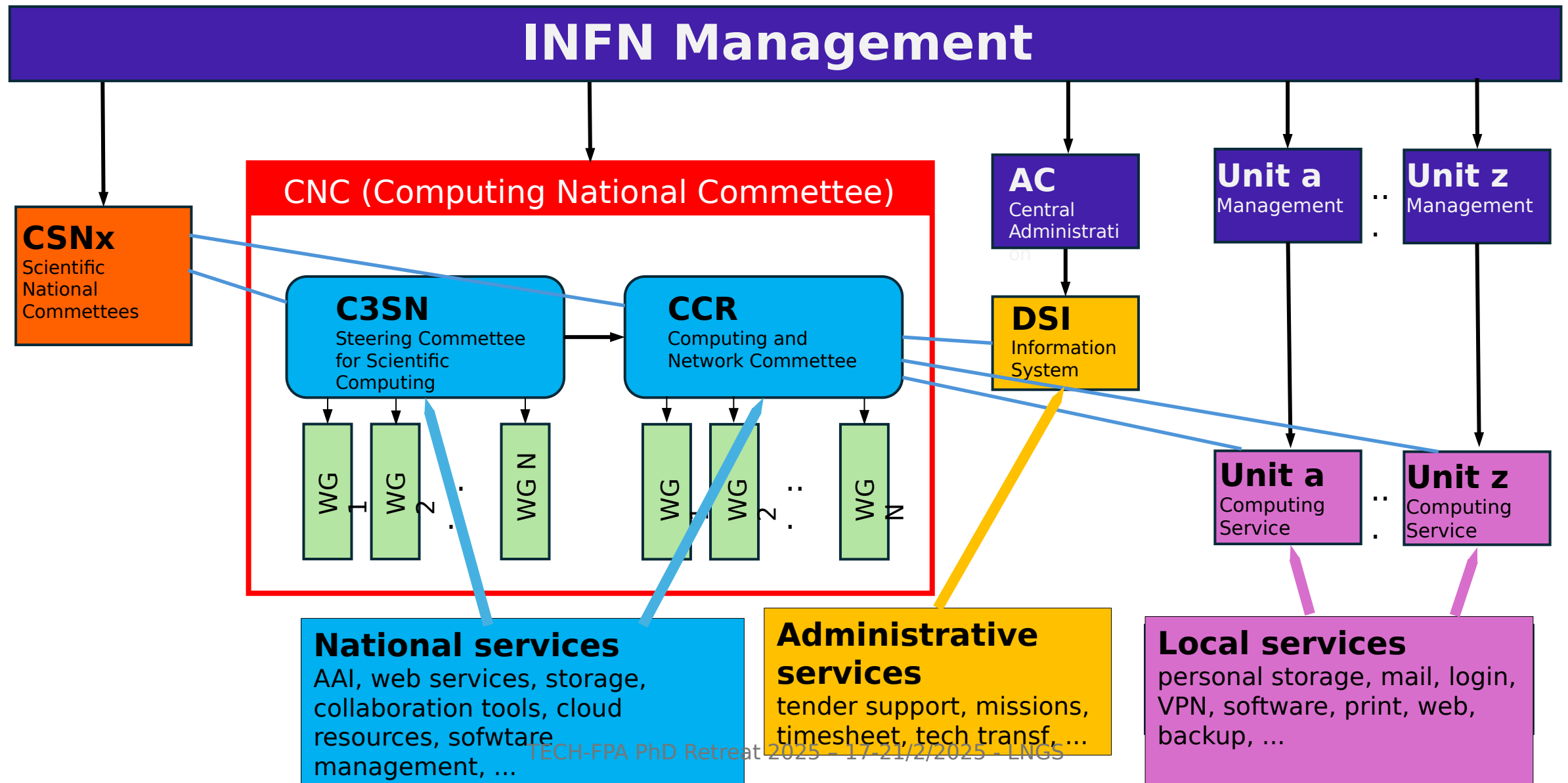
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Computing governance



Computing INFN organization



Computing centers and networking

1 Tier1 (INFN CNAF)

- CPU: ~ 550 nodi, 60 kcore, 1.2 MHS06
- Disk storage: ~ 85 PB
- Tape storage: ~ 195 PB

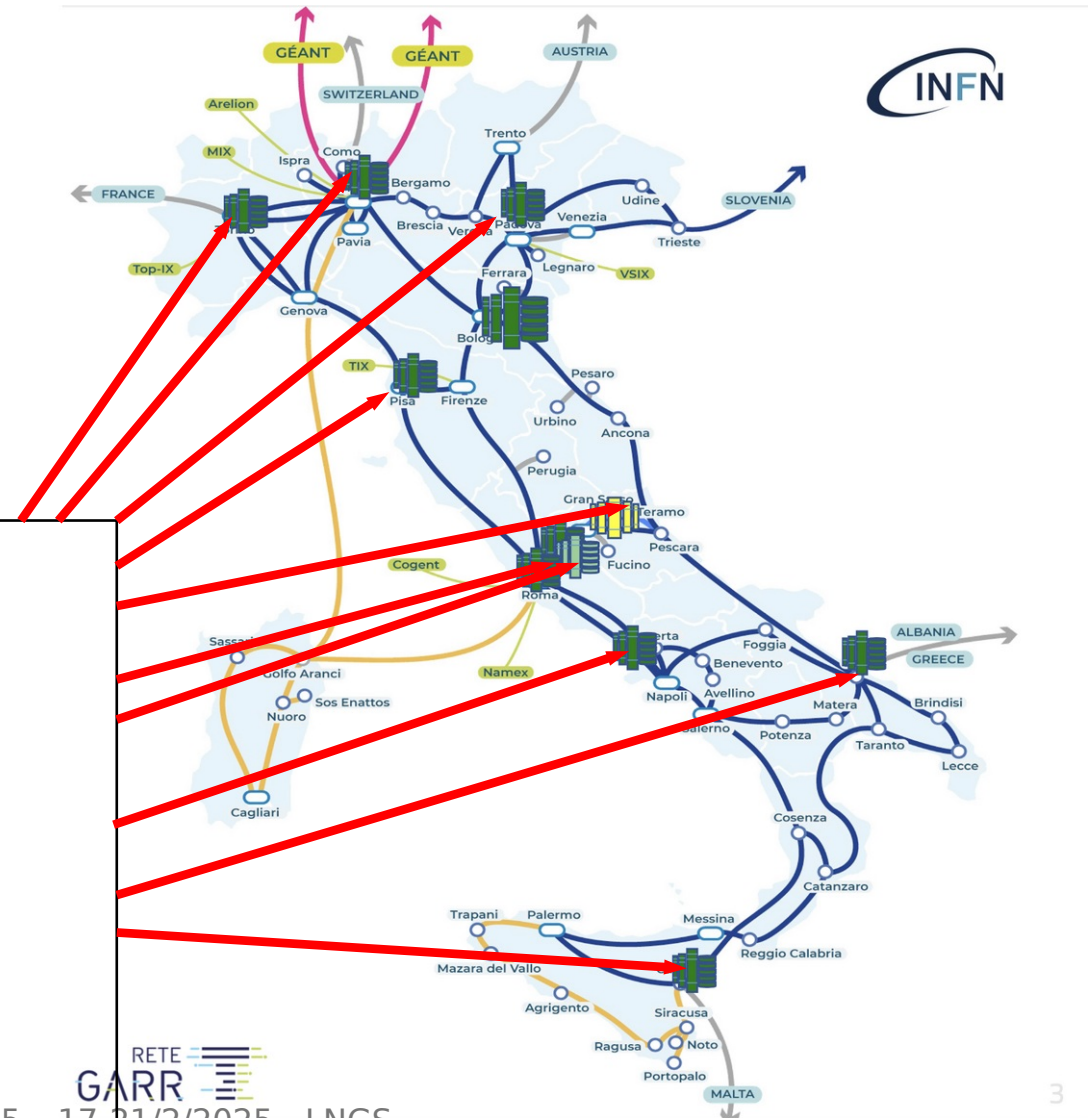
9 Tier2

(Ba,Ct,LNF,LNL/PD,Mi,Na,Pi,Rm1,To)

