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ENERGY SCIENCES NETWORK

Enabling *Intent* to Configure Scientific Networks for High Performance Demands

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Talk Agenda

- Current challenges in network provisioning and scheduling file transfers
- Solution: development of the INDIRA tool
- Use of semantic ontology
- Network provisioning and rendering of commands
- Current state – interaction with NSI and Globus tools
- Evaluation and Future work

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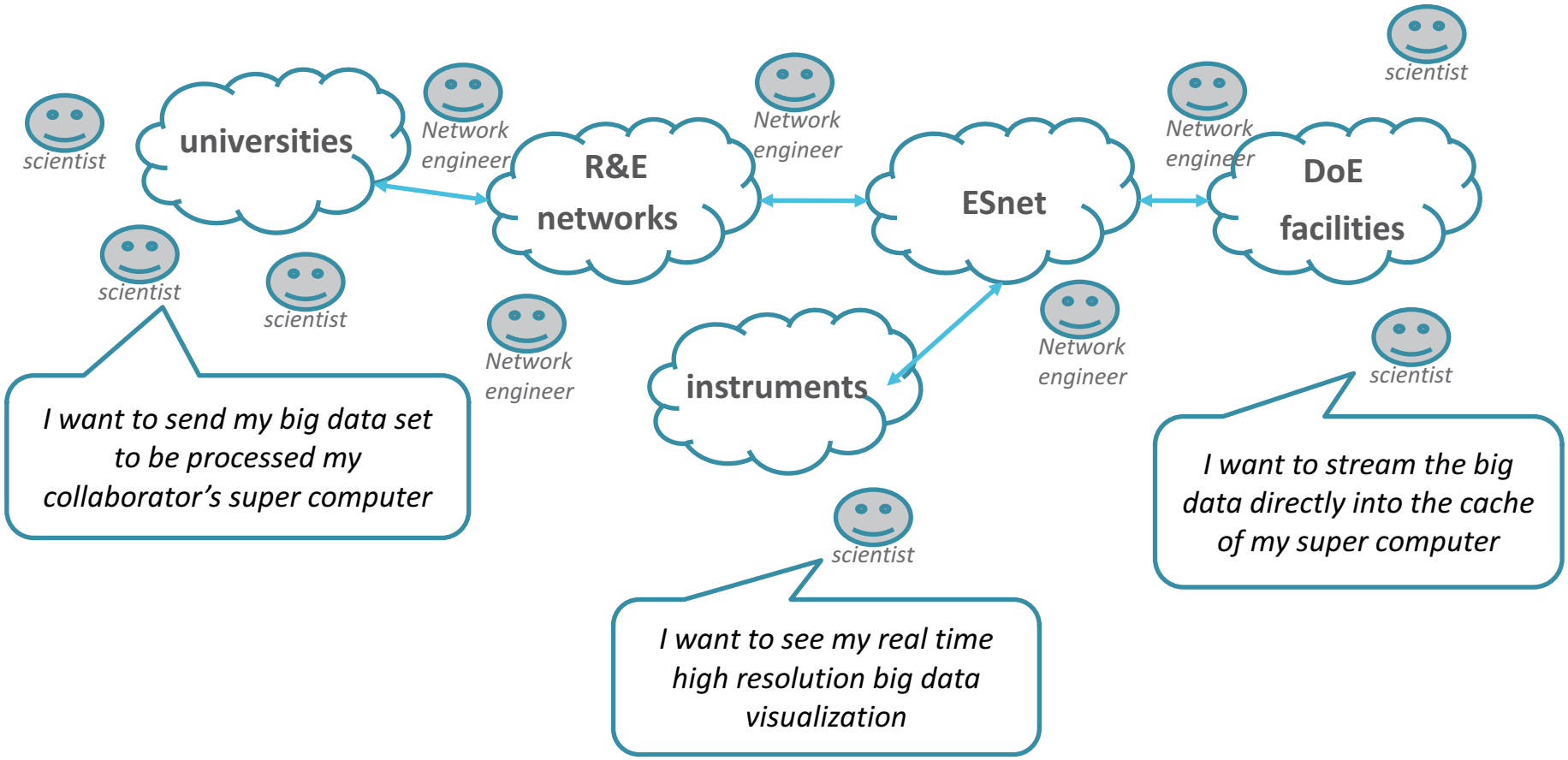
Current Problem: Communication gap



- Applications have complex workloads
- Network behavior tailored for my application '***intent***'
- Difficult to fulfill these diverse set of needs
  - Learning curve is huge and complex
  - Difficult to specify needs in 'english'
  - Specify in high-level language, portable, multi-domain

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Current infrastructure.

