

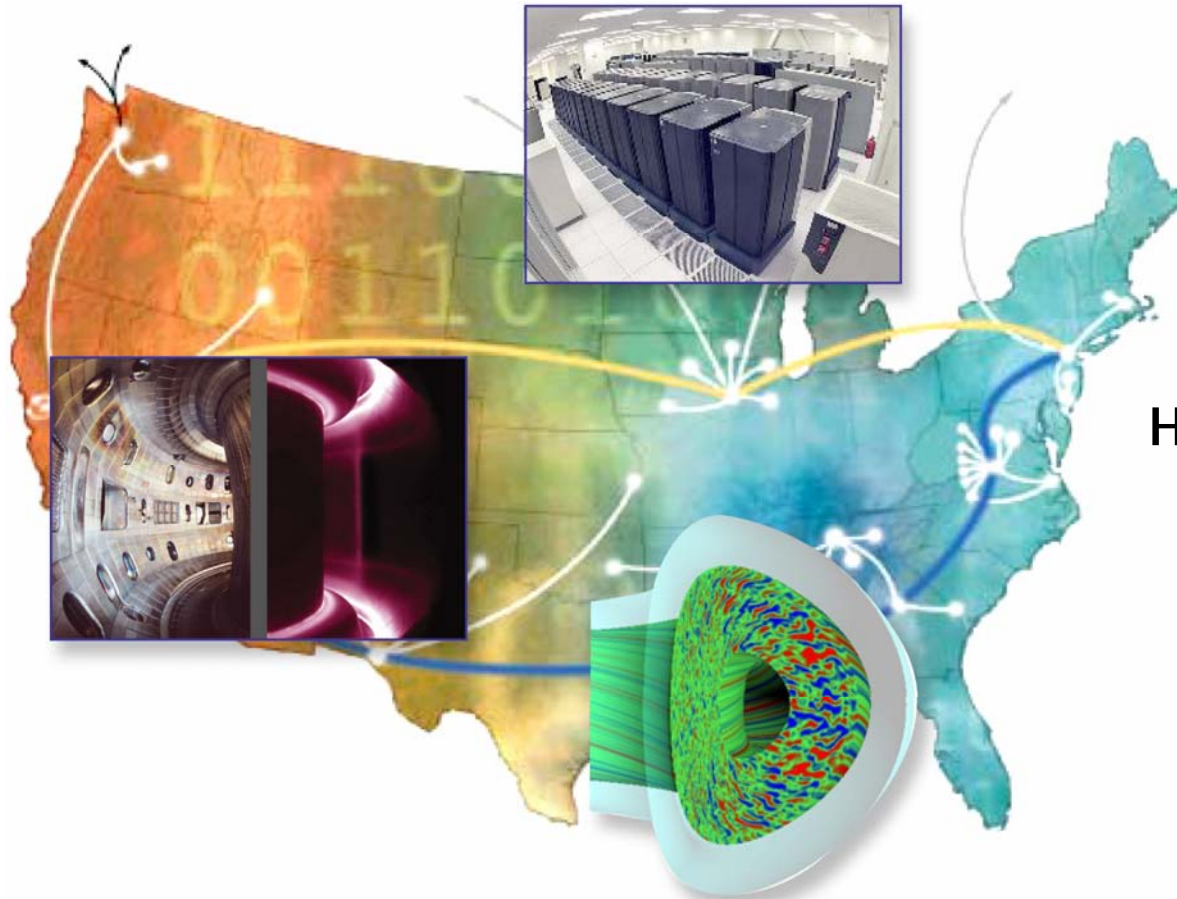
Network Quality of Service For Experimental Magnetic Fusion Energy Research