1 HPC centre LNGS

Aggregated resources:

- CPU: ~ 0.85 MHS06
- GPU: ~ 100
- Disk storage: ~ 65 PB



The INFN Cloud approach

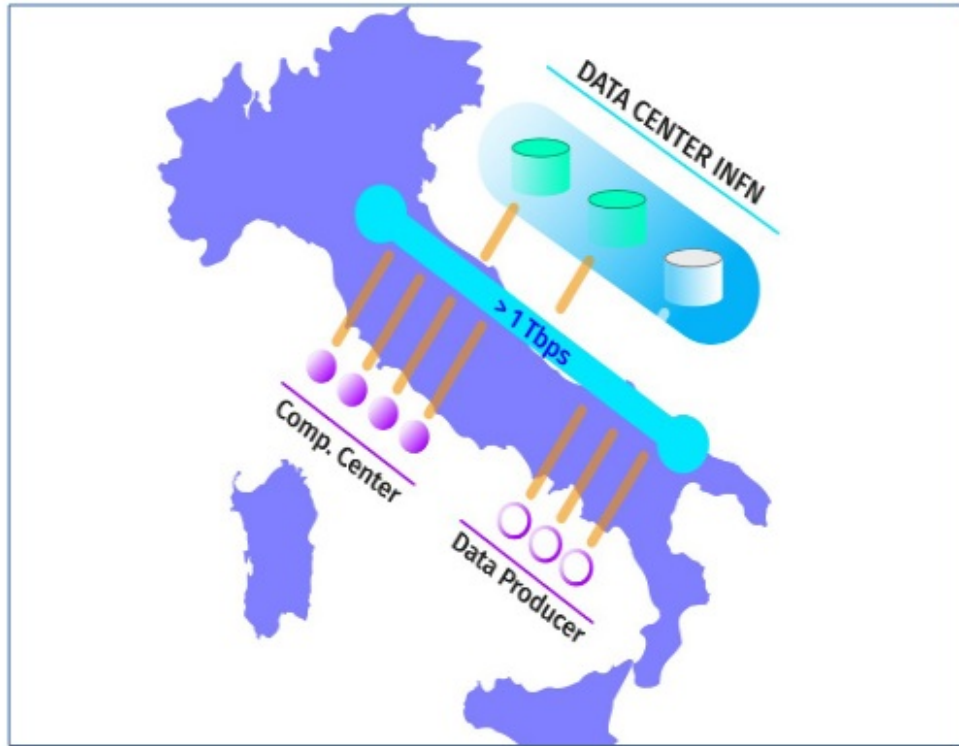
- To support and evolve use cases that could not easily exploit the Grid paradigm, for many years several INFN sites have been investing in Cloud computing infrastructures
 - heterogeneous in hardware, software and cloud middleware.
- To optimize the use of available resources and expertise, INFN decided to implement a national Cloud infrastructure for research
 - as a federation of existing distributed infrastructures extending them if necessary in a transparent way to private and commercial providers;
 - as an “user-centric” infrastructure making available to the final users a dynamic set of services tailored on specific use cases;
 - leveraging the outcomes of several national and European cloud projects where INFN actively participated.
- INFN Cloud was officially made available to users in March 2021.

Cloud at CNAF
Cloud at Bari
CloudVeneto
Cloud at Torino...

Federation of data,
resources and knowledge



INFN federated cloud implementation



- The infrastructure is based on a core backbone connecting the large data centers of CNAF and Bari and on a set of loosely coupled distributed and federated sites connected to the backbone
 - backbone's sites are high speed connected and host the INFN Cloud core services.
- A site can join the INFN Cloud infrastructure accepting the Rules of Participation and after the approval of the INFN Cloud project management board.
 - Rules define access to resources and policies, according to INFN national and European laws.
- INFN Cloud's distributed organization provides support and management of both infrastructure and services.

INFN federated cloud features

- Open source, vendor neutral architecture
- Dynamic orchestration of federated resources
- Consistent AA technologies and policies
- Architecture makes it possible to help researchers in exploiting the computing resources in a flexible way
- Services can be deployed by users via an easy-to-use dashboard



Portal: <https://mycloud.infn.it>

INFN Cloud

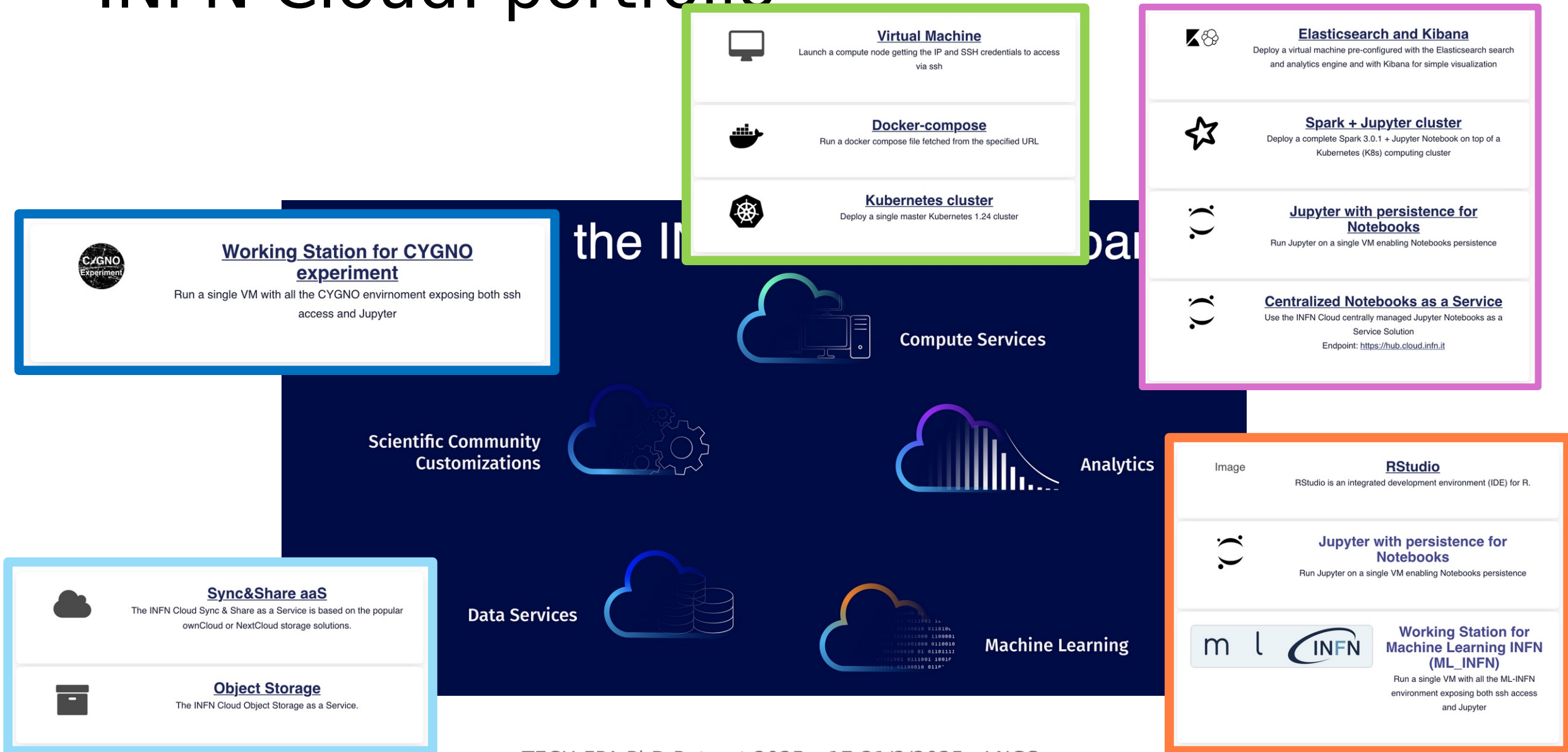


Global resources:

