

GENI Work Breakdown Structure

GDD-06-29

GENI: Global Environment for Network Innovations

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Note to the Reader: This document was prepared as a template for GENI Working Groups to reference in the preparation of the GENI WBS Outline and WBS Dictionary. This Version (Release 1.0A) is based on the PEP of January 10, 2006. It is incomplete and contains both textual and budgetary information that is no longer current. An updated GENI WBS Document is in preparation by the GENI Working Groups. The updated WBS Outline and Dictionary will be published from time to time as revisions are completed and approved by the Working Groups.

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1 GENI WBS Outline

What follows is the *WBS Outline* for the GENI project. It shows the six major components of the project and the supporting tasks that are necessary to complete the major deliverables. Thus, for example, the *Project Management* component incorporates six parts, and each of these parts is broken down further. In the case of PM, the planning for each of these parts will be undertaken by the Project Management Team. Similarly, the *GENI Facility Construction* component contains several parts as developed during the first part of the Conceptual Design Stage. It is anticipated that these parts will change, so the WBS Outline here will change accordingly. Also, the arrangement of this outline is not exactly the same as it is in the PEP. For example, the *Systems Engineering* part has been extracted from the GPO; this is not to say that it will ultimately reside outside the GPO, but to focus attention on the importance of the Systems Engineering function, it is shown separately. In general, the association of major tasks with one another is less important at this stage – and in this document – than the tasks themselves. We are focusing on *what is to be done*, and not how that “what” fits into an organizational structure for GENI in this document.