by
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Research PI Meeting

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Presentation's Key Points

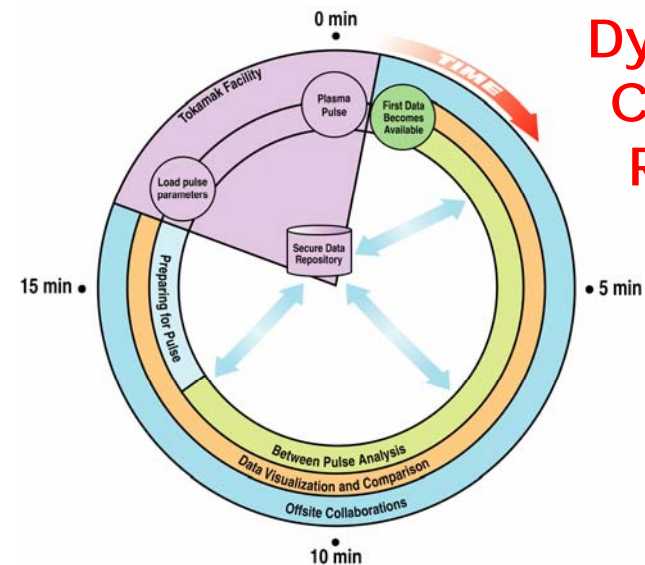
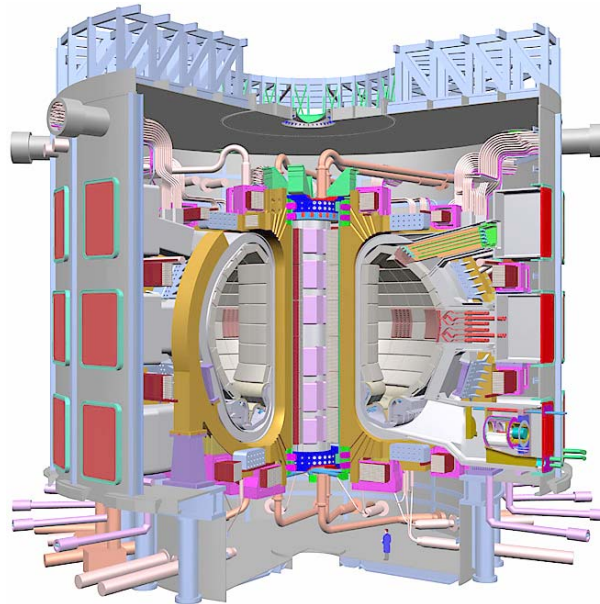
- **Our ultimate goal is to advance fusion energy research**
 - Leverage existing DIII-D (OFES) and SciDAC (OASCR) projects
- **Robust, reliable, network QoS is aimed to help experimental operations**
 - Allow a scale of calculation previously not possible
- **WAN QoS demonstrated from DIII-D (San Diego) to NERSC**
 - Data moved via MDSplus, experimental fusion's de facto data system
- **On target to deploy fusion code with WAN/LAN QoS for DIII-D operations**
 - April 2006 time frame for DIII-D to resume operations
- **Network QoS via MDSplus is an extremely general solution for fusion**
 - MDSplus used at over 30 sites worldwide
 - MDSplus extension being considered for next generation device (ITER)



Experimental Fusion Science is a worldwide Very Demanding Pseudo-Real-Time Activity



ITER in
France,
Worldwide
Team



Dynamic
Control
Room

Long Term Science Goal: Advanced Reservation Computation for Data Analysis to Support Experiments

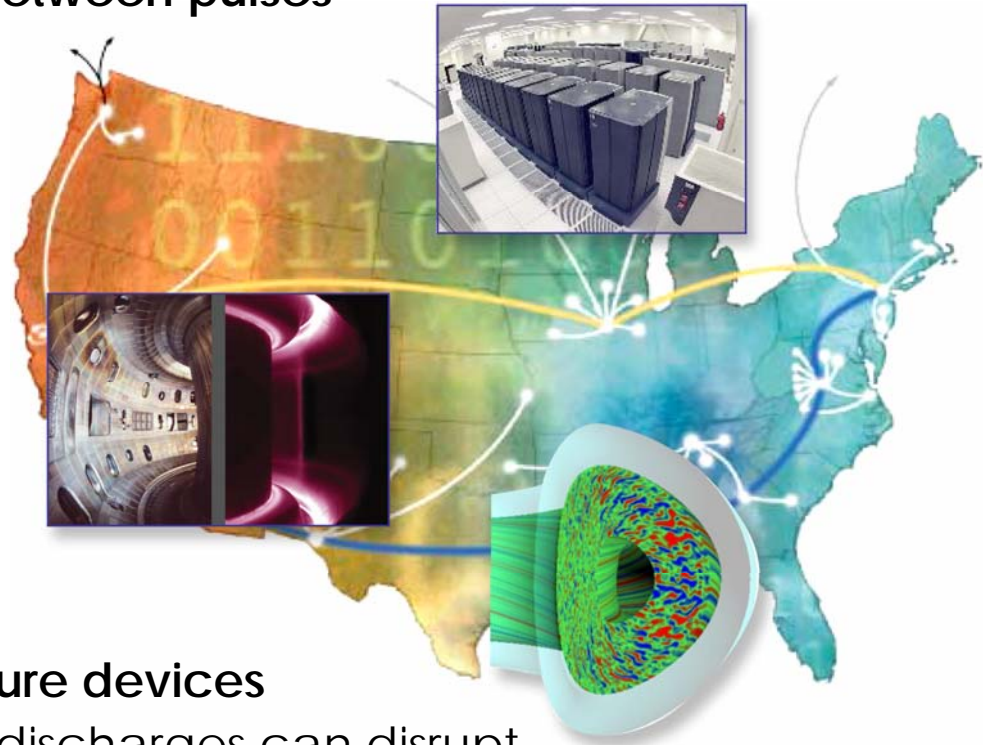
- **SciDAC Supercomputing code between pulses**