- 3900 cores
- 16 TB RAM
- 380 TB disk storage

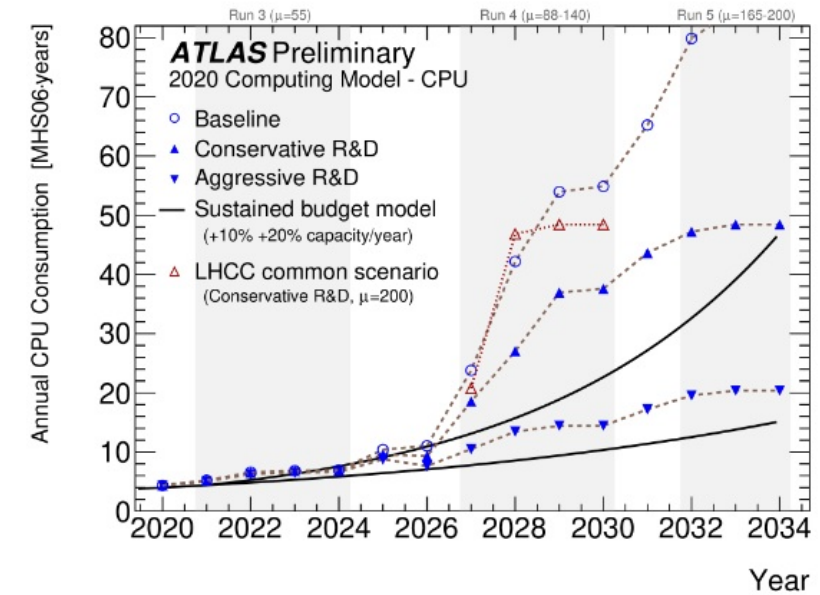
- IaaS, PaaS and SaaS services
- Based on INFN resources
- Implemented using OpenSource software
- Federated architecture
 - Backbone: CNAF – Bari
 - infrastructural services, redundant
 - RECAS Bari Cloud
 - CloudVeneto
 - Cloud Catania
 - Cloud@CNAF T1
 - Cloud Ibisco Napoli
- Access based on Indigo IAM
 - federated access, support for INFN AAI
- Detailed info in <https://www.cloud.infn.it>

INFN Cloud: portfolio

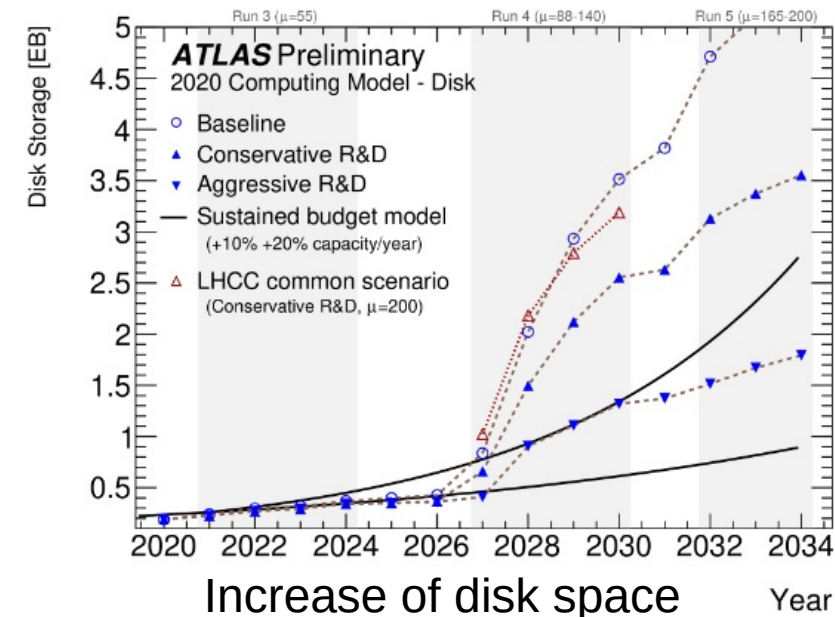


Towards the future

- The main driver for the growth of INFN computing resources are the LHC experiments
- The computing needs are expected to increase significantly with the Hi-Lumi LHC
- In the last two years INFN has had the opportunities to promote and participate to projects in the field of infrastructure innovation and technology transfer, with the aim to improve its infrastructure and services
 - the Bologna Technopole: new very large facility hosting the main Italian scientific computing centers (ECMWF-CC, CINECA-Leonardo, INFN-CNAF)
 - a new National Research Center for HPC, Big Data and Quantum Computing (ICSC) funded with €320 M
 - 25 Univ., 12 Res. Inst., 14 companies
 - a new "Terabit network for Research and Academic Big data in Italy" project funded with €41 M
 - integration of HPC and Cloud resources