1.0 GENI Project

1.1 Project Management

1.1.1 Administration

- 1.1.1.1. Payroll Administration

- 1.1.1.2. Administrative Services

- 1.1.1.3. Human Resources

- 1.1.1.4. Publications and Publicity

1.1.2 Financial Management and Control

- 1.1.2.1. Financial Planning, Budgeting, and Reporting

- 1.1.2.2. Purchasing and Procurements

- 1.1.2.3. Accounting and Records

1.1.3 Legal Affairs

- 1.1.3.1. Contracts & Agreements

- 1.1.3.2. Intellectual Property

- 1.1.3.3. Government Legal Liaison

1.1.4 Operations and Planning

- 1.1.4.1. PMCS Processes

- 1.1.4.2. Contractor Supervision and Liaison

- 1.1.4.3. Facilities Management

- 1.1.4.4. Prototyping Operations

1.1.5 Management Systems

- 1.1.5.1. Risk Management

- 1.1.5.2. Change Control Management

- 1.1.5.3. Contingency Management

1.1.6 External Liaison

1.2 GENI Facility Construction

1.2.1 Facility Node Devices

- 1.2.1.1 Flexible Edge Devices

- 1.2.1.1.1 Device Engineering and Assembly

- 1.2.1.1.2 Component Manager Software
- 1.2.1.1.3 Subsystems Integration and Testing
- 1.2.1.1.4 Distribution, Installation and On-Site Testing
- 1.2.1.2 Customizable High-Speed Routers
 - 1.2.1.2.1 Platform Engineering and Construction
 - 1.2.1.2.2 Component Manager Software
 - 1.2.1.2.3 Subsystems Integration and Testing
 - 1.2.1.2.4 Distribution, Installation and On-Site Testing of Routers
- 1.2.1.3 Optical Switches (ROADM and D-OS)
 - 1.2.1.3.1 Type-1 and Type-2 D-OS Devices
 - 1.2.1.3.2 Component Manager Software
 - 1.2.1.3.3 D-OS Device Type Selection
 - 1.2.1.3.4 D-OS Construction and Testing
 - 1.2.1.3.5 Optical Switch Distribution, Installation, and On-Site Testing
- 1.2.2 Facility Management Software
 - 1.2.2.1 GENI Management Core (GMC) Software
 - 1.2.2.1.1 Slice Manager
 - 1.2.2.1.2 Resource Controller
 - 1.2.2.1.3 Auditing Archive
 - 1.2.2.1.4 Web Front End
 - 1.2.2.1.5 GMC Subsystems Integration and Testing
 - 1.2.2.2 Infrastructure Services Software
 - 1.2.2.2.1 Provisioning Services
 - 1.2.2.2.2 Information Plane
 - 1.2.2.2.3 Resource Broker
 - 1.2.2.2.4 Development Tools
 - 1.2.2.2.5 Other Infrastructure Services
 - 1.2.2.3 Underlay Services Software
 - 1.2.2.3.1 Security Service
 - 1.2.2.3.2 Topology Service
 - 1.2.2.3.3 File Naming Service
 - 1.2.2.3.4 Legacy Internet Service
 - 1.2.2.3.5 Other User Services
 - 1.2.2.4 Instrumentation Software
 - 1.2.2.4.1 Data Collection Software
 - 1.2.2.4.2 Data Archiving Software
 - 1.2.2.4.3 Data Analysis Software
 - 1.2.2.4.4 Other Instrumentation Software
- 1.2.3 Network Assembly and Management
 - 1.2.3.1 National Backbone Assembly
 - 1.2.3.1.1 National Fiber & Core Bandwidth Implementation
 - 1.2.3.1.2 Additional Core Bandwidth (Wavelengths)
 - 1.2.3.1.3 Network Facilities Preparation
 - 1.2.3.1.4 Backbone Node Deployment
 - 1.2.3.1.5 Network Integration and Testing
 - 1.2.3.2 Tail Circuits / Edge Site Assembly
 - 1.2.3.2.1 Dark Fiber Lease with 155Mb/s Service

- 1.2.3.2.2 Connection of Existing Fiber with 45Mb/s Service
- 1.2.3.2.3 Pulled Fiber Deployment and 1-10 Gb/s Service
- 1.2.3.2.4 Connection of Existing Fiber with IP Service
- 1.2.3.2.5 New Connection Technologies Deployment (TBD)
- 1.2.3.3 Internet Exchange Assembly
 - 1.2.3.3.1 Connectivity at 45Mb/s
 - 1.2.3.3.2 Connectivity at 155Mb/s
 - 1.2.3.3.3 Connectivity at 1-10 Gb/s
- 1.2.3.4 Network Management in Construction
 - 1.2.3.4.1 TBD
 - 1.2.3.4.2 TBD
- 1.2.4 Wireless Subnets
 - 1.2.4.1 Urban *Ad-hoc* Subnets
 - 1.2.4.1.1 Urban Ad Hoc Subnet Hardware
 - 1.2.4.1.2 Urban Ad Hoc Subnet Software
 - 1.2.4.1.3 Urban Ad Hoc Subnet Field Distribution and On-Site Testing
 - 1.2.4.2 Suburban Wide Area Subnets
 - 1.2.4.2.1 Suburban Wide Area Subnet Hardware
 - 1.2.4.2.2 Suburban Wide Area Subnet Software
 - 1.2.4.2.3 Suburban Wide Area Deployment
 - 1.2.4.3 Cognitive Radio Subnets
 - 1.2.4.3.1 Cognitive Radio Subnet Hardware
 - 1.2.4.3.2 Cognitive Radio Subnet Software
 - 1.2.4.3.3 Cognitive Radio Subnet Field Assembly and Test
 - 1.2.4.4 Application-Specific Sensor Subnets
 - 1.2.4.4.1 Application-Specific Sensor Subnet Hardware
 - 1.2.4.4.2 Application-Specific Sensor Subnet Software
 - 1.2.4.4.3 Application-Specific Sensor Subnet Field Assembly and Test
 - 1.2.4.5 Wireless Emulation Subnets
 - 1.2.4.5.1 Emulation Subnet Hardware Assembly
 - 1.2.4.5.2 Emulation Subnet Software Development
 - 1.2.4.5.3 Emulation Subnet Field Assembly and Test
- 1.3 Systems Engineering**
 - 1.3.1 Requirements & Specifications Management
 - 1.3.2 Fiber Plant Engineering
 - 1.3.3 Equipment Installation Engineering
 - 1.3.4 Standards, Safety and Environmental Engineering
 - 1.3.5 Network Documentation Operations
- 1.4 Facility Commissioning**
 - 1.4.1 Initial Use Commissioning
 - 1.4.1.1 Initial Research Use Requirements
 - 1.4.1.2 Facility Test Plan for Initial Use
 - 1.4.1.3 Facility Testing
 - 1.4.1.4 Facility Commissioning for Initial Use

