University of Texas at El Paso
Energy Dashboard

Project Manager / Systems Engineer:
Stefan Hempel
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RIMES

Research Institute for Manufacturing and Engineering Systems

Agenda

- Project Background
- Project Objectives
- Systems Engineering Design Process
- Dashboard Prototype
- Acknowledgments

About Green Fund

GREEN FUND

A Student Initiative at The University of Texas at El Paso

- Home
- About GF
- Why Vote YES?
- Get Involved!
- Contact Us

About Green Fund

What is the GF?
GF stands for Green Fund, which is a fee referendum that will cost $3 per student per semester, raising up to $40,000 per year for campus sustainability projects. These projects will minimize UTEP's negative impact on the environment* by:

-Investing in renewable energy such as solar panels
-Promoting environmental sustainability in campus and the community
-Providing educational opportunities such as student internships
-Increasing energy efficiency
-Conserving water and other resources

*GF will NOT pay for anything the university is already required to do by law or policy.

Who and how are projects chosen?
The Green Fund Grant Making Committee will oversee the funds. It will be conformed by four students, two administrators and one faculty appointed annually.

To choose the projects, students, faculty or staff can submit proposals asking for funding, and the GF Grant Making Committee reviews the proposals and selects them based on The Green Fund Bylaws. To read the GF Bylaws, click here.

How will I know where my money go?
The GF Grant Making Committee will report all GF projects to the Student Government Association annually and the projects will be made available online.

When can I vote for the GF?
Voting will take place on April 21 and 22. Stay tuned for the URL link!

First Green Fund Project

GREEN FUND

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Think Green.

facebook
Find me there.

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environmental advocates

Green Fund passes at UTEP!

This past Thursday April 22, students let their voice be heard. 69% of student voters supported the green fund, a student referendum asking for a $3 increase in student fees for student-led initiative green projects. Thanks to everyone that voted.

The results are as follows:

Accepted	2435
Rejected	1086

Thank you and stay tuned for new updates on how YOU can participate as a member of the Grant Making Committee, or propose a great green project on campus.

Source: The Prospector, UTEP

Comments

energydashboard *2011.7.11 08:53*
I need to find the person in charge for this website. I am working on the Green Fund sponsored UTEP Energy Dashboard.

jorge *2010.6.17 12:51*
the bylaws: https://docs.google.com/View?id=ddh6frqs_0crh5jmcv

jorge *2010.4.16 10:44*
the by-laws should be posted in the SGA voting site soon.

Add a comment

First Green Fund Project

THE UNIVERSITY OF TEXAS AT EL PASO

ENERGY DASHBOARD

[Log In]

Home | Project Description | Project Progress | Energy Consumption by Building | Contact Us | About Us | Benefits

Green Energy And Smarter Distribution For A Brighter Tomorrow

The UTEP Energy Dashboard System provides access for public users to the energy consumption of individual campus buildings. The System is able to convert and display the kilowatt-hour electrical utilization and the estimated gasoline consumption equivalent. This project is the first UTEP Green Fund initiative and is the introductory step in creating a smart energy grid for the campus.

RIMES

Research Institute for Manufacturing and Engineering Systems

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The University of Texas at El Paso | College of Engineering | RIMES
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GREEN FUND

Project Abstract

- Facility Services at UTEP has the need to design and develop an Energy Dashboard automated web services system that provides information on the energy efficiencies within buildings and facilities on campus.
- The Facilities Services department has the long term goal to provide energy efficiency on campus through an intelligent building program that provides centralized operations to monitor, control and manage energy use in UTEP via an Operations Center.
- The UTEP Energy Dashboard will able to display the energy consumption for all the UTEP buildings, any cluster of buildings, or an individual building.
- The UTEP Energy Dashboard System will be able to convert and display the kilowatt-hour electrical utilization and the estimated gasoline consumption equivalent.

This project is the first UTEP Green Fund initiative and is the introductory step in creating a smart energy grid for the campus.

Stakeholders

- The stakeholders involved:
  - **UTEP Green Fund**: Funded the project, initial requirements, supervise and manage project progress
  - **UTEP Facilities Services:** Technical Resource support, detailed requirements, etc.
  - **The Center for Environmental Resource Management** (CERM): guidance and fundamental expertise
  - **Research Institute for Manufacturing and Engineering Systems** (*RIMES*): leadership, mentoring and technical expertise for the engineering project team.
  - **Others:** ECE (communications expertise), ETC (IT expertise)

NOTE: For Campus wide deployment other stakeholders need to be included (e.g., CIO, Public Relations, etc.)

Project Objective

The objectives of this project are to:

- Develop a database of similar projects by researching the literature on the Web on energy dashboards and building energy efficiency systems.
- Develop the system requirements for the UTEP Energy Dashboard system starting with an “As-Is” condition and leading to a “To-Be” state.
- Design a database and Web Services for the UTEP Energy Dashboard.
- Deploy a prototype that will display the energy consumption of **one** campus building.