Increase of CPU

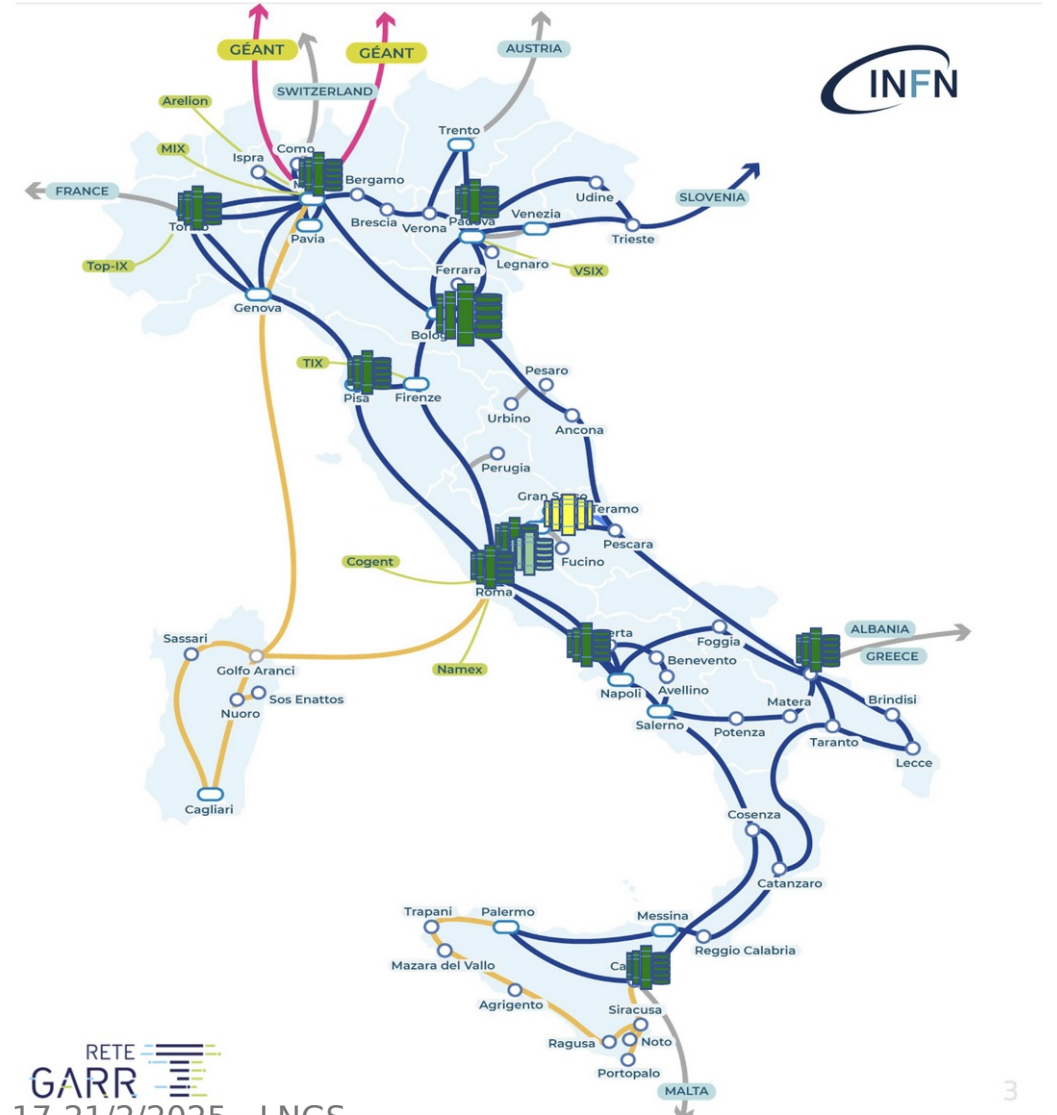


Increase of disk space

Computing centers and networking

Network connection through GARR (Italian Research Network)

- GARR backbone: 400-800 Gbps
 - increasing
- INFN bandwidth
 - CNAF: $n \times 100/400$ Gbps
 - Tier2s: 100/200 Gbps
 - Other sites: 10/20 Gbps



National services infrastructure

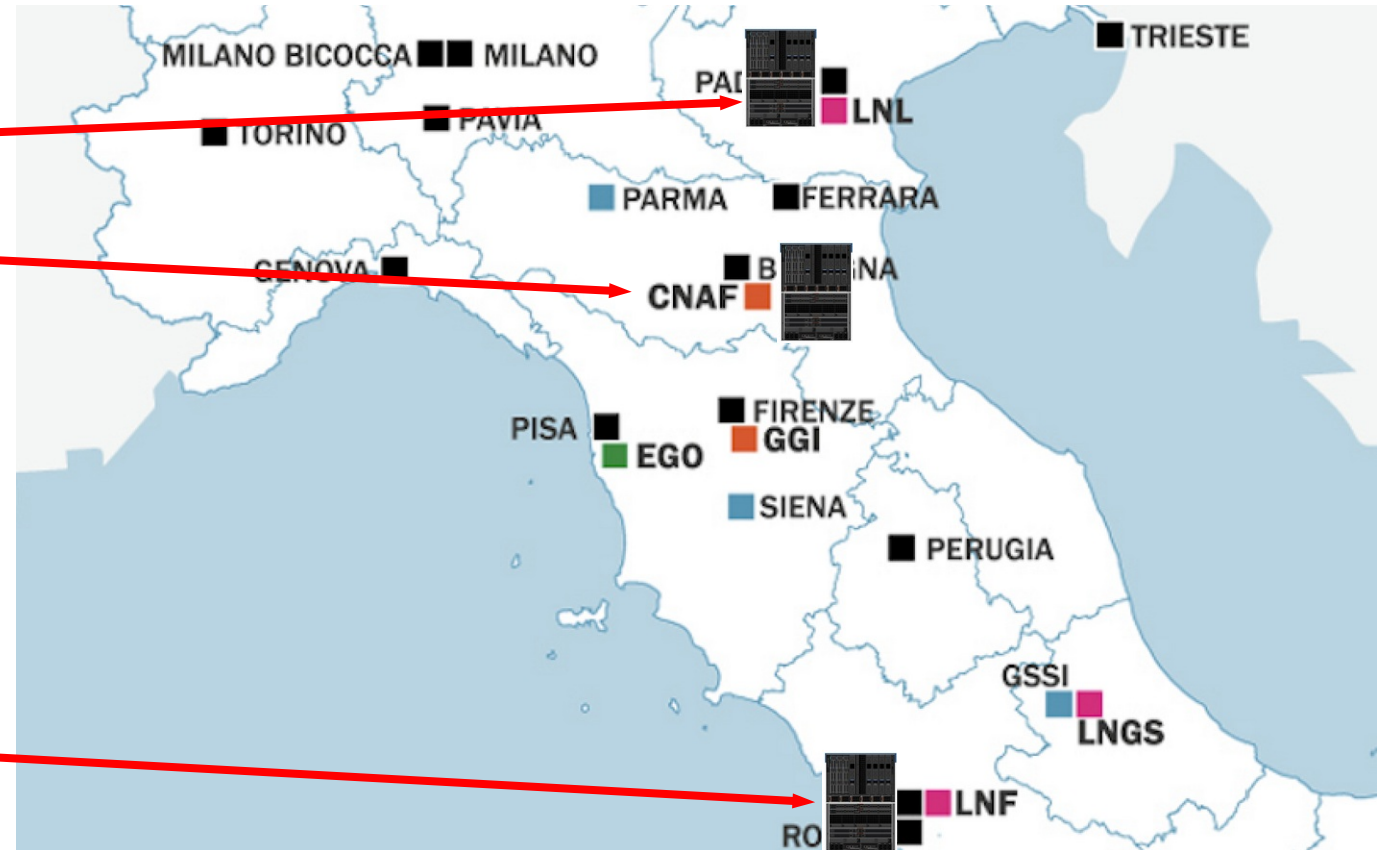
Business Continuity

site 2 (LNL)
site 1 (CNAF)