- 1.4.2 Mid-Construction Commissioning
 - 1.4.2.1 Mid-Construction Use Requirements
 - 1.4.2.2 Mid-Construction Test Plan
 - 1.4.2.3 Facility Testing – Mid Construction
 - 1.4.2.4 Facility Commissioning for Mid-Construction Use
- 1.4.3 Final Facility Commissioning
 - 1.4.3.1 Final Acceptance Criteria
 - 1.4.3.2 Test Plan, Procedures, Exit Reporting
 - 1.4.3.3 Final Facility Testing by GENI Systems Engineering
 - 1.4.3.4 Final Facility Testing by External Testing Group
 - 1.4.3.5 Final Reporting
 - 1.4.3.6 Transition to Operations

1.5 Science Support

- 1.5.1 Construction Stage Final Research Selection
- 1.5.2 Research Experiment Plans and Definitions Review
- 1.5.3 Research Policies and Governance for Research Use During Construction
- 1.5.4 Selection of Research Users during Construction Stages
- 1.5.5 Monitoring of Research Use by GENI Management
- 1.5.6 Research Report Evaluations for Research Users

1.6 Education & Outreach

- 1.6.1 Scientific Communities Education
 - 1.6.1.1 Topical Workshops
 - 1.6.1.2 Town Hall Meetings
 - 1.6.1.3 Conference Presentations
- 1.6.2 Public Outreach Education
 - 1.6.2.1 GENI Web Site
 - 1.6.2.2 Broadcast and Newspaper Media

2 GENI WBS Dictionary

WBS Element:	1.1 Project Management
Responsible Manager:	Project Manager (TBD), GENI Project Office
Management Cost Target:	21,764,000 (CDS-PEP)
Project Account Number:	TBD

The Project Management WBS element encompasses all management processes, procedures, and tasks associated with the direction and management of the GENI Project during the construction stage. This includes, but is not limited to, administration, financial management and control, legal affairs, operations and planning, and external liaison.

DELIVERABLES

- Deliver the fully constructed and functional GENI Facility according to the costs, schedule, specifications and performance requirements provided to facility subcontractors
- Operate a Project Management Office that provides all services, processes, procedures required to effectively manage the GENI project, including (but not limited to): administration, financial planning and control, legal, operations, and liaison to project stake holders
- *Others to be defined by the Project Management Team*

COMPONENTS

The GENI Project Management WBS element consists of the following major components:

- 1.1.1 Administration
- 1.1.2 Financial Management and Control
- 1.1.3 Legal Affairs
- 1.1.4 Operations and Planning
- 1.1.5 Management Systems
- 1.1.6 External Liaison

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the management components of the GENI Project:

- Project Director (TBD), GENI Project
- Project Manager (TBD), GENI Project Office (GPO)

- Finance Manager (TBD), GPO-Finance Office
- Legal Officer (TBD), GPO-Legal Affairs Office
- Operations Manager (TBD), GPO-Operations & Planning Office
- Liaison Manager (TBD), GPO-Liaison Office

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction stage cost breakdown for the major components of the GENI Project Management WBS. It is based on the CDS PEP. All dollars are in 1000s.

Cost Element	Total	2009	2010	2011	2012	2013
Wages & Salaries	17,875	3,575	3,575	3,575	3,575	3,575
Non-Wage Expenses	3,660	732	732	732	732	732
Total OPEX	21,535					
CAPEX	229					
TOTAL	21,764					

Table 1.1: Cost breakdown for management of the GENI project during construction. Includes operating and capital expenses.

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					

• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.2A: Basis of personnel expense associated with GENI management during the construction stage

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Furniture					
Equipment					
Computers					
Major Software					
Totals					

Table 1.2B: Basis of capital cost for management operations during the GENI construction stage (2009-2013). Estimates taken from CDS-PEP.