- Data management
- Network QoS
- Visualization
- CPU Scheduling
- Faster CPUs & algorithms

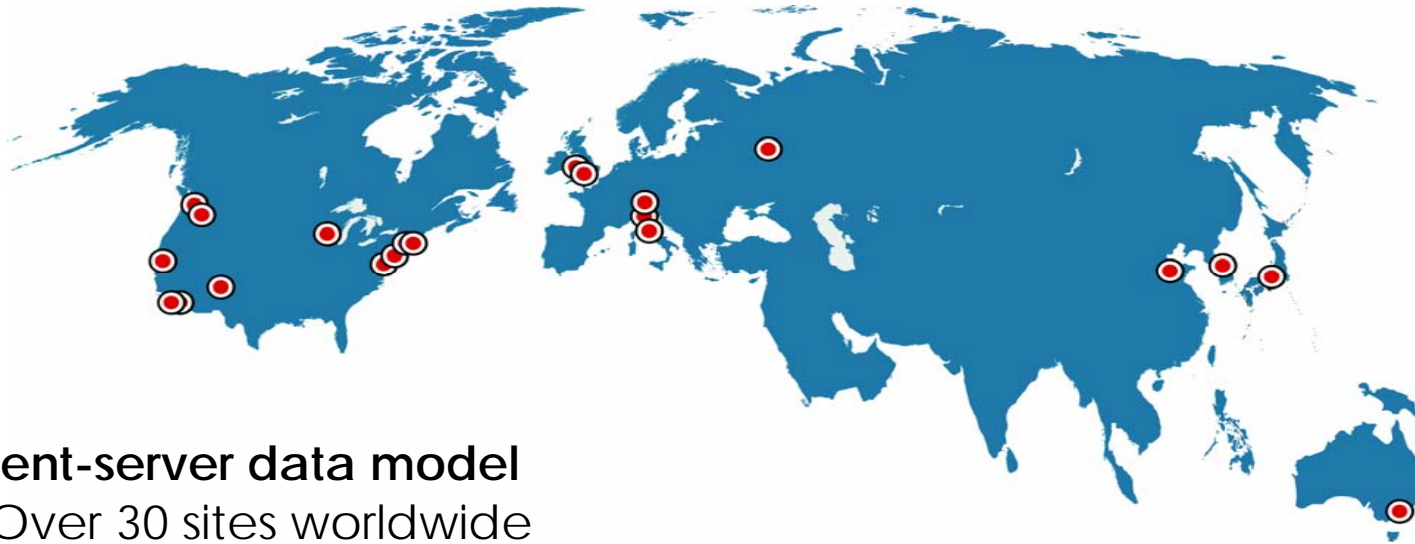
- **Enhance the science**

- **Can have a safety impact for future devices**

- e.g. ITER: <10% of high power discharges can disrupt

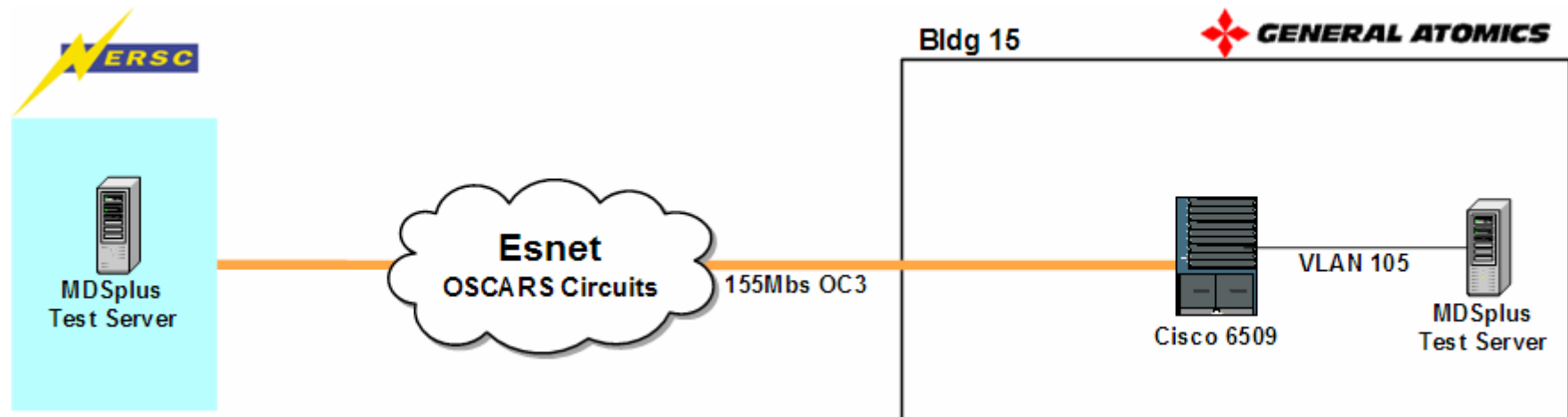


Network QoS Imbedded in MDSplus Data Systems is a Very General Solution for Worldwide fusion Research