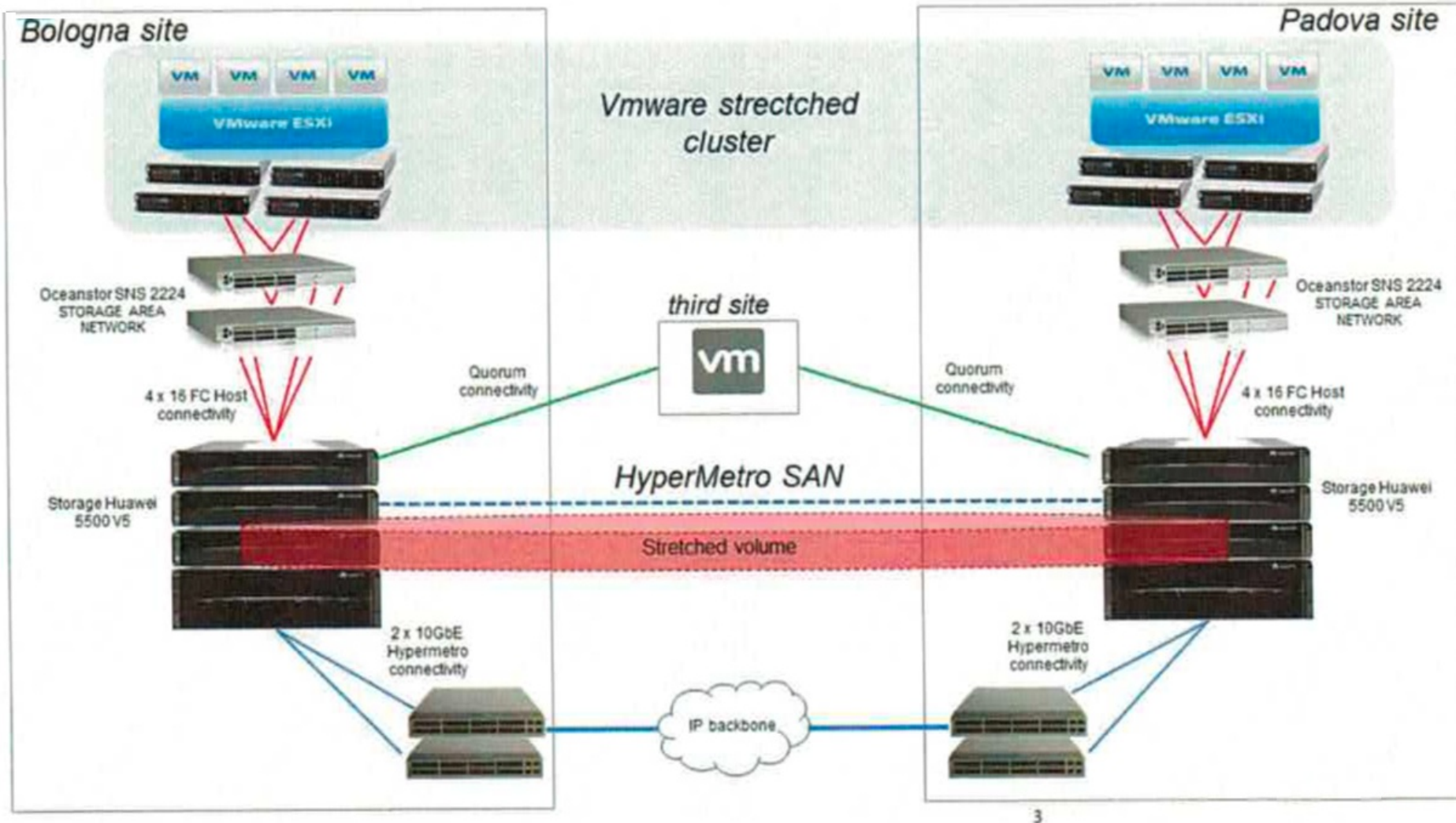
- CPU: 1500 core
- VM: 500 VM
- RAM: 14 TB
- Storage: 300 TB

Disaster Recovery (LNF)

- CPU: 500 core
- RAM: 4 TB
- Storage: 200 TB



Business Continuity infrastructure



Training

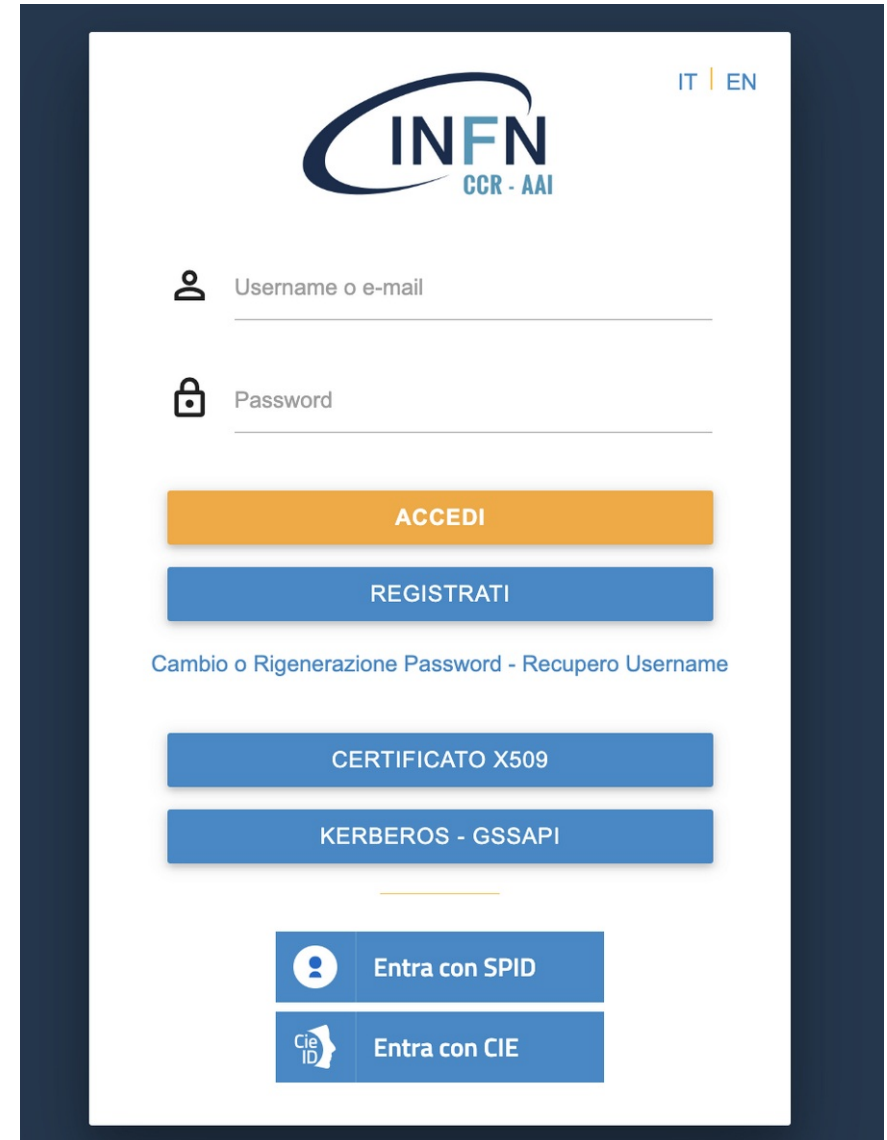
- Using computing resources, tools and services in an effective way require a significant amount of training
- INFN provides several opportunities for personnel, young researchers and users
- Special school are regularly organized
- A good example is the ESC School: international advanced computing School held every year in Bertinoro, addressed mainly to PhD students and post-doc
 - next edition: 28/9-9/10 2025

The screenshot shows the website for the ESC Efficient Scientific Computing School. The header includes navigation links: Home, About, Program, Team, Location, and Contact. A circular logo in the top left corner features the INFN logo and the text 'EFFICIENT SCIENTIFIC COMPUTING SCHOOL'. The main heading is 'ESC Efficient Scientific Computing School' in a large, bold, blue font. Below this, a subtitle reads: 'Architectures, tools and methodologies for developing efficient large scale scientific computing applications.' There are social media icons for YouTube and LinkedIn. A date line states 'ESC 2025: 28th September to 9th October 2025'. A grey button labeled 'INFO' is positioned at the bottom left. On the right side, there is a partnership logo for 'NextGen' (Next Generation Triggers) and a large photograph of a lecture hall with rows of red chairs and a whiteboard at the front. A series of small circles at the bottom right of the photo indicates the current slide in a gallery.