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.1.1 Administration
Responsible Manager: Administration Manager (TBD)
Management Cost Target: TBD
Project Account Number: TBD

The Administration WBS element encompasses the administrative functions and processes that are part of GENI Management and that are required during the GENI construction stage to provide administrative management services. These services include, but are not limited to, payroll administration, human resources, publications, publicity, etc.

DELIVERABLES

- Provide timely and effective administrative services to the GENI project during the construction stage, including secretarial, payroll, human resources, publications, and related.
- Others TBD as appropriate based on roll-ups from components below.

COMPONENTS

The Administration WBS element consists of the following major components:

- 1.1.1.1 Payroll Administration
- 1.1.1.2 Administrative Services
- 1.1.1.3 Human Resources
- 1.1.1.4 Publications and Publicity
- 1/1/1/5 Others TBD during GENI Planning

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Administration WBS components:

- Project Manager (TBD), GENI Project Office
- Administration Office Manager (TBD), GPO Administration
- Payroll Manager (TBD), GPO Administration
- HR Manager (TBD), GPO Administration
- Publications Manager (TBD), GPO Administration

CONSTRUCTION COST BREAKDOWN

Cost Element	Total	2009	2010	2011	2012	2013
Wages & Salaries						
Non-Wage Expenses						
Subtotal Expense						
Capital Equipment						
TOTAL COST						

Table 1.3: Cost breakdown for administrative functions in the GENI project during construction. Includes operating and capital expenses.

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				

• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				
Expense Elements	Salary & Wage (Loaded Rates)	Non-Wage Expenses	Other Expenses	Totals	
Sr. Manager/Director	350,000				

Table 1.4A: Basis of expense elements during GENI construction for administrative management functions.

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Furniture					
Equipment					
Other					
Totals					

Table 1.4B: Basis of capital costs for office administration during the GENI construction stage (2009-2013). Estimates taken from CDS-PEP.

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.1.2 Financial Management and Control
Responsible Manager: Finance Manager (TBD)
Management Cost Target: TBD
Project Account Number: TBD

The Financial Management and Control WBS element encompasses the financial management and control functions and processes that are part of GENI Management and that are required during the GENI construction stage. These processes include financial planning, budgeting, purchasing, procurements, accounting, and similar financial functions.

DELIVERABLES

- Carry out the overall administrative and technical strategic financial plan for the project; renew strategic plan annually with project manager, project director, CCC management, and NSF MREFC account office
- Develop and administer annual operating and capital budgets for the GENI project in accordance with the requirements of the MREFC account
- Provide accounting services to the project in accordance with requirements of the MREFC and general accounting practices of the NSF and U.S. government
- Direct procurement of materials and services for the GENI project in accordance with requirements of the MREFC and U.S. government
- Maintain financial records including income, disbursements and non-cash transactions in appropriate journals and ledgers and provide reports to NSF and/or others in a timely way
- Perform annual audit of financial condition of the project, including support of external auditors

COMPONENTS

The Financial Management WBS element consists of the following major components:

- 1.1.2.1 Financial Planning, Budgeting, and Reporting
- 1.1.2.2 Purchasing and Procurements
- 1.1.2.3 Accounting and Records

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Financial Management WBS components:

- Project Director (TBD), GENI Project
- Project Manager (TBD), GENI Project Office
- Chief Financial Officer (TBD), GENI Financial Management

CONSTRUCTION COST BREAKDOWN

Cost Element	Total	2009	2010	2011	2012	2013
Wages & Salaries						
Non-Wage Expenses						
Subtotal Expense						
Capital Equipment						
TOTAL COST						

Table 1.5: Cost breakdown for financial management and reporting functions in the GENI project during construction. Includes operating and capital expenses.

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				

• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.6A: Basis of expense elements during GENI construction for financial management and reporting functions

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Furniture					
Equipment					
Other					
Totals					

Table 1.6B: Basis of capital costs for financial management and reporting during the GENI construction stage (2009-2013). Estimates taken from CDS-PEP.