Gantt Chart

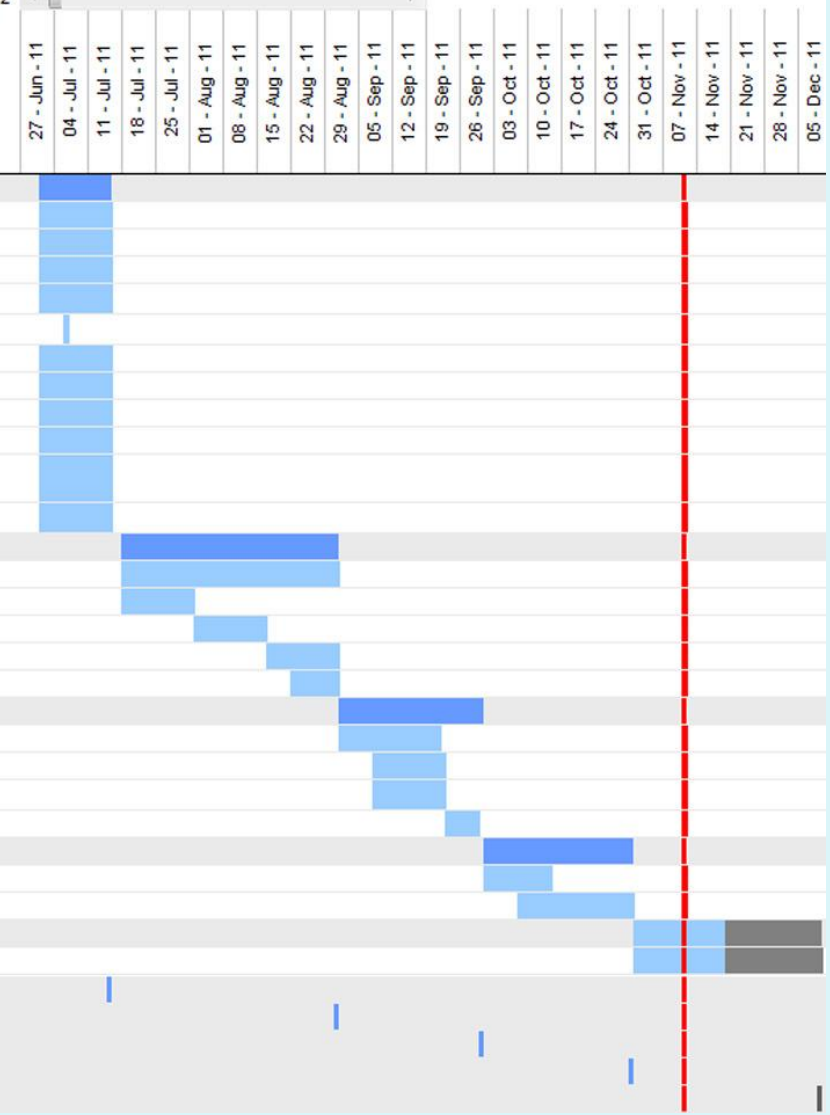
UTEP Energy Dashboard

Today's Date: 11/11/2011 Friday
(vertical red line)

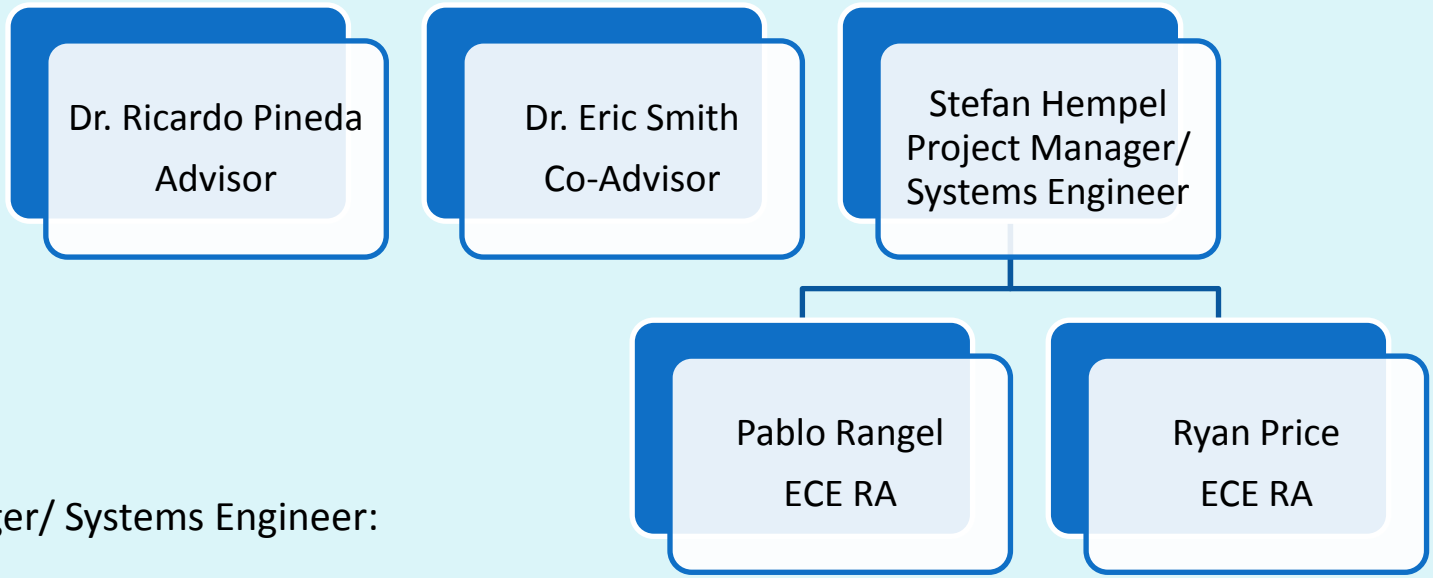
Project Lead: Stefan Hempel
Start Date: 7/1/2011 Friday

First Day of Week (Mon=2): 2

WBS	Tasks	Task Lead	Start	End	Duration (Days)	% Complete	Working Days	Days Complete	Days Remaining
1	**Phase 1: Development**	Stefan	7/01/11	7/15/11	15	100%	11	15	0
1.1	Research Systems	Stefan	7/01/11	7/15/11	15	100%	11	15	0
1.2	Research Hardware	Ryan	7/01/11	7/15/11	15	100%	11	15	0
1.2.1	Analyze SM Specs on EATON website	Ryan	7/01/11	7/15/11	15	100%	11	15	0
1.2.2	Find EATON SM delivery and setup date	Ryan	7/01/11	7/15/11	15	100%	11	15	0
1.2.3	Stakeholder requirements	All	7/06/11	7/06/11	1	100%	1	1	0
1.3	Research Software	Pablo	7/01/11	7/15/11	15	100%	11	15	0
1.3.1	Download EATON EMS Trial Software	Pablo	7/01/11	7/15/11	15	100%	11	15	0
1.4	Development of Database	Pablo	7/01/11	7/15/11	15	100%	11	15	0
1.4.1	Database Structure	Pablo	7/01/11	7/15/11	15	100%	11	15	0
1.4.2	Analyze Existing UTEP Facilities SM Data from A2D	Pablo	7/01/11	7/15/11	15	100%	11	15	0
1.5	Service description document (power point)	All	7/01/11	7/15/11	15	100%	11	15	0
2	**Phase 2: Qualification/Requirements**	Stefan	7/18/11	8/31/11	45	100%	33	45	0
2.1	Develop Requirements	Stefan	7/18/11	8/31/11	45	100%	33	45	0
2.1.1	Operational Requirements	Stefan	7/18/11	8/01/11	15	100%	11	15	0
2.1.2	Functional Requirements	Ryan	8/02/11	8/16/11	15	100%	11	15	0
2.1.3	Performance Requirements	Ryan/Pablo	8/17/11	8/31/11	15	100%	11	15	0
2.2	Rationalize Project	All	8/22/11	8/31/11	10	100%	8	10	0
3	**Phase 3: Acceptance**	Stefan	9/01/11	9/30/11	30	100%	22	30	0
3.1	Webservice Development	Pablo	9/01/11	9/21/11	21	100%	15	21	0
3.2	Design Database	Ryan	9/08/11	9/22/11	15	100%	11	15	0
3.2.1	Put Existing UTEP Facilities SM Data into Database	Ryan	9/08/11	9/22/11	15	100%	11	15	0
3.3	Preliminary Cost	Stefan	9/23/11	9/29/11	7	100%	5	7	0
4	**Phase 4: Prelaunch**	Stefan	10/01/11	10/31/11	31	100%	21	31	0
4.1	Build Pilot System	All	10/01/11	10/14/11	14	100%	10	14	0
4.2	Test Pilot System	All	10/08/11	10/31/11	24	100%	16	24	0
5	**Phase 5: Launch**	Stefan	11/01/11	12/09/11	39	50%	29	19	20
5.1	Promotion of Pilot System	All	11/01/11	12/09/11	39	50%	29	19	20
1	**Milestone 1**		7/15/11	7/15/11	1	100%	1	1	0
2	**Milestone 2**		8/31/11	8/31/11	1	100%	1	1	0
3	**Milestone 3**		9/30/11	9/30/11	1	100%	1	1	0
4	**Milestone 4**		10/31/11	10/31/11	1	100%	1	1	0
5	**Milestone 5**		12/09/11	12/09/11	1	50%	1	0	1