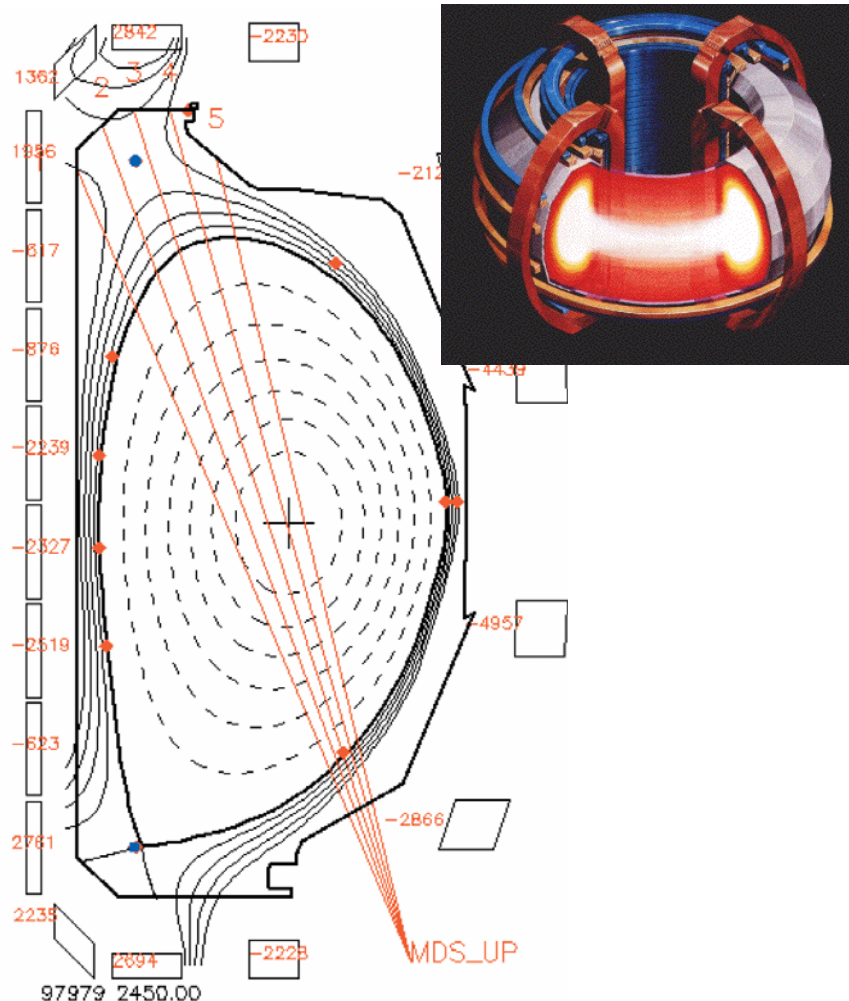
- **Client-server data model**
 - Over 30 sites worldwide
- **Full security via FusionGrid deployment**
 - Authentication (X.509), authorization (ROAM)
- **QoS in MDSplus makes vast majority of codes/data QoS enabled**
 - Eliminate the piecemeal work of doing code to code