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use Microsoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.1.3 Legal Affairs
Responsible Manager: Legal Affairs Officer (TBD)
Management Cost Target: TBD
Project Account Number: TBD

The Legal Affairs WBS element encompasses the legal functions and tasks that must be carried out during the GENI construction stage to ensure that legal requirements of the project are met, including coordination with the NSF, the MREFC, and other agencies of the US government as required.

DELIVERABLES

- Provide ongoing legal advice and expertise to the project in all parts of its operation, including (but not limited to) coordination with NSF and other government agency legal offices, development of contracts and agreements, protection and licensing of intellectual property developed in the project, and ...
- Ensure compliance with all government-specified rules, regulations, practices, etc.
- *Others TBD as appropriate to this office*

COMPONENTS

The Legal Affairs WBS element consists of the following major components:

- 1.1.3.1 Contracts and Agreements
- 1.1.3.2 Intellectual Property
- 1.1.3.3 Government Legal Liaison
- 1.1.3.4 Others TBD by WG for GENI Management

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for Legal Affairs WBS components:

- Project Director (TBD), GENI Project
- Project Manager (TBD), GENI Management
- Legal Affairs Officer (TBD), Legal Affairs Office

CONSTRUCTION COST BREAKDOWN

Cost Element	Total	2009	2010	2011	2012	2013
Wages & Salaries						
Non-Wage Expenses						
Subtotal Expense						
Capital Equipment						
TOTAL COST						

Table 1.7: Cost breakdown for legal affairs functions in the GENI project during construction. Includes operating and capital expenses.

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				

• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.8A: Basis of expense elements during GENI construction for legal affairs and reporting functions

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Furniture					
Equipment					
Other					
Totals					

Table 1.8B: Basis of capital costs for legal affairs and reporting during the GENI construction stage (2009-2013). Estimates taken from CDS-PEP

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use Microsoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.1.4 Operations and Planning
Responsible Manager: Operations Manager (TBD)
Management Cost Target: TBD
Project Account Number: TBD

The Operations & Planning WBS element encompasses the project scheduling and tracking functions required to ensure that GENI Facility construction is completed on schedule, within budget, and according to requirements and specifications developed for its construction. This WBS element also includes prototyping operations required to validate the insertion of new technologies into the GENI Facility.

DELIVERABLES

- Manage the GENI project construction task schedule during construction and provide tracking of the multitude of tasks, activities, and deliverables of contractors responsible for the build of various elements of GENI
- Administer contracts to GENI builders and provide liaison with contractors as required to ensure timely compliance with contract requirements and smooth flow of contracted work
- Report to project director, project manager and others, as appropriate, related to progress of project
- Produce and maintain documentation of all construction activity; provide reports of project status at regular intervals during the construction period
- Oversee the operation of external facilities that house GENI systems, network elements, etc. Ensure that safety and environmental laws, regulations, and related are carried out.
- *Others TBD as appropriate to this office*

COMPONENTS

The Operations and Planning WBS element consists of the following major components:

- 1.1.4.1 PMCS Processes
- 1.1.4.2 Contractor Supervision and Liaison
- 1.1.4.3 Facilities Management
- 1.1.4.4 Prototyping Operations
- 1.1.4.5 *Other components as appropriate TBD during planning*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Operations & Planning WBS components:

- Project Director (TBD), GENI Project

- Project Manager (TBD), GENI Management
- Operations Manager (TBD), Operations & Planning
- Facilities Manager (TBD), Operations & Planning
- Prototyping Operations Manager (TBD), Operations & Planning

CONSTRUCTION COST BREAKDOWN

Cost Element	Total	2009	2010	2011	2012	2013
Wages & Salaries						
Non-Wage Expenses						
Subtotal Expense						
Capital Equipment						
TOTAL COST						

Table 1.9: Cost breakdown for operations and planning functions in the GENI project during construction. Includes operating and capital expenses.

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				

• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.10A: Basis of expense elements during GENI construction for operations and planning functions

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Furniture					
Equipment					
Other					
Totals					

Table 1.10B: Basis of capital costs for operations and planning functions during the GENI construction stage (2009-2013). Estimates taken from CDS-PEP.