Team Members and Responsibilities



Project Manager/ Systems Engineer:

- Project lead
- Identifying customers and understanding customer needs
- Discovering requirements and defining system functions
- Model the system, clarifies requirements, reveals bottlenecks and fragmented activities, reduces cost and exposes duplication of efforts
- Integrate; bringing system elements together so they work as a whole, this requires extensive communication and coordination.
- Launch the system, making the system do what it was intended to do
- Assess performance, re-evaluation

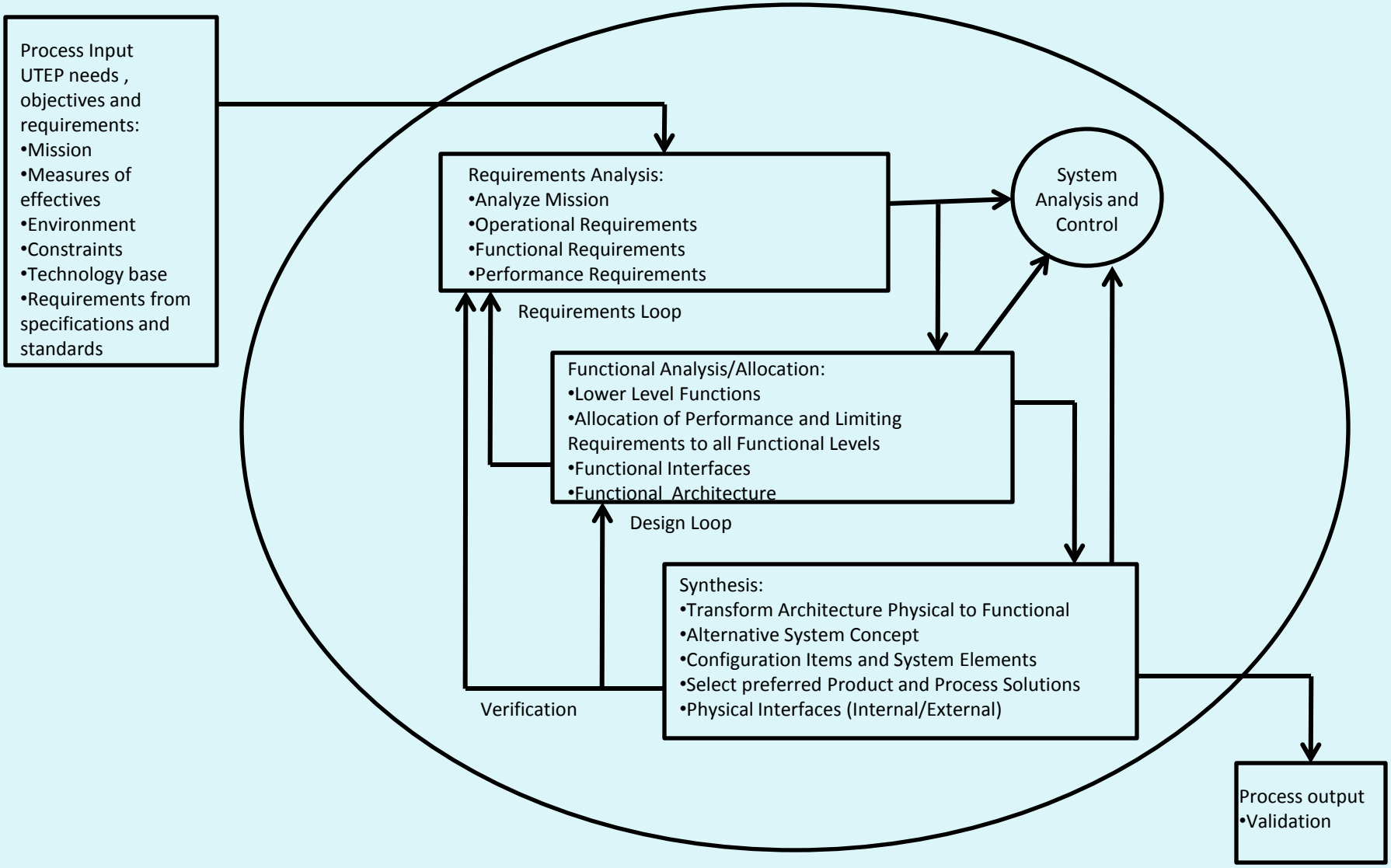
ECE RA:

- Help define requirements
- Develop code, develop model
- Test the model
- Build pilot
- Test pilot