- Science workflows (NSI)
  - Some level of automation
  - Necessary for complex instruments and collaboration

Designed for a specific science

- Transfer tools (Globus)
  - Ease of use
  - Reliable

Designed for end users.

- R&E Networks support big data oriented services (ScienceDMZ)
  - Bandwidth on demand, loss free.
  - Isolation.
  - Network virtualization

Designed for network engineers and networking automation.

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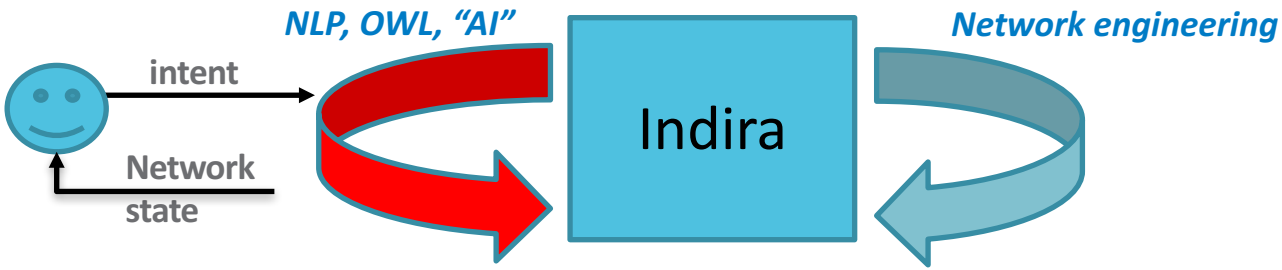
Introducing Indira... “Hello! Im Indira”

(Intelligent Network Deployment Intent Renderer Application)



- Understand in English (e.g. transfer, connect)
- Check conditions are correctly defined
- Ask for any further details, if anything missing from user, and record in memory
- Check conflicts and permissions

- Render input into network commands
- Render bandwidth, time schedule, topology
- Provision/optimize the network
- Transfer the data.
- Return success or failure to user

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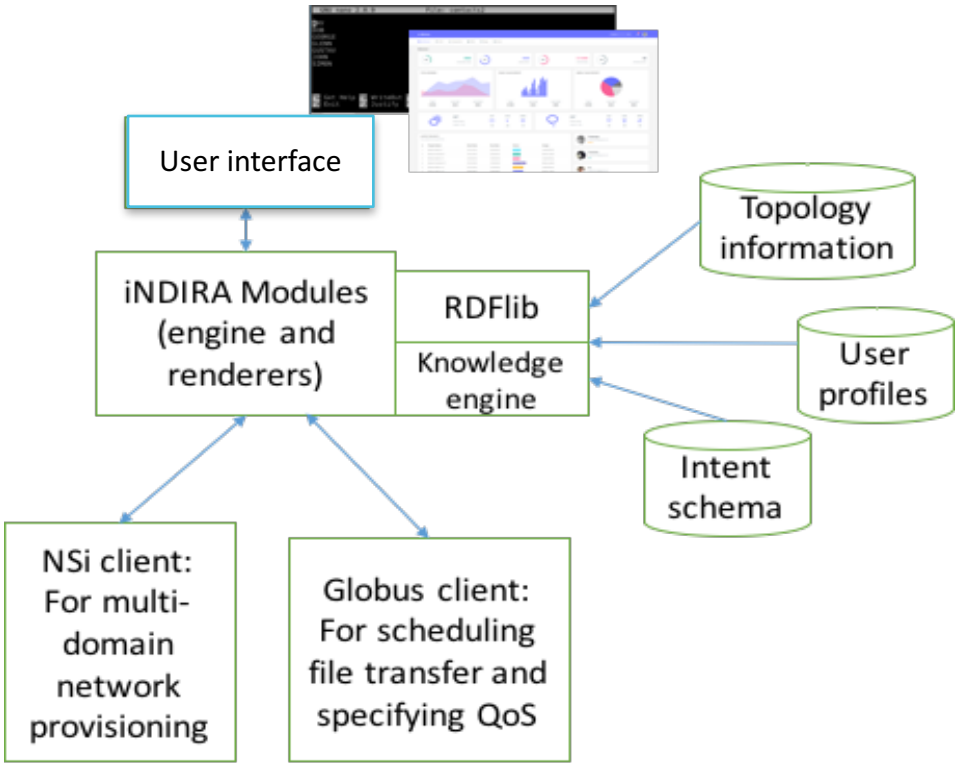
Indira's working: top level view