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.1.5 Management Systems
Responsible Manager: Management Systems Manager (TBD)
Management Cost Target: TBD
Project Account Number: TBD

The Management Systems WBS element encompasses the work required to build, operate and update management systems (including software tools) required to manage the GENI project during construction in areas including: risk management, change control management, and contingency management.

DELIVERABLES

- Acquire or construct and integrate management systems for risk management, change control management, and contingency management. Such systems must adhere to the principle that management decisions should be able to be made quickly, with a minimum of time in committee, and so that the management process is visible to the entire GENI management team
- *Others TBD as appropriate to this office*

COMPONENTS

The Management Systems WBS element consists of the following major components:

- 1.1.5.1 Risk Management
- 1.1.5.2 Change Control Management
- 1.1.5.3 Contingency Management
- 1.1.5.4 *Other Management Systems TBD during planning stages*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Management Systems WBS components:

- Project Director (TBD), GENI Project
- Project Manager (TBD), GENI Management
- Operations Manager (TBD), Operations & Planning
- Task Manager (TBD), Management Systems

CONSTRUCTION COST BREAKDOWN

Cost Element	Total	2009	2010	2011	2012	2013
Wages & Salaries						
Non-Wage Expenses						
Subtotal Expense						
Capital Equipment						
TOTAL COST						

Table 1.9: Cost breakdown Management Systems during construction.

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				

• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.10A: Basis of expense elements during GENI construction for Management Systems functions

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Risk Management System					
Change Control Management					
Contingency Mgmt. System					
TBD					
Other					
Totals					

Table 1.10B: Basis of capital costs for Management Systems function during the GENI construction stage (2009-2013)

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.1.6 External Liaison
Responsible Manager: Liaison Manager (TBD)
Management Cost Target: TBD
Project Account Number: TBD

The External Liaison WBS element encompasses the work to identify and maintain necessary and appropriate contacts with the external community insofar as this is required for the proper operation of the GENI project. These relationships include those with industry, government, and academia to obtain expert advice and support for selected elements of the GENI Project.

DELIVERABLES

- Establish and maintain appropriate contacts in industry, government, and academia as required to ensure that this project is “well connected” within the broader community
- Establish connections with international participants in GENI and bring contributions from these into the project
- Develop advisory teams and related (as required) to acquire critical information from the broad community of potential GENI supporters and users (including research and education)
- Provide timely feedback from liaison activity to GENI management, including new ideas for architecture, technology incorporation, and GENI operation
- Maintain relationships with standards bodies to ensure that technologies deployed in GENI meet international standards
- *Others TBD as appropriate for this task*

COMPONENTS

The External Liaison WBS element consists of the following major components:

- 1.1.6.1 Industrial Relationships
- 1.1.6.2 Government Relationships
- 1.1.6.3 Academic and Research Institutions Relationships
- 1.1.6.4 International Relationships
- 1.1.6.5 *Other TBD during planning, if appropriate*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we’ll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for External Liaison WBS components:

- Project Director (TBD), GENI Project
- Project Manager (TBD), GENI Management
- Liaison Office Manager (TBD), GENI Liaison Office

CONSTRUCTION COST BREAKDOWN

Cost Element	Total	2009	2010	2011	2012	2013
Wages & Salaries						
Non-Wage Expenses						
Subtotal Expense						
Capital Equipment						
TOTAL COST						

Table 1.9: Cost breakdown for external liaison functions in the GENI project during construction. Includes operating and capital expenses

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				

• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.10A: Basis of expense elements during GENI construction for external liaison functions

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Furniture					
Equipment					
Other					
Totals					

Table 1.10B: Basis of capital costs for external liaison functions during the GENI construction stage (2009-2013). Estimates taken from CDS-PEP.

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use Microsoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2 Facility Construction
Responsible Manager: Project Manager (TBD)
Construction Cost Target: \$312,246,000 (CDS-PEP)
Project Account Number: TBD

The Facility Construction WBS element encompasses all activities associated with the construction of the GENI network, including its facility nodes, wireless subnets, management software, and distributed services software. This WBS element also includes all work related to the assembly and deployment of the Facility, as well as the operation of the Facility during the construction stage; commissioning processes and related expenses are specified separately.