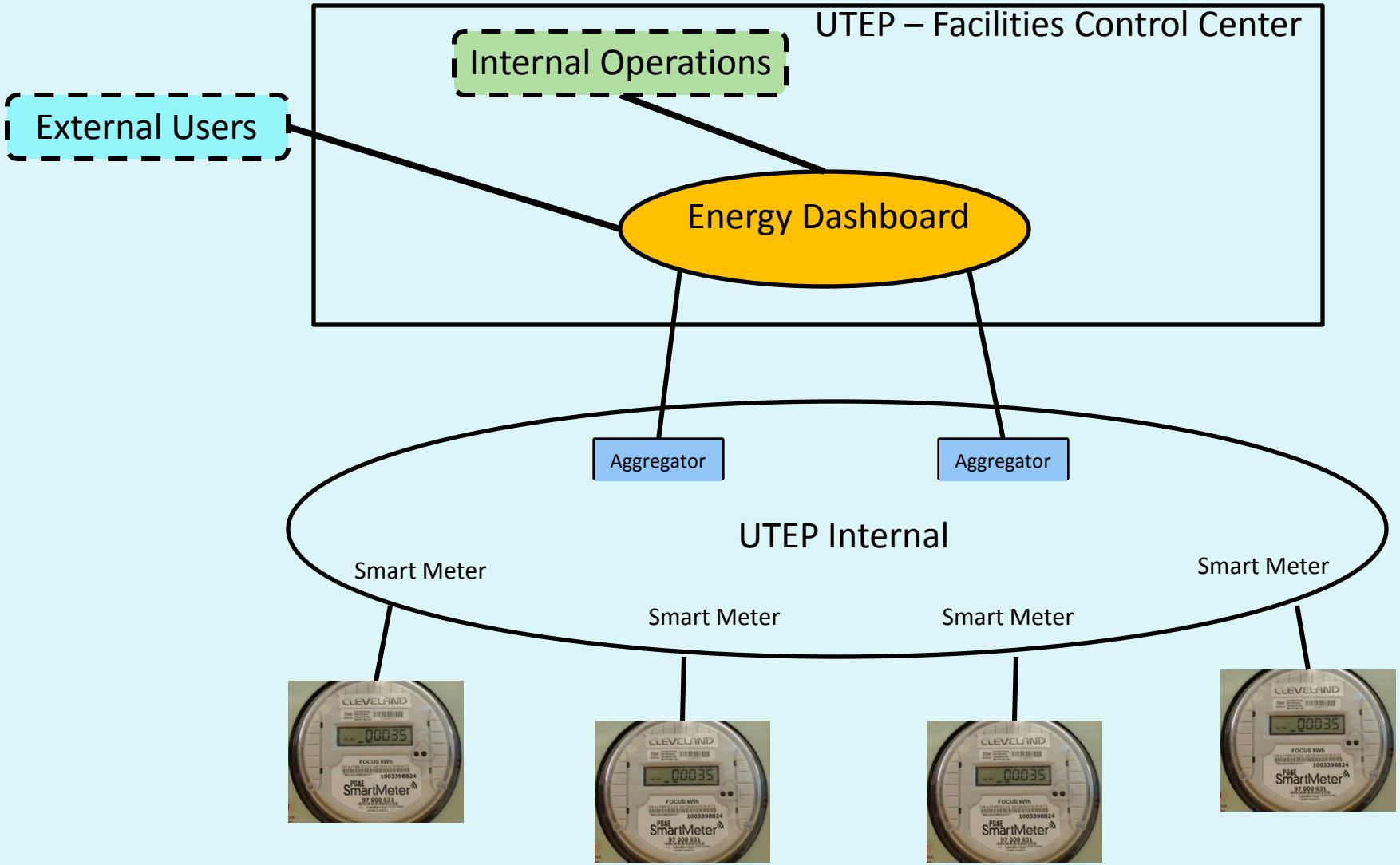
Advisor:

- Management
- Expertise
- Supervision
- Support by appropriate campus official

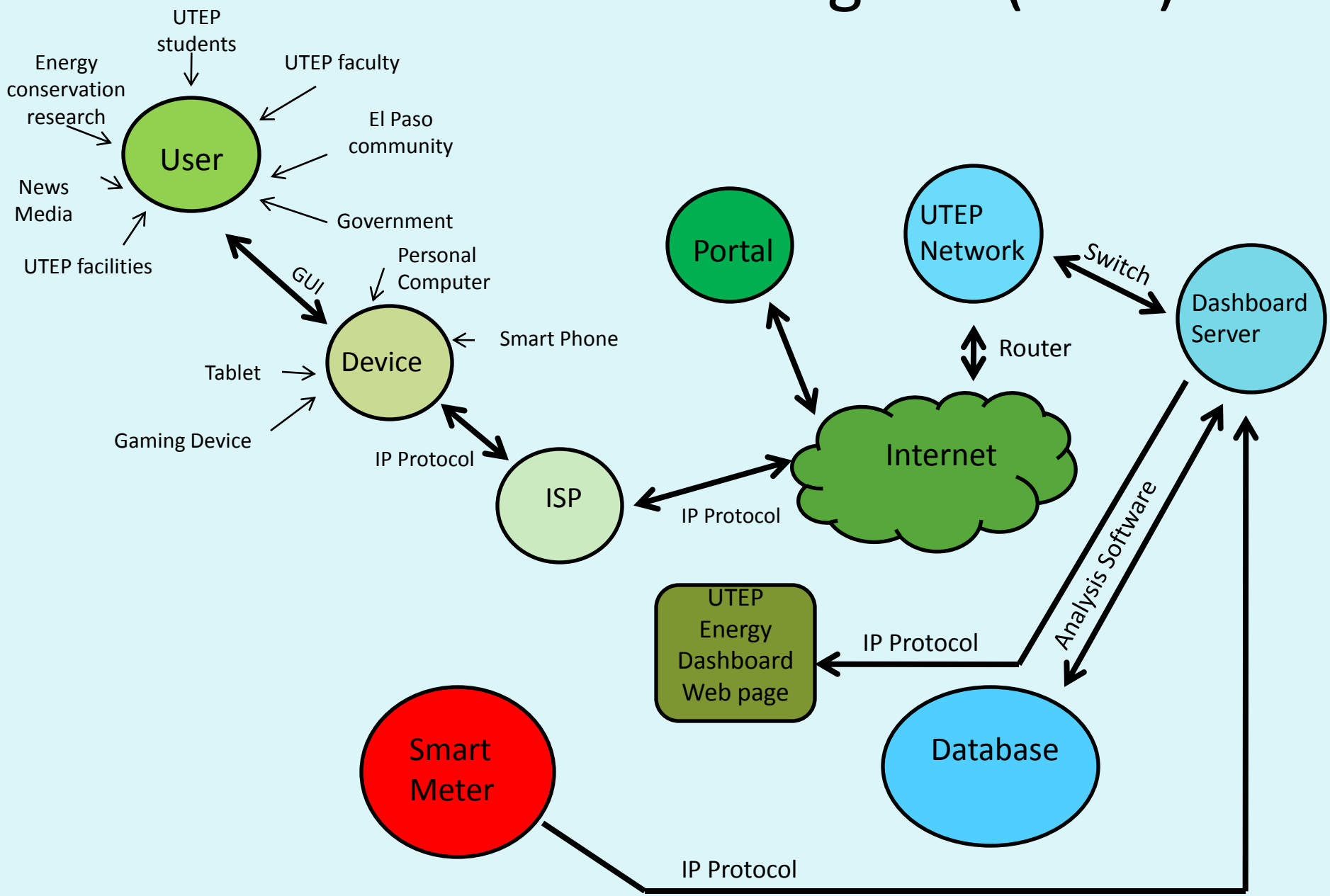
Systems Engineering Process



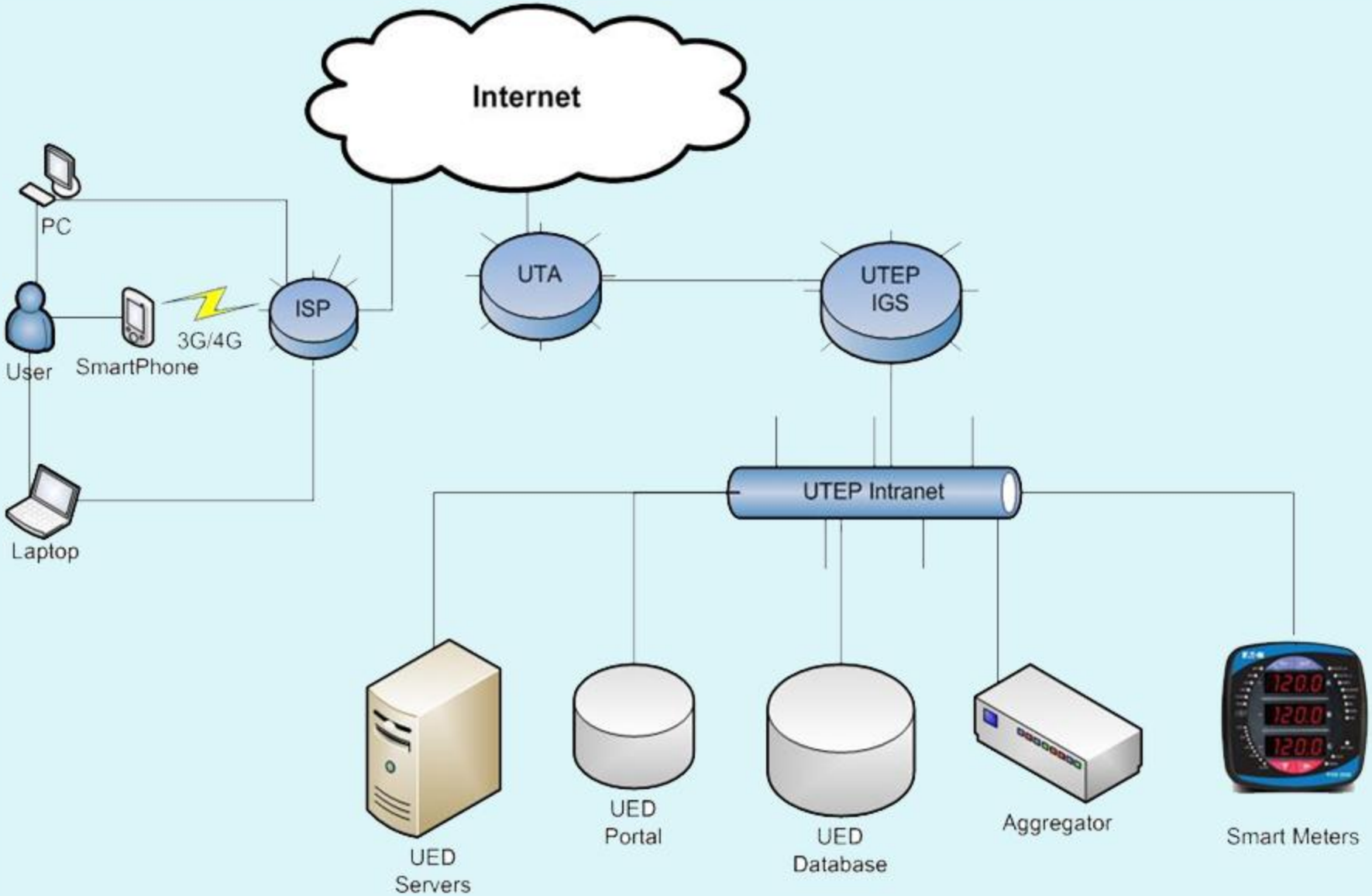
Concept of Operation



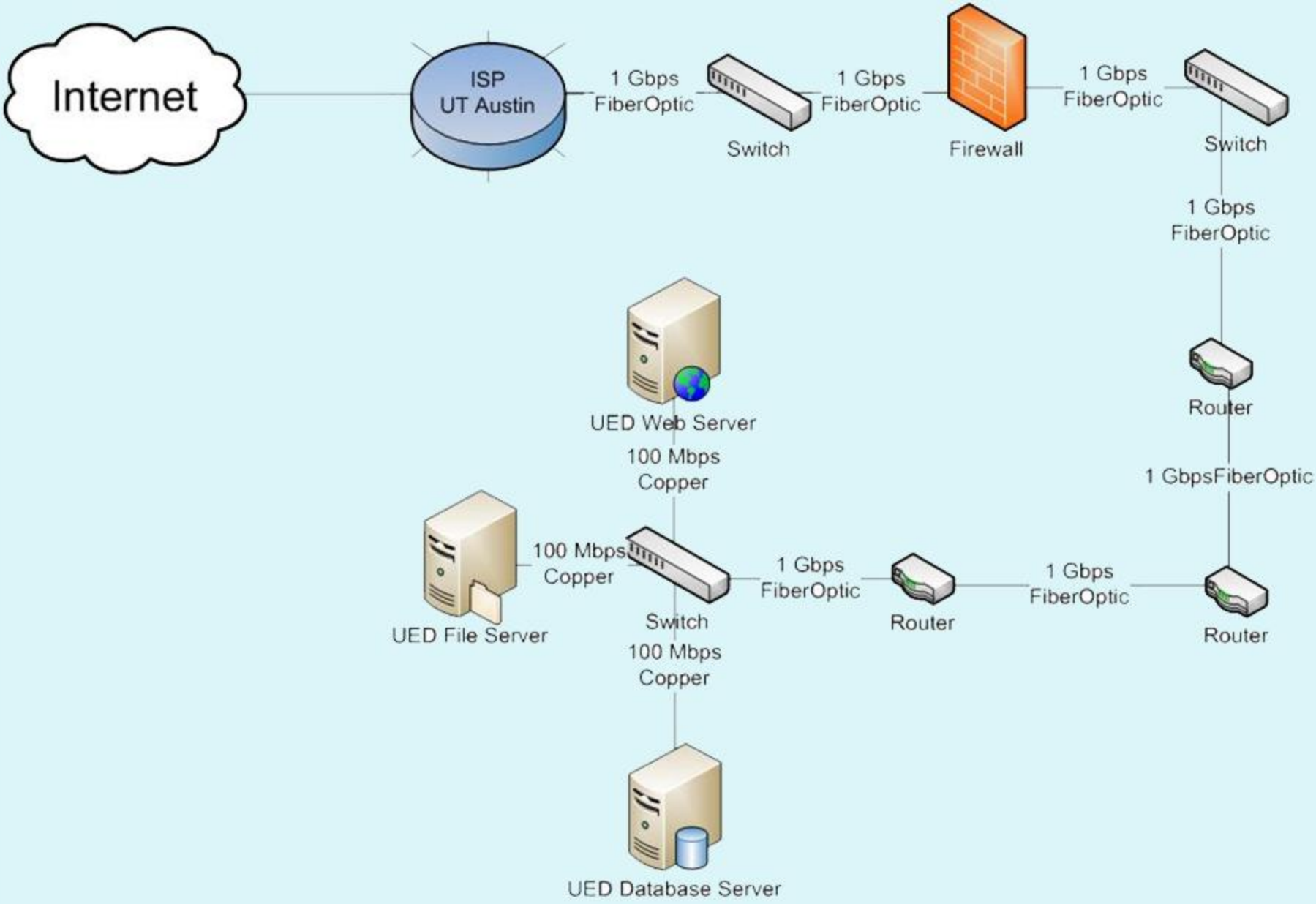
Architectural Block Diagram (ABD)