<https://esc.infn.it>

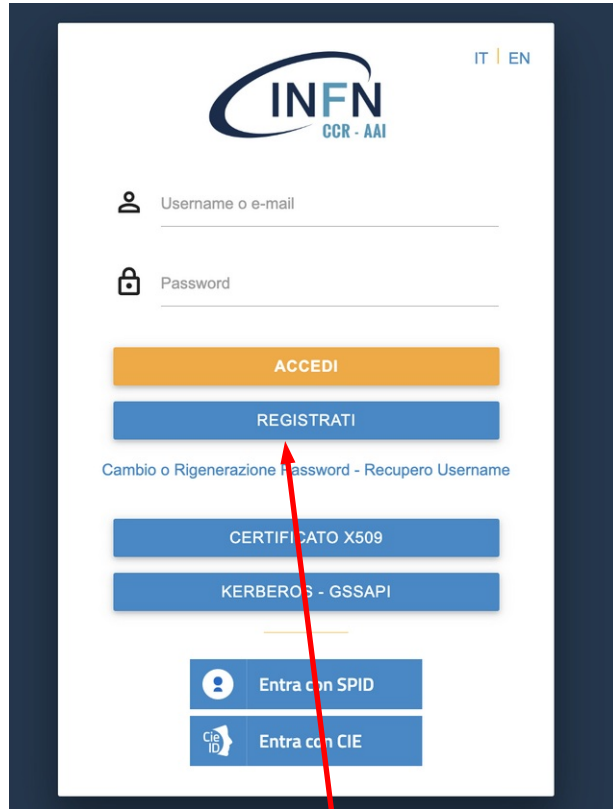
INFN Authentication/Authorization Infrastructure (AAI)

- **One digital identity for everybody in INFN**
- Open to inclusion of external collaborators/visitors
- Support for different level of assurance
- Support for **different auth method**
 - user/pwd, X.509 cert., KRB, SPID, CIE
- Support for **SSO (SAML, OIDC)**
 - web app, OAuth2 app
- Support for **2FA**
 - **available, will be mandatory soon**
- Integrated with LDAP interface
 - auth support for other app (ssh...)
- Integrated with federated services
 - **IDEM**: italian, managed by GARR
 - digital libraries, scientific journals, e-learning...
 - **EDUgain**: worldwide, managed by Geant
- Registration and proper authorization is needed to have access to all national services
 - and some local services



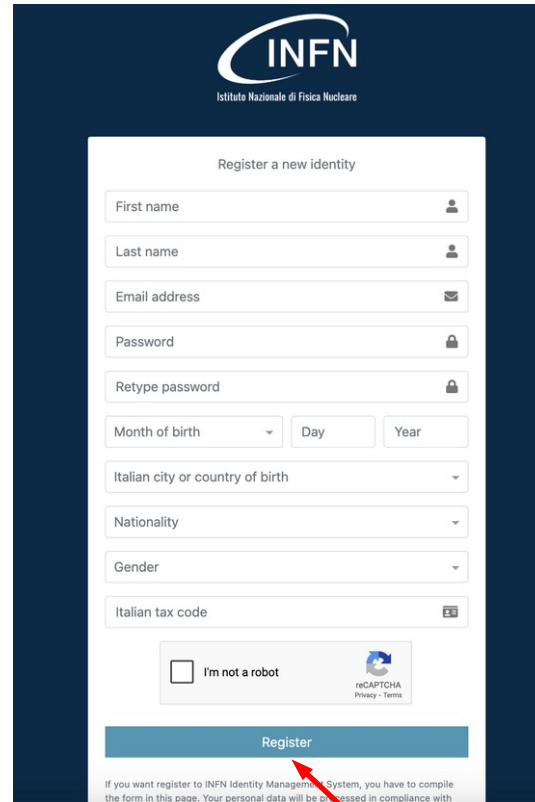
The image shows the INFN CCR - AAI login interface. At the top right, there are links for 'IT' and 'EN'. The INFN logo is prominently displayed. Below the logo, there are two input fields: 'Username o e-mail' and 'Password'. Below these fields are two large buttons: 'ACCEDI' (orange) and 'REGISTRATI' (blue). Underneath these buttons is a link: 'Cambio o Rigenerazione Password - Recupero Username'. Further down are two more blue buttons: 'CERTIFICATO X509' and 'KERBEROS - GSSAPI'. At the bottom, there are two blue buttons for federated login: 'Entra con SPID' and 'Entra con CIE', each preceded by its respective logo.

INFN AAI: auto registration process



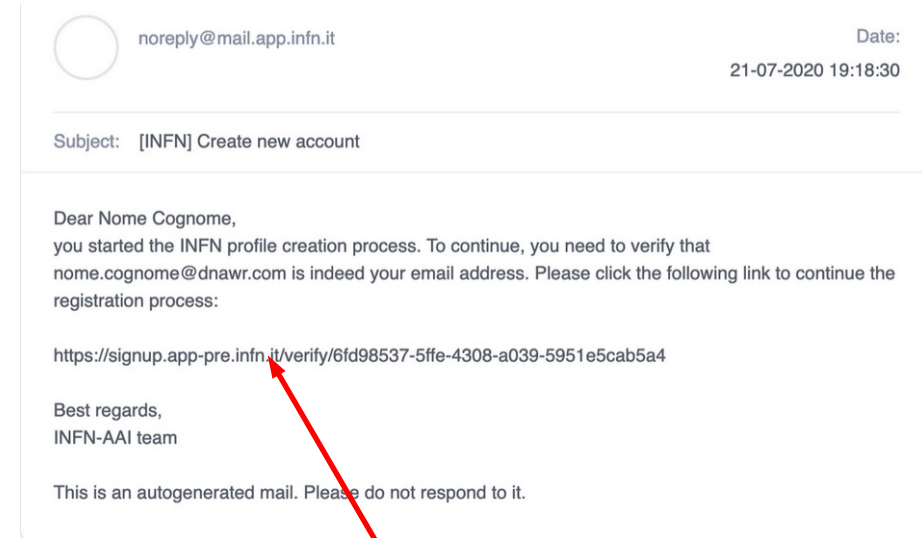
The image shows the INFN AAI login and registration page. At the top is the INFN logo and the text 'CCR - AAI'. Below the logo are two input fields: 'Username o e-mail' and 'Password'. There are two main buttons: 'ACCEDI' (orange) and 'REGISTRATI' (blue). Below these buttons are links for 'Cambio o Rigenerazione Password - Recupero Username', 'CERTIFICATO X509', and 'KERBEROS - GSSAPI'. At the bottom, there are two buttons for external authentication: 'Entra con SPID' and 'Entra con CIE'. A red arrow points from the 'REGISTRATI' button to the 'Step 1' text below.

- Step 1:
- Go to <https://userportal.app.infn.it>
 - Select “Register”



The image shows the INFN AAI registration form. At the top is the INFN logo and the text 'Istituto Nazionale di Fisica Nucleare'. Below the logo is the title 'Register a new identity'. The form contains several input fields: 'First name', 'Last name', 'Email address', 'Password', 'Retype password', 'Month of birth', 'Day', 'Year', 'Italian city or country of birth', 'Nationality', 'Gender', and 'Italian tax code'. There is a checkbox for 'I'm not a robot' and a reCAPTCHA logo. At the bottom is a blue 'Register' button. A red arrow points from the 'Register' button to the 'Step 2' text below.

- Step 2:
- Fill the form, choose a password and click on “Register”



The image shows an email confirmation page. At the top is the email address 'noreply@mail.app.infn.it' and the date '21-07-2020 19:18:30'. Below this is the subject line 'Subject: [INFN] Create new account'. The main body of the email contains the text: 'Dear Nome Cognome, you started the INFN profile creation process. To continue, you need to verify that nome.cognome@dnawr.com is indeed your email address. Please click the following link to continue the registration process:'. Below this is a blue link: <https://signup.app-pre.infn.it/verify/6fd98537-5ffe-4308-a039-5951e5cab5a4>. Below the link is the text 'Best regards, INFN-AAI team'. At the bottom is the text 'This is an autogenerated mail. Please do not respond to it.' A red arrow points from the link to the 'Step 3' text below.

- Step 3:
- Click on the link sent you by email to confirm your registration

INFN AAI: request to access IT resources

INFN User Portal

Tex Willer

Profilo

Titoli di studio

Abilitazioni

Richieste di abilitazione

Seleziona le richieste

☒ **Verifica identità**
Seleziona questa richiesta per iniziare il processo di verifica della tua identità (sarà selezionata automaticamente se necessario).