Successful QoS Test From NERSC to GA



- MPLS tunnel for layer 3 transport
 - Utilizing MDSplus

EFIT Code Will Calculate Plasma Shape at NERSC Utilizing MDSplus/QoS to Support Operations



- **Simplify the problem**
 - EFIT well understood
 - Not QoS in DIII-D LAN
- **Utilize OSCARs reservation system**
 - Point-to-point MPLS tunnel
- **Simplified Security**
 - IP-display based in control room
- **MDSplus for data transfer**

Not All MDSplus Traffic In/Out of DIII-D Will be for QoS



- 90 institutions participate
- 425 active users
- 317 scientific authors
- Students and faculty from
 - 65 universities
 - 28 states

Active Collaborations 2004

US Labs

ANL (Argonne, IL)
LANL (Los Alamos, NM)
LBNL (Berkeley, CA)
LLNL (Livermore, CA)
ORNL (Oak Ridge, TN)
PPPL (Princeton, NJ)
SNL (Sandia, NM)

Industries

Calabasas Creek (CA)
CompX (Del Mar, CA)
CPI (Palo Alto, CA)
Digital Finetec (Ventura, CA)
DRS (Dallas, TX)
DTI (Bedford, MA)
FAR Tech (San Diego, CA)
IOS (Torrance, CA)
Lodestar (Boulder, CO)
SAIC (La Jolla, CA)
Spinner (Germany)
Tech-X (Boulder, CO)
Thermacore (Lancaster, PA)
Tomlab (Willow Creek, CA)
TSI Research (Solana Beach, CA)

US Universities

Auburn (Auburn, Alabama)
Colorado School of Mines (Golden, CO)
Columbia (New York, NY)
Georgia Tech (Atlanta, GA)
Hampton (Hampton, VA)
Lehigh (Bethlehem, PA)
Maryland (College Park, MD)
Mesa College (San Diego, CA)
MIT (Boston, MA)
Palomar (San Marcos, CA)
New York U. (New York, NY)
SDSU (San Diego, CA)
Texas (Austin, TX)
UCB (Berkeley, CA)
UCI (Irvine, CA)
UCLA (Los Angeles, CA)
UCSD (San Diego, CA)
U. New Mexico (Albuquerque, NM)
U. Rochester (NY)
U. Utah (Salt Lake City, UT)
Washington (Seattle, WA)
Wisconsin (Madison, WI)

Russia

Ioffe (St. Petersburg)
Keldysh (Udmurtia, Moscow)
Kurchatov (Moscow)
Moscow State (Moscow)
St. Petersburg State Poly (St. Petersburg)
Triniti (Troitsk)
Inst. of Applied Physics (Nizhny Novgorod)

European Community

Cadarache (St. Paul-lez, Durance, France)
Chalmers U. (Göteborg, Sweden)
CFN-IST (Lisbon, Portugal)
CIEMAT (Madrid, Spain)
Consorzio RFX (Padua, Italy)
Culham (Culham, Oxfordshire, England)
EFDA-NET (Garching, Germany)
Frascati (Frascati, Lazio, Italy)
FOM (Utrecht, The Netherlands)
Helsinki U. (Helsinki, Finland)
IFP-CNDR (Italy)
IPP (Garching, Garching, Germany)
ITER (Garching, Germany)
JET-EFDA (Oxfordshire, England)
KFA (Jülich, Germany)
Kharkov IPT, (Ukraine)
Lausanne (Lausanne, Switzerland)
IPP (Garching, Garching, Germany)
RFX (Padua, Italy)
U. Dusseldorf (Germany)
U. Naples (Italy)
U. Padova (Italy)
U. Strathclyde (Glasgow, Scotland)

Japan

JAERI (Naka, Ibaraki-ken, Japan)
JT-60U
JFT-2M
Tsukuba University (Tsukuba, Japan)
NIFS (Toki, Gifu-ken, Japan)
LHD