- Python frontend
- Knowledge base
  - Topology
  - Project profiles
  - Semantics
  - Network services and conditions
- Parser engine



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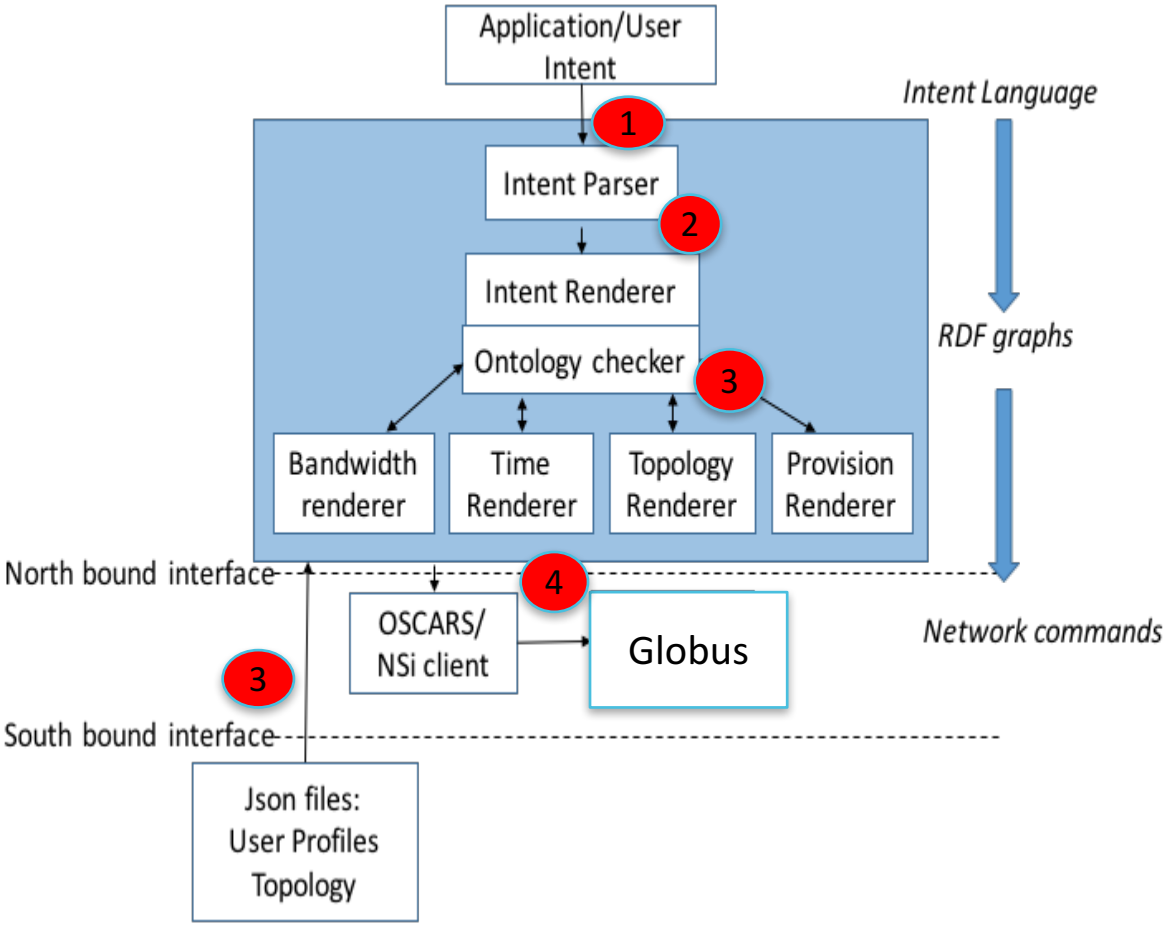
Indira's working: Inside view



1. Intent is given
2. Initial semantic and condition checks
3. Convert intent into network using profiles and topology information
4. Call network service (NSI)
4. Call File Management System (Globus)