☒ **Risorse IT**
Seleziona questa voce se vuoi essere autorizzato a utilizzare **Abilitazioni** IT dell'INFN.

☐ **Rapporti fiscali**
Seleziona questa voce se prevedi di dover avere rapporti economici con l'INFN (futura richiesta di associazione, ospitalità istituzionale, ecc.).

Precedente

Passo successivo

Step 1:

- Go to <https://userportal.app.infn.it>
- Select “Enabling Requests”
- Select “IT Resources”

Richieste di abilitazione

Referente per l'utilizzo delle risorse IT

Devi indicare una persona di riferimento INFN. Per farlo devi selezionare la sede e quindi la persona. Puoi anche inviare un messaggio al tuo referente INFN.

Sede del referente

Sezione di Lecce

Nome del referente

Fasanelli, Enrico Maria Vincenzo

Messaggio al referente (Opzionale)

Devo accedere alla farm dell'esperimento ADN (Aquila Della Notte)

Disciplinare

☒ **Dichiaro di aver letto e accettato il disciplinare INFN per l'utilizzo delle risorse IT**

☒ Disciplinare per l'uso delle risorse informatiche nell'INFN

Precedente

Passo successivo

Step 2:

- Select the INFN Division and the name of your INFN referent
- Read and accept the “Regulation for the use of INFN IT resources”

National services

National services portal: <https://servizinazionali.infn.it>



Document management



Alfresco

Enterprise Content
Management

Document sharing, workflow



Office365

Sharepoint
Onedrive

Pydio/Cells

Cloud storage
Sync and share



Organizational tools



Indico

Event management.
Web site, agenda,
registration, contributes,
abstract, fees,...



SoGo

Manage personal and
shared calendars



LimeSurvey

Create surveys, market
research, user
feedback



Dress

E-voting (even official)

Web services



Url Shortening

Get (short) URL alias in infn.it domain



Wiki

Get your wiki site based on dokuwiki

Matomo Analytics

Web site statistics report: visitors, origin, keywords, most visited pages, etc.



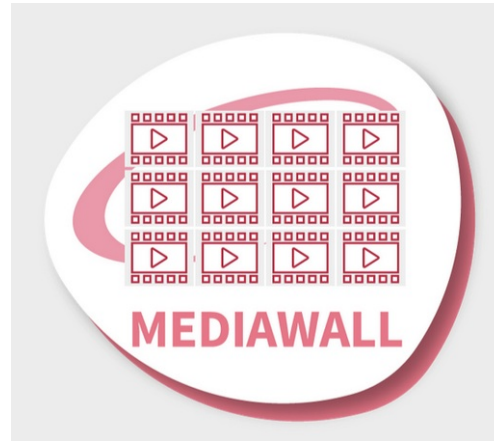
WebSite

Managed service to create WP/Joomla! web sites

Web services (cont.)



Vault
INFN credential
manager



Mediawall
Open source service
for collecting and
managing multimedia
content



Newdle
Open source meeting
organizer

Development collaborative platforms



Jira Software

Collaborative platform from the Atlassian suite designed to facilitate and make team project development more effective



Confluence

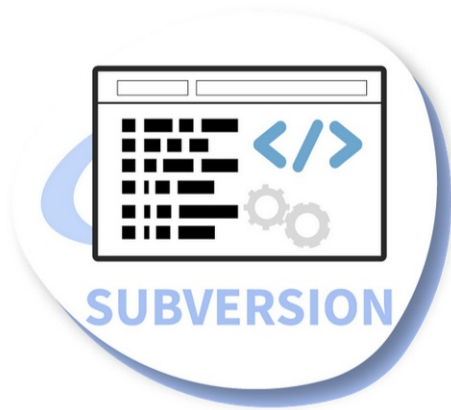
Atlassian suite collaborative wiki for project and development documentation



Jira Service Management

Ticketing system and asset management from the Atlassian suite

Development collaborative platforms (cont.)

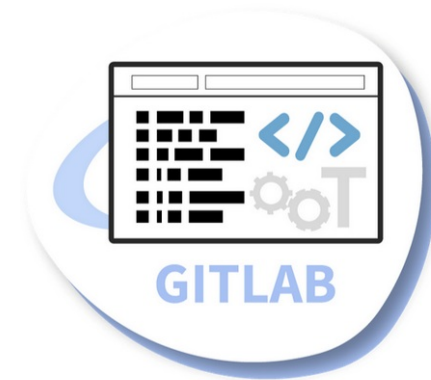


Subversion

software development
version manager, based
on Subversion VCS

Baltig

software development
version manager, based
on Gitlab VCS

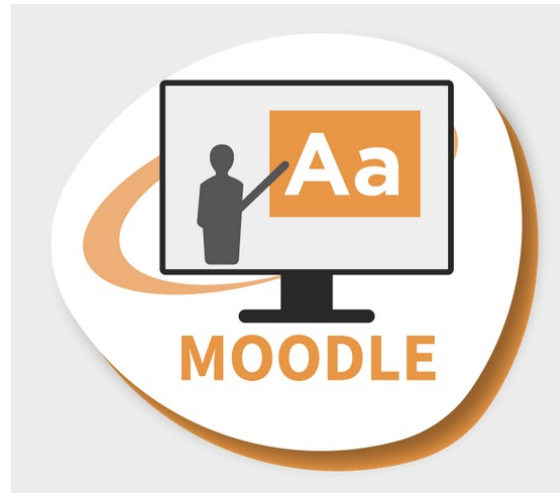


Other services



X.509 Certificate Service

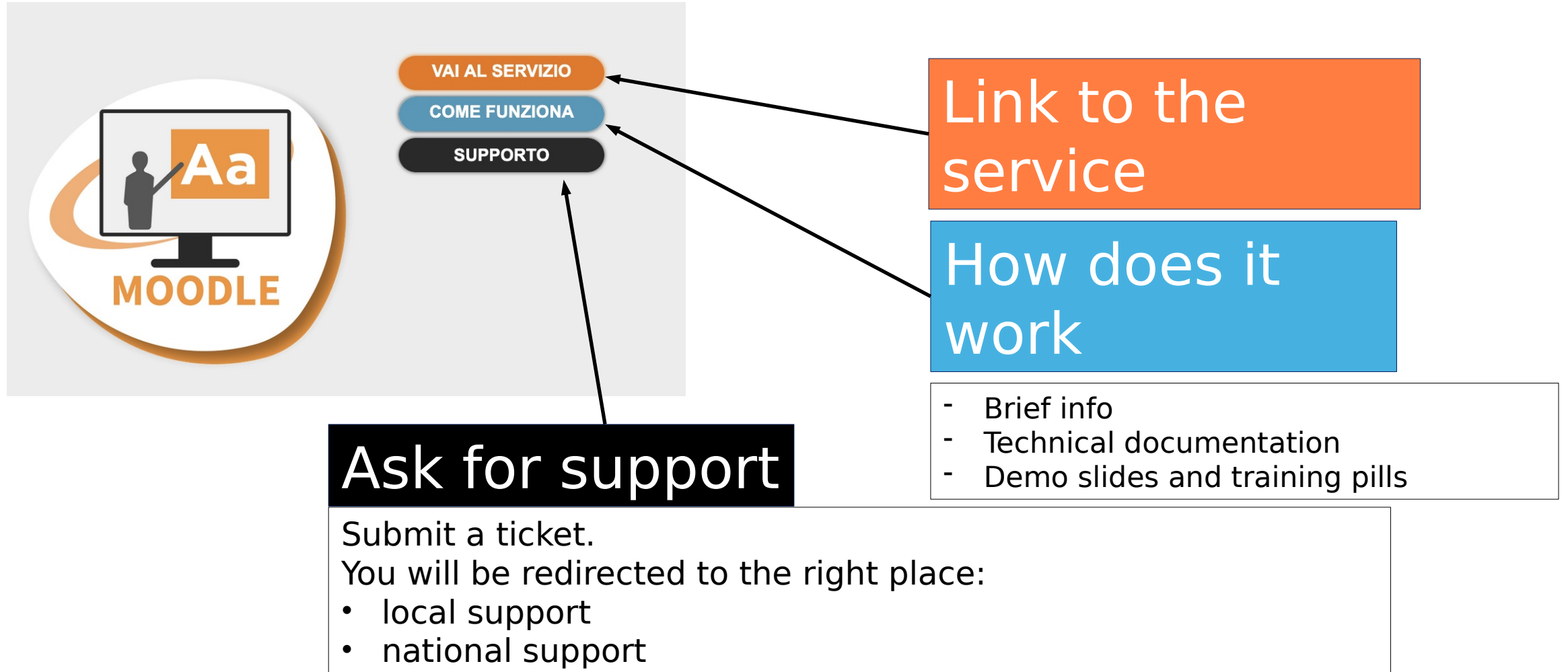
Personal and server SSL certificate request