System Network Interaction

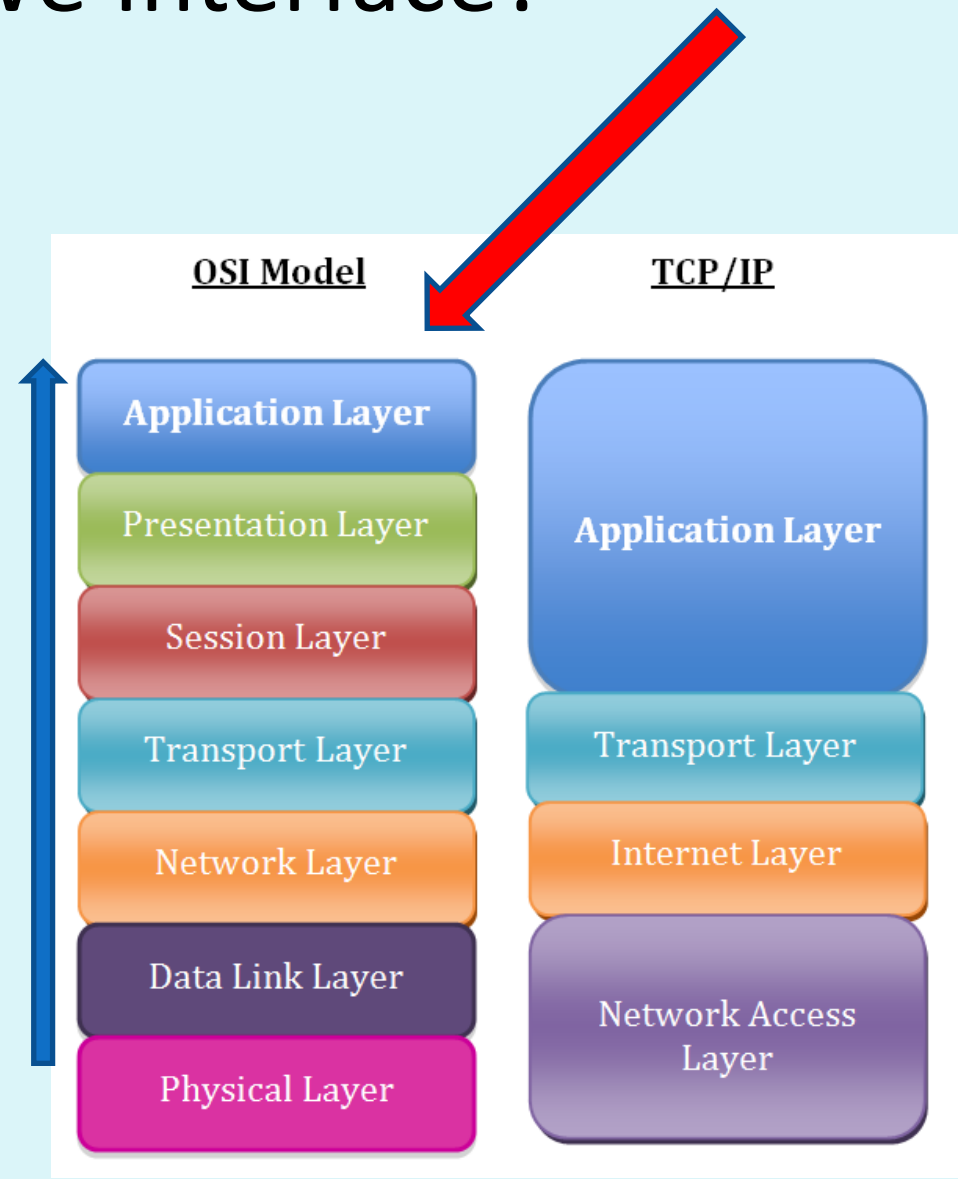


UTEP Energy Dashboard to Internet Network Topology



So How Do We Interface?

- SNMP
  - Located inside of the OSI model not on top, like HTTP
  - Protocol widely used for network management
  - Eaton made the Real-time and Interval Measurements available
- The way it works
  - We send a network packet request to GET with a value called an Object Identifier or OID
  - The meter responds with the current value of that OID
  - Find the right OID in the Management Information Block



So Why Use SNMP

- Secure interface to the meter
- Smaller bandwidth used on the UTEP network
- Access Time
  - Http > 15 Seconds
  - SNMP < 300 milliseconds

Top Level Operational Requirements

R.O.1 The system shall **be accessed** by the external user through an Internet enabled device.

R.O.2 The system shall **be operated** by the internal user through an network enabled device.

R.O.3 The system shall **have** an interface that makes energy information available through a network portal.

R.O.4 The system shall **manage** energy information through the Energy Dashboard interface.

Top Level Functional Requirements

R.F.1 The Dashboard System shall **collect** energy data from the AMI.

R.F.2 The System shall **store** energy data.

R.F.3 The System shall **monitor** critical changes within the system and data for maintenance purposes.

R.F.4 The System shall **analyze** the energy data.

R.F.5 The System shall **display** historical information of the environmental impact of used energy.

R.F.6 The System shall **create** reports of the energy data.

Top Level Non-Functional Requirements

R.N.1 The System shall utilize a user-friendly graphical user interface (GUI).

R.N.2 The System shall utilize different security levels of user access to ensure the security of the servers and the data.

R.N.3 The System shall be accessible through any IP, Wi-Fi, 3G, 4G and Bluetooth enabled device.

R.N.4 The System shall be compatible with the UTEP Energy Management Center.

R.N.5 The System shall be described in a set of System Engineering documents.

Top Level Performance Requirements

R.P.1 The System prototype shall ensure data storage capacity for at least 2 years.