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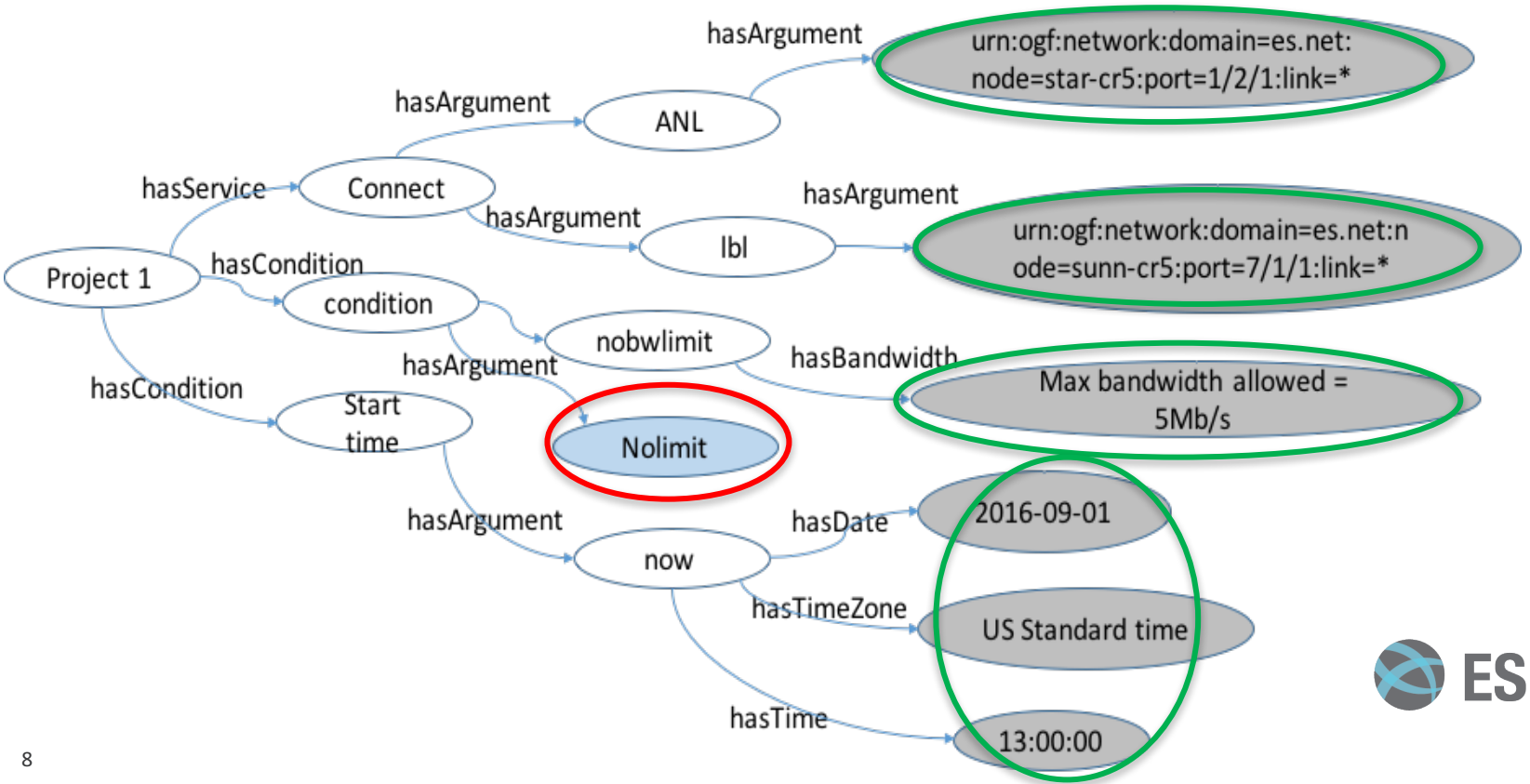