Moodle

INFN e-learning service
asynchronous online
training

Get info, use the service, ask for support



Local ICT services

Division Computing Service

Network connectivity

- wired and wireless access
- eduroam is available in all INFN sites

Interactive access

- unix and farm login server
- unix/windows remote desktop

Remote VPN access

- local mailbox, mail alias, mailing list

Mail services

- Unix, Windows, local cloud sync and share

Storage services

Web services

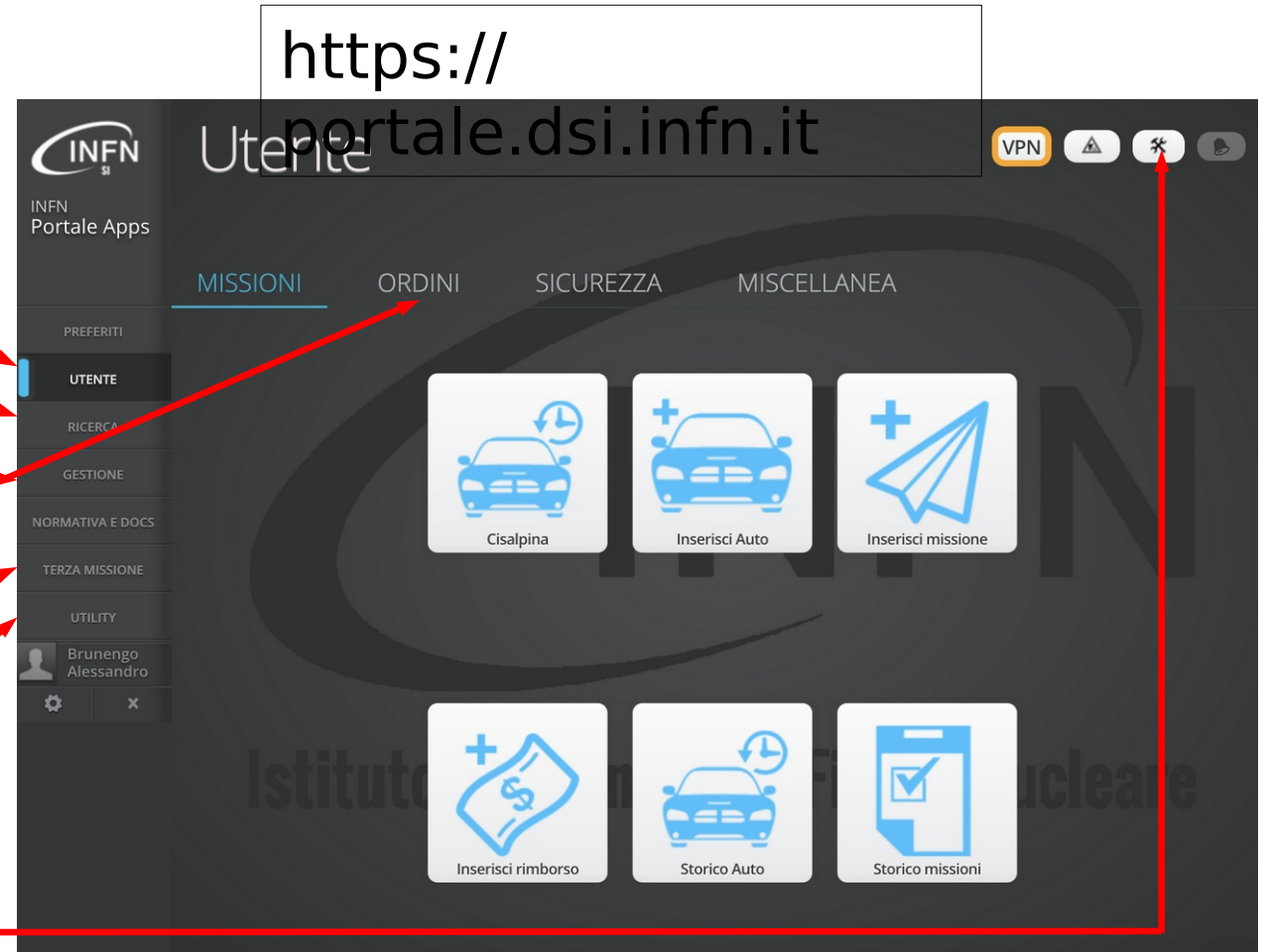
- CMS web sites, webmail, wiki, ...

Other local services

- backup, print service, ...

Administrative IT services

- Administrative services
- Tools for research support (collaboration, timesheet)
- Found management services and authorization workflows
- Purchase and tender procedures workflow
- Utilities for third mission (technology transfer, outreach)
- Tools: BI, legal digital signing, ...
- Get support



Software platforms available at INFN (I/II)



Adobe Acrobat
Pro



Adobe Creative
Cloud



Atlassian
Confluence



Atlassian Jira
Software



Atlassian
JSM



Microsoft 365
products



Microsoft 365
Copilot



Outlook



OneDrive



Word



Excel



PowerPoint



OneNote



SharePoint



Teams



Sway



Forms



Project



Visio



Planner



More apps



Zoom Pro
Large 500/1000
Webinar
500/1000



Overleaf

Software platforms available at INFN (II/II)

Simulation



CDF, EM, HFSS, Lumerical, Granta, Zemax fluid, em, multiphysics, optical



COMSOL multiphysics numerical sim



Radiation sim



Dassault Opera (em 2d/3d)
Dassault CST (em fields 3d)

Computation and data analysis



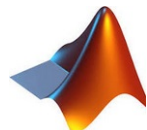
National Instruments



PTC Mathcad



Wolfram Mathematica



MathWorks Matlab

Electronic and Mechanical Design

Altium

SYNOPSYS

cadence

Mentor

A Siemens Business

FPGA design: **AMD** **XILINX**



Autodesk PDM coll., AEC coll., Autocad, Inventor, Fusion



PTC Creo



Dassault SolidWorks



Dassault Catia

Software licensing

- All commercial platforms **require a valid license**
- Different licensing model:
 - individual, shared, campus (with or without limits)
 - perpetual (pay for maintenance), subscription (usually yearly)
- Different license coverage:
 - educational, research, commercial
 - educational eligibility is not always available for INFN
 - it can depend on the usage (i.e. research vs industry collaborations)
- **Usage of unlicensed software is strictly forbidden on INFN devices or on personal devices connected to the INFN network**
 - please always check EULAs carefully
 - info in <https://web.infn.it/CCR>

Thanks !