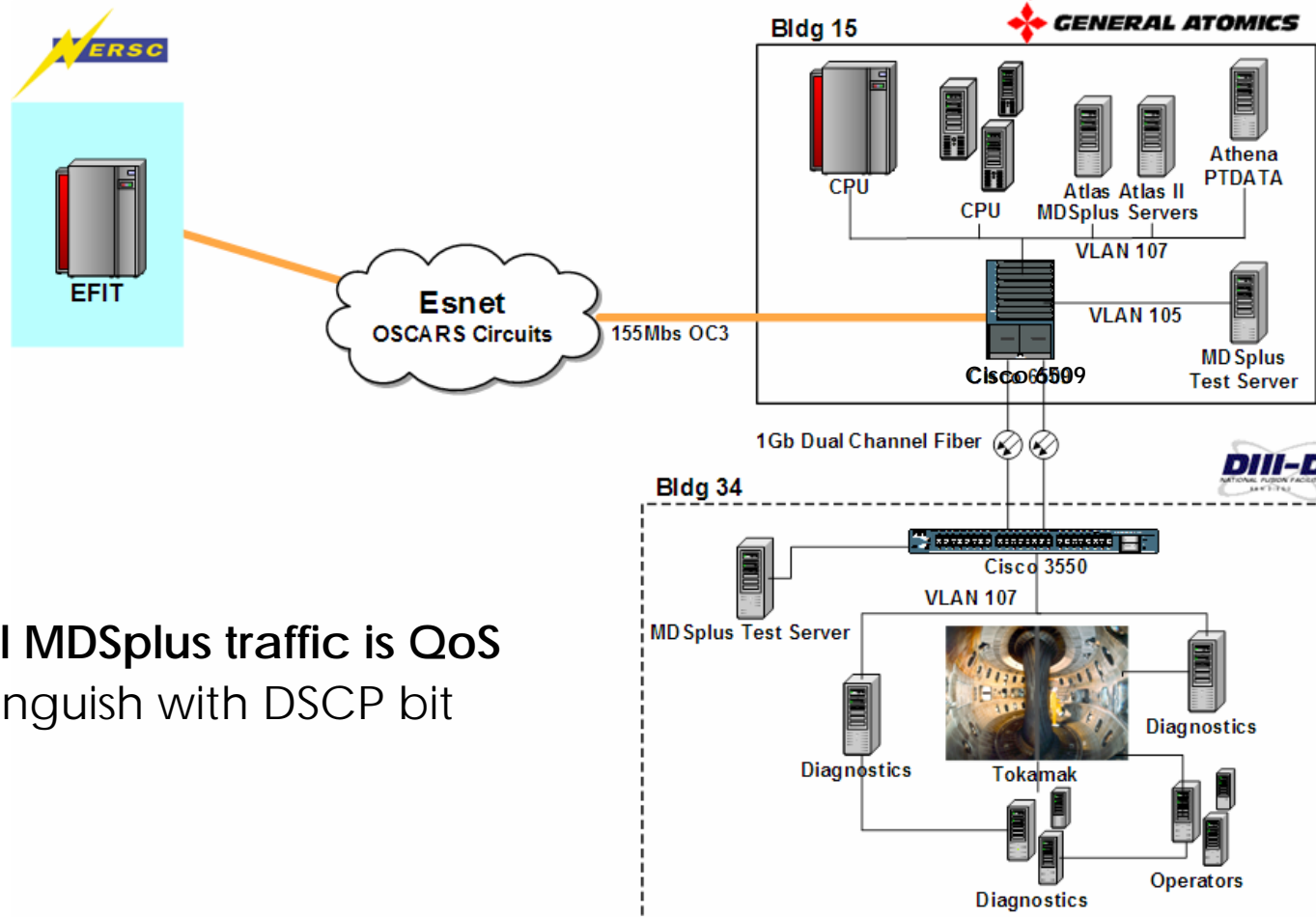
Other International

Australia National U. (Canberra, AU)
ASIPP (Hefei, China)
Dong Hau U. (Taiwan)
KBSI (Daejeon, S. Korea)
KAERI (Daejeon, S. Korea)
Nat. Nucl. Ctr. (Kurchatov City, Kazakhstan)
Pohang U. (S. Korea)
Seoul Nat. U. (S. Korea)
SWIP (Chengdu, China)
U. Alberta (Alberta, Canada)
U. of Kiel (Kiel, Germany)
U. Toronto (Toronto, Canada)