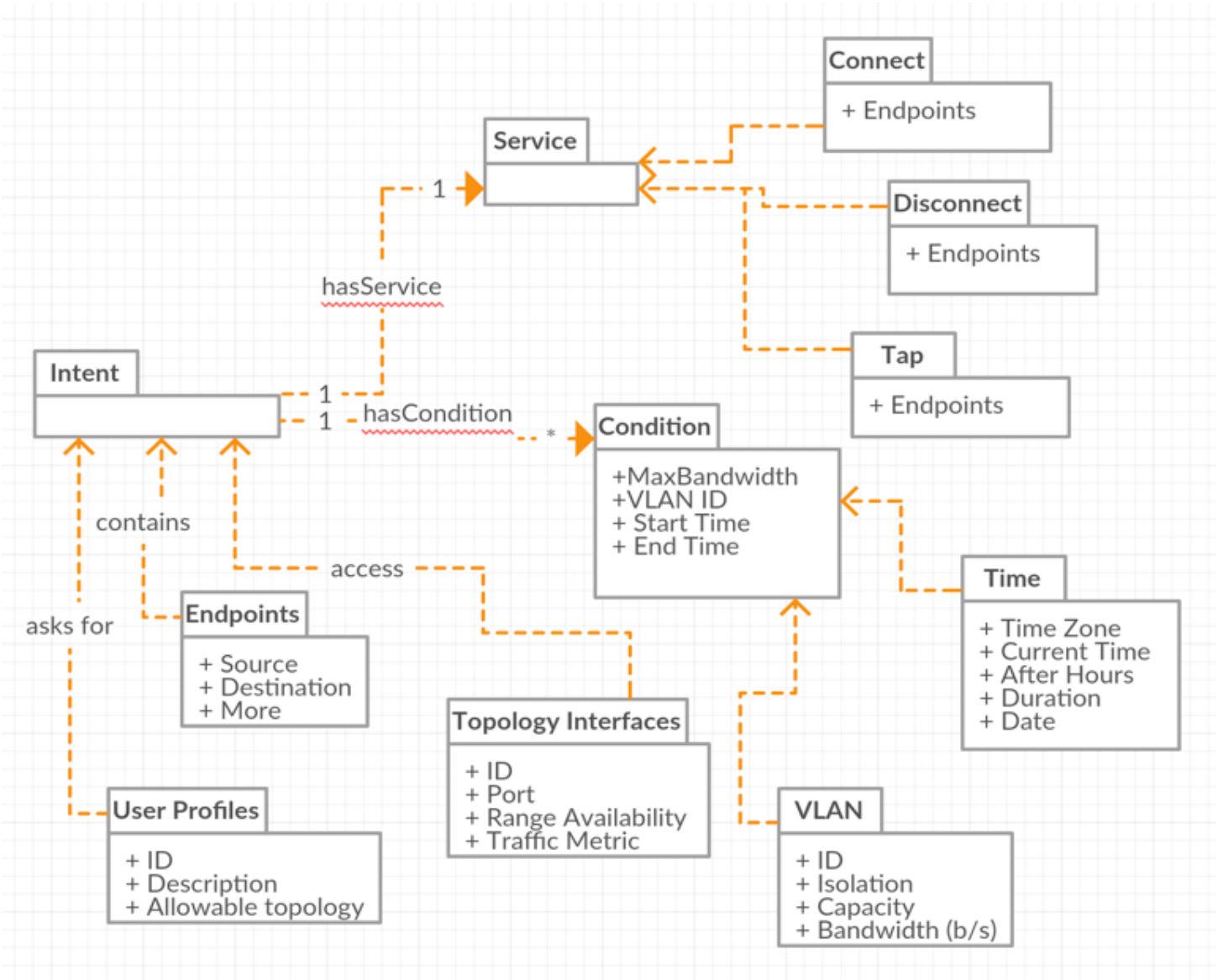
Indira's Description language