R.P.2 The System prototype shall give the user access to the energy consumption reports in less than 400 milliseconds.

R.P.3 The System prototype shall be available 95% of 365 days of the year x 7 hours of the week x 24 hours of the day.

R.P.4 The System shall refresh information every 15 minutes.

Risk Analysis

Requirement	Description	Risk Cost	Risk Schedule	Risk Technology	Comment
R.O.1	The System shall be accessed by the external user through an Internet enabled device.	✓	IEEE	🟢	Institute of Electrical and Electronics Engineers, IEEE 802.6, 802.3, 802.2, 802.1
R.O.2	The System shall be operated by the internal user through an network enabled device.	✓	UTEP PP	🟢	UTEP web Privacy Policies, Institute of Electrical and Electronics Engineers, IEEE 802.6, 802.3, 802.2, 802.1
R.O.3	The System shall generate an interface that makes energy information available through a network portal.	✓	IEEE/ISO	🟢	Institute of Electrical and Electronics Engineers / International Organization for Standardization, IEEE 802.2
R.O.4	The System shall manage energy information through the Energy Dashboard interface.	✓	ISO	🟢	International Organization for Standardization
R.F.1	The Dashboard System shall collect energy data from the AMI.	✓	ISO/UTEP PP	🟡	International Organization for Standardization / UTEP web Privacy Policies
R.F.2	The System shall store energy data.	✓	ISO	🟢	International Organization for Standardization
R.F.3	The System shall monitor critical changes within the System and data.	✓	IEEE	🟢	Institute of Electrical and Electronics Engineers, IEEE 1044
R.F.4	The System shall analyze the energy data.	✓	IEEE	🟢	Institute of Electrical and Electronics Engineers, IEEE 829,1012,830,1061
R.F.5	The System shall display the environmental impact of used energy.	✓	EPA	🟢	Environmental Protection Agency, Greenhouse Gas Emissions
R.F.6	The System shall create reports of the energy data.	✓	IEEE	🟢	Institute of Electrical and Electronics Engineers, IEEE 1061,1012
R.N.1	The System shall utilize a user-friendly graphical user interface (GUI).	✓	IEEE	🟢	Institute of Electrical and Electronics Engineers, IEEE 1061,830
R.N.2	The System shall utilize different security levels of user access to ensure the security of the servers and the data.	✓	IEEE	🟡	Institute of Electrical and Electronics Engineers, IEEE 802.1,802.10
R.N.3	The System shall be accessible through any IP, Wi-Fi, 3G, 4G and Bluetooth enabled device.	✓	ISO/IEEE	🟢	International Organization for Standardization / Institute of Electrical and Electronics Engineers, IEEE 802.2
R.N.4	The System shall be compatible with the UTEP Energy Management Center	✓	NIST	🔵	National Institute of Standards and Technology, U.S. Department of Commerce
R.N.5	The System shall be described in a set of System Engineering documents	✓	INCOSE	🟢	International Council on Systems Engineering
R.P.1	The System prototype shall ensure data storage for at	✓	IEEE	🟢	Institute of Electrical and Electronics Engineers, IEEE 12207
R.P.2	The System prototype shall give the user access to the energy consumption in less than 400 milliseconds.	✓	IEEE	🟡	Institute of Electrical and Electronics Engineers, IEEE 1008,802.1,802.2
R.P.3	The System prototype shall be available 95% of 365 days of the year x 7 days of the week x 24 hours of the day.	✓	IEEE	🟡	Institute of Electrical and Electronics Engineers, IEEE 12207
R.P.4	The System shall refresh information every 15 minutes.	✓	IEEE	🟢	Institute of Electrical and Electronics Engineers, IEEE 12207

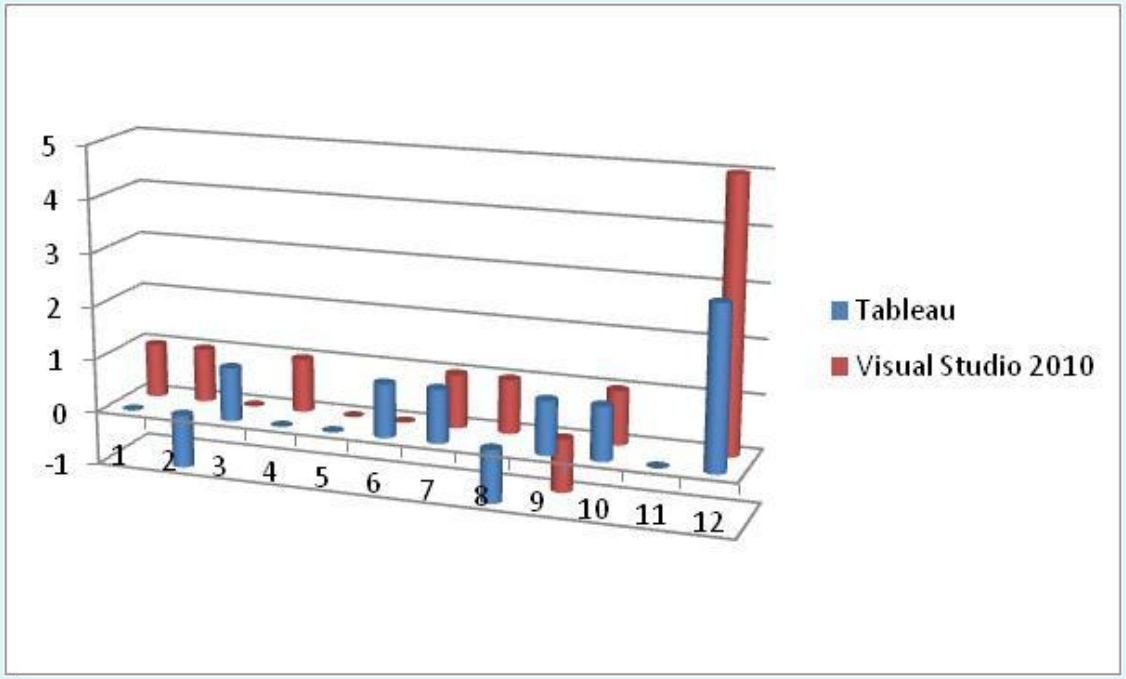
🔴	High Impact High Risk
🔵	High Impact Medium Risk
🟡	Low Impact Medium Risk
🟢	Low Impact Low Risk