• Worldwide team
reads/writes MDSplus

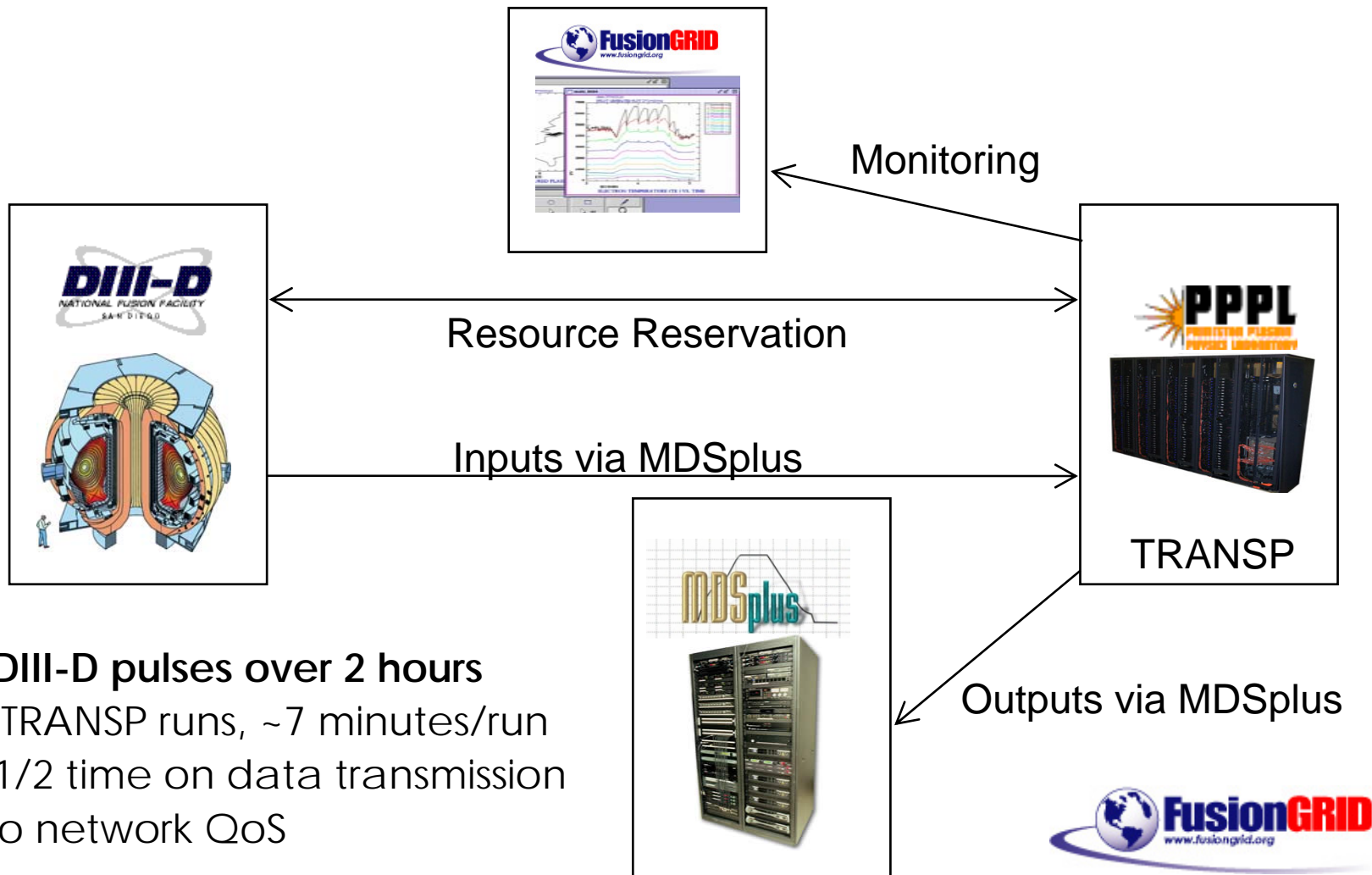
• Only certain MDSplus
bits special
— Determined by
the experimental team