- Uses RDF and OWL
- Allows description of intent
- Intent:
  - "For Project1 connect anl lbl condition nobwlimit nolimit starttime now"



UML Description of Indira's language



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What about negotiating dialogues?

INDIRA> Hello and welcome! Tell me your project name?

Scientist> Bob

INDIRA> Is 'Bob' your project username? Y/N

Scientist> N

INDIRA> What is your project username

Scientist> Project1

INDIRA> Tell me what want the network to do? Hint "I want to [connect] [disconnect] services

Scientist> I want to transfer files from LBL to ANL

INDIRA> Do you have any time constraints with the transfer from LBL to ANL?

Scientist> Yes start now stop 1800

INDIRA> Ok. Give me the link to the file to be moved.

Scientist> project_test@LBL/datasource1 to project2@ANL/dataset

INDIRA> Do you have any bandwidth requirements?

Scientist> Yes Maximum

INDIRA> Sorry, you have only 5Mb/s allowable to use. Do you want to use all of this?

Scientist> No

INDIRA> Thankyou. I am configuring your transfer to start 'now' at 5GB/s…

INDIRA> Thankyou. Please contact the network administrator to allow you more bandwidth, as you don't have permission to go above 5Mbps

……..

Congratulations....All Done!

INDIRA> Ok. Give me the link to the file to be moved.

Scientist> project_test@LBL/datasource1 to project2@ANL/dataset

INDIRA> Do you have any bandwidth requirements?

Scientist> No

INDIRA> Thankyou. I am configuring your transfer to start 'now' at 5GB/s…

No changes to other tools

- No changes introduced to production tools NSI or Globus
  - Indira is able to 'converse' with users and translate their needs to NSI/Globus
- Uses natural language processing and semantics (RDF, OWL)
  - Can find available links and provision these
  - Schedule transfers in the future
  - Introduce bandwidth control and topology awareness
- Demonstration at SC
  - Provisioning network links using NSI
  - Schedule file transfers in the future with Globus with dedicated QoS

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Evaluation

- Comparing to current efforts Boulder, NEMO, ONOS intent, NIC and more:
  - High-level language to input intent similar to English commands
  - Based on ontology engineering to identify services and arguments using RDF specifications. Can be extended further with other network semantic tools.
  - Use graph theory to identify conflicts, check rules and policies.
  - Communicates network status back to users.
  - Can be integrated with other tools to allow higher level of QoS translation.

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Conclusions and Future work

- Vision forward: *How can we optimize network behavior for their individual needs?*
- Adding intelligence level to predict user needs in advance
- Add fault tolerance to understand and re-provision for future if current needs might fail
- Multi-client capability to cater to multiple scientists at one time through web-server interaction
- Advanced intent dashboard: monitor your intents
- Improve query processing time through backend databases

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- Thankyou

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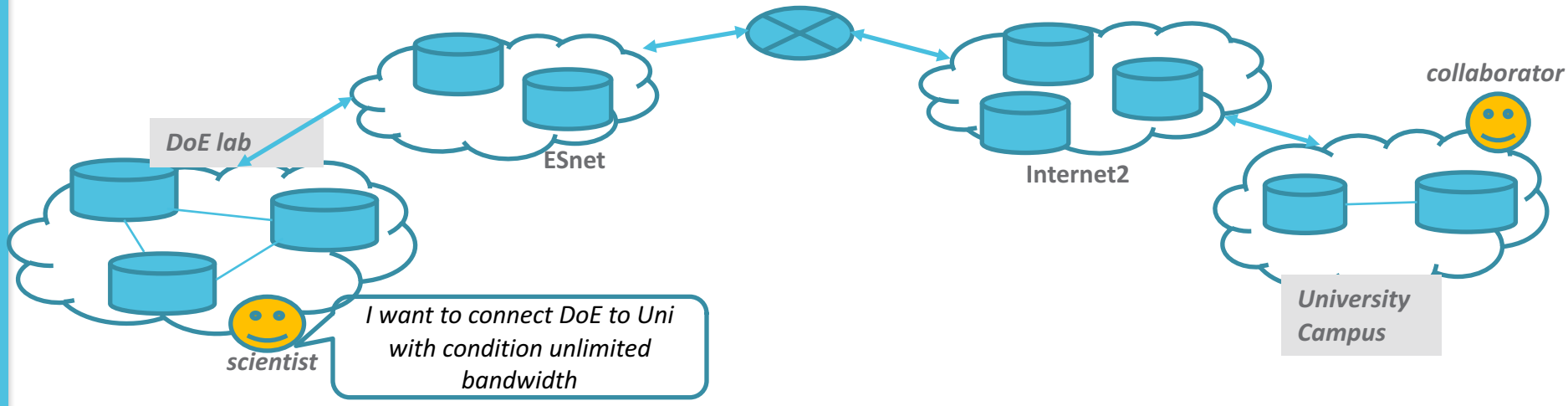
Current Problems: Setting the Stage



- Imagine this scenario:
  - Dedicated links with specific QoS and are scheduled
  - Various actors involved: Scientists->network engineers->IT->Scientists
  - Manual provisioning
  - Gathering requirements – understanding and communication
- Applications have complex workloads
  - Moving large files to certain endpoints
  - Make sure they have arrived in time
  - Network behavior tailored for my application '***intent***'

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