R.N.1	The System shall utilize a user-friendly graphical user interface (GUI).	✓	IEEE		Institute of Electrical and Electronics Engineers, IEEE 1061,830
R.N.2	The System shall utilize different security levels of user access to ensure the security of the servers and the data.	✓	IEEE		Institute of Electrical and Electronics Engineers, IEEE 802.1,802.10
R.N.3	The System shall be accessible through any IP, Wi-Fi, 3G, 4G and Bluetooth enabled device.	✓	ISO/IEEE		International Organization for Standardization / Institute of Electrical and Electronics Engineers, IEEE 802.2
R.N.4	The System shall be compatible with the UTEP Energy Management Center	✓	NIST		National Institute of Standards and Technology, U.S. Department of Commerce
R.N.5	The System shall be described in a set of System Engineering documents	✓	INCOSE		International Council on Systems Engineering
R.P.1	The System prototype shall ensure data storage for at	✓	IEEE		Institute of Electrical and Electronics Engineers, IEEE 12207
R.P.2	The System prototype shall give the user access to the energy consumption in less than 400 milliseconds.	✓	IEEE		Institute of Electrical and Electronics Engineers, IEEE 1008,802.1,802.2
R.P.3	The System prototype shall be available 95% of 365 days of the year x 7 days of the week x 24 hours of the day.	✓	IEEE		Institute of Electrical and Electronics Engineers, IEEE 12207
R.P.4	The System shall refresh information every 15 minutes.	✓	IEEE		Institute of Electrical and Electronics Engineers, IEEE 12207

Trade Off Study

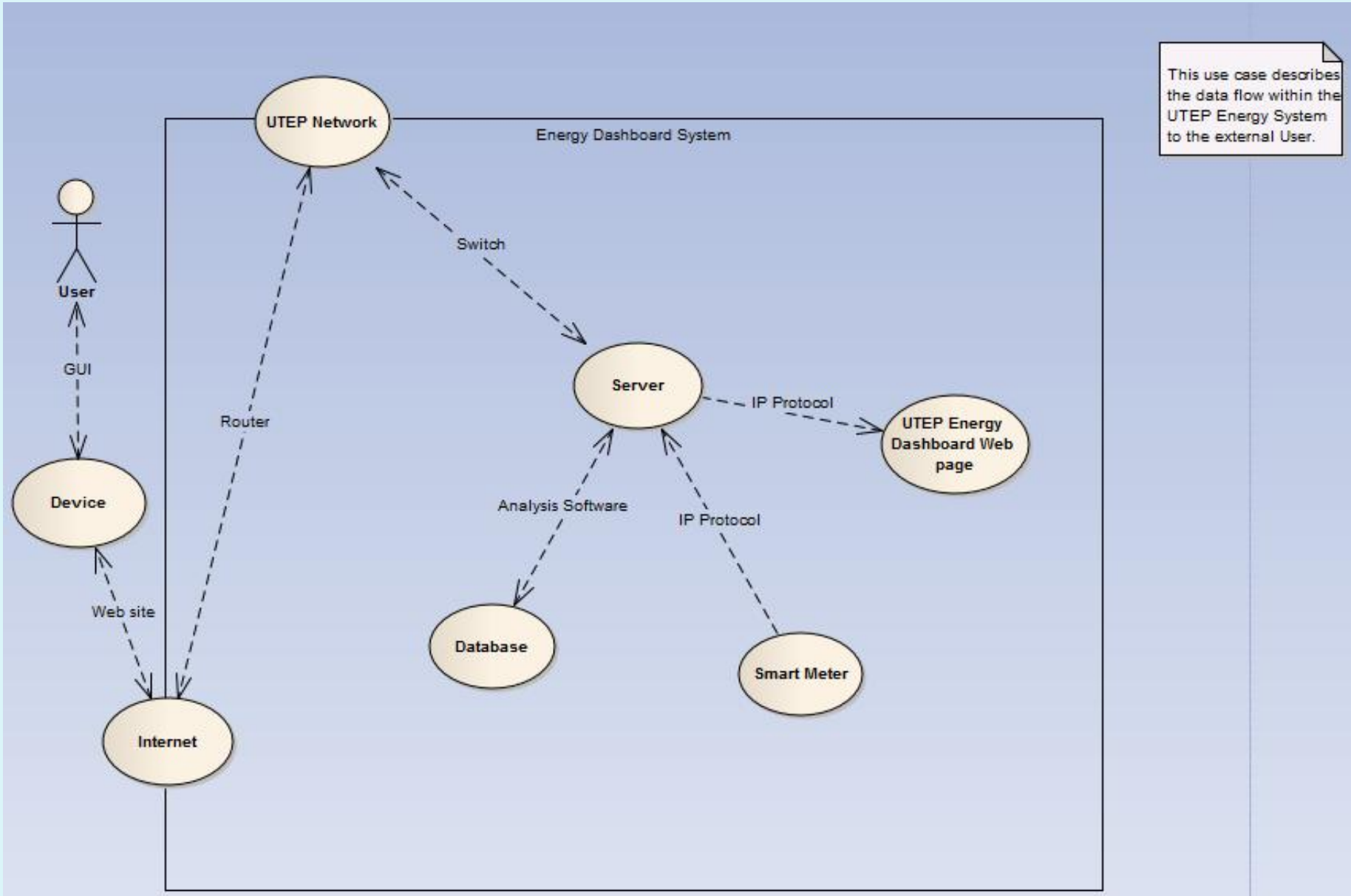
Trade Off Study (functionality based)	
Tableau	Visual Studio 2010
predefined dashboard templates	flexible web design templates
no flexible analysis software	can add analysis software
no need for coding	needs code
drag and drop functions	drag and drop functions that can be modified with code
core functions require tutorial	common programming knowledge required
very user friendly	too many options
easy to add onto web page, by pasting links	flexibility to choose desired file format
requires a vendor database	flexible data base adaption
does not require compilation and debugging	need compilation and debugging
aesely adapts to any web page	allows and adapts to multiple web page platforms

functionality assessment	
Tableau	Visual Studio 2010
0	1
-1	1
1	0
0	1
0	0
1	0
1	1
-1	1
1	-1
1	1
Total	
3	5



Good	Neutral	Bad
1	0	-1

Dashboard System Use Case



Dashboard Use Case

- Brief description: Data flow from Energy Dashboard System to User.
- Information: Server, Database, Smart Meter and UTEP Energy Dashboard Portal.
- Scope: User energy data access.
- Primary actor: User
- Supporting actors: Device, Internet and UTEP Network.
- Precondition: The User request energy data.
- Trigger: Energy data provided.
- Main Success Scenario: User obtains desired data.

Live Webpage

http://energydashboard.utep.edu

ACKNOWLEDGEMENTS

- Green Fund Committee: Dr. Martinez, Omar Holguin
- Facilities Services: Dr. Villalobos, Javier Navar
- COE-ETC: Jose Hernandez, David Munoz
- RIMES: Dr. Pineda, Dr. Smith, Raul Lezama

Questions?

RIMES

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