EFIT Running at NERSC Will Test QoS Both on ESnet and on the Local GA Network

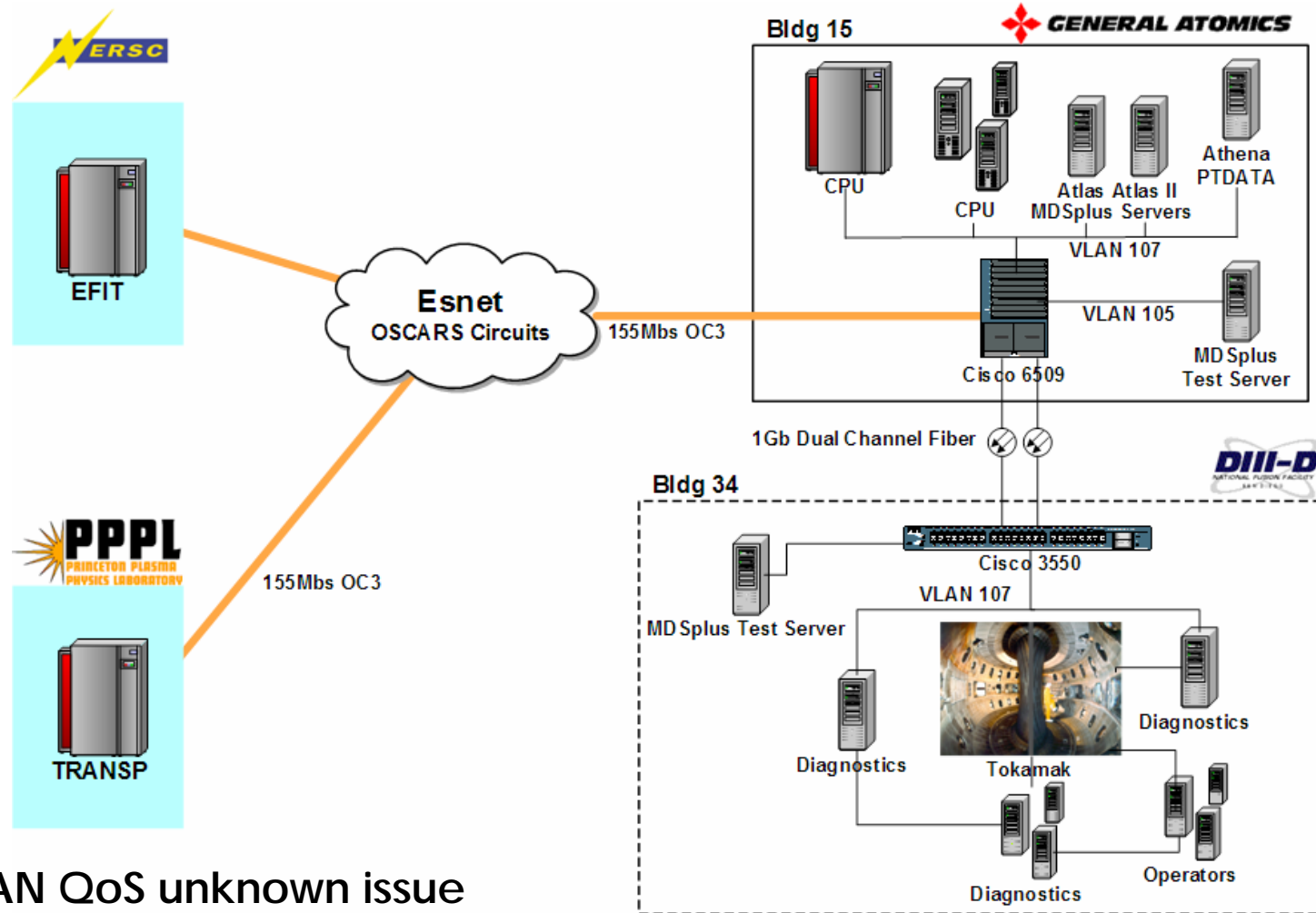


- Not all MDSplus traffic is QoS
 - Distinguish with DSCP bit

Between Pulse TRANSP Successfully Tested



TRANSP will be Tested with QoS After EFIT



- PPPL LAN QoS unknown issue

Systems Refinements Added After Initial Success

- **Fusion Scientist User Interface for Reservation**
 - Code & data wanted, not bandwidth and QoS
 - Behind the scene: select only WAN data traffic tagged for QoS
- **Security**
 - FusionGrid certificate and ROAM authentication based
 - Role based authorization may be required
- **Use Policy**
 - Facilities need to understand these issues



Concluding Comments

- **Good initial progress showing capability**
 - Operations in a few months time with EFIT and MDSplus big test
- **Success making MDSplus QoS aware will have a large impact**
 - Scales quickly to other codes and to the two other US tokamaks
- **With success will come enhancements**
 - Security and user (fusion scientist) interface
- **Adds to our portfolio of work to present to ITER**
 - QoS not being worked on in the world fusion community