DELIVERABLES

- Build, deliver, and deploy all network components of the GENI Facility, including all nodes, management software, and wireless subnets
- Build and deploy software services for the infrastructure, core management, underlay services, and instrumentation of the GENI Facility
- Assemble backbone network and tail circuits; integrate backbone with edge devices and the legacy Internet; test integrated network and deploy GENI Facility for commissioning
- *Others TBD as appropriate for this task*

COMPONENTS

The GENI Facility Construction WBS element consists of the following major components:

- 1.2.1 Facility Node Devices
- 1.2.2 Facility Management Software
- 1.2.3 Network Assembly and Construction Stage Management
- 1.2.4 Wireless Subnets

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the WBS elements associated with the construction of the GENI Facility:

- Project Director (TBD), GENI Project
- Project Manager (TBD), GENI Project Office
- Chief Architect (TBD), Technical Advisory Board
- Chief Engineer (TBD), Systems Engineering Office

CONSTRUCTION COST BREAKDOWN

Table 2.1 below summarizes the construction cost breakdown for the major components of the GENI Facility, including network assembly and cost of operations management during the construction period. Figures (in 1000s of dollars) include both expense and capital for each year, based on estimates made during the Conceptual Design Stage.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.1	Facility Nodes	75,047	16,481	14,976	12,229	16,682	14,679
1.2.2	Management Software	113,405	23,670	22,455	22,255	22,880	22,145
1.2.3	Network Assembly & Management	68,278	11,552	12,857	13,119	15,235	15,515
1.2.4	Wireless Subnets	55,516	21,604	8703	8403	8403	8403
1.2	Subtotals	312,246	73,307	58,991	56,006	63,200	60,742
	Contingency						
	Totals						

Table 2.1: Cost summary for the major network elements to be deployed in GENI, including expenses for assembly of the GENI network and cost of its management during the construction stage (2009-2013)

BASIS OF COST

Table 2.2 below shows the basis of cost used for Conceptual Design Stage estimates of expense and capital costs for construction of the GENI Facility.

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			

• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.2A: Basis of cost for estimation of expenses during GENI construction

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Facility Node Devices					
Wireless Subnets					
Network Assembly					

Totals					
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Table 2.2B: Basis of capital costs for GENI Facility construction during the GENI construction stage (2009-2013). Estimates taken from CDS-PEP

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.1 Facility Node Devices
Responsible Manager: Project Manager (TBD)
Construction Cost Target: \$75,047,000 (CDS-PEP)
Project Account Number: TBD

The Facility Node Devices WBS element encompasses work associated with the construction and delivery of the principal node elements in the GENI Facility, including (but not limited to) flexible edge devices, customizable high-speed routers, and optical switches.

DELIVERABLES

- Construct and deliver network nodes to the GENI Facility on schedule and according to the requirements & specifications developed for each of them, including Flexible Edge Devices, Customizable High-Speed Routers, and Optical Switches (D-OS and ROADM).
- Install five ROADM platforms in the GENI Facility by the end of the first year of construction to support optical research starting in year-2 of construction
- *Other deliverables to be specified by Working Groups as appropriate to each node type.*

COMPONENTS

The Facility Node Devices WBS element consists of the following major subassemblies:

- 1.2.1.1 Flexible Edge Devices
- 1.2.1.2 Customizable High-Speed Routers
- 1.2.1.3 Optical Switches (ROADMs and D-OSs)
- 1.2.1.4 *Other node types TBD during planning, as appropriate*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for WBS elements associated with node devices during the GENI Facility construction stage:

- Project Director (TBD)
- Project Manager (TBD)
- Chief Architect (TBD)
- Systems Engineering Manager (TBD)
- Task Manager/Leader (TBD), Flexible Edge Devices
- Task Manager/Leader (TBD), Customizable High-Speed Routers
- Task Manager/Leader (TBD), Optical Switches

CONSTRUCTION COST BREAKDOWN

Table 2.3 summarizes the estimated costs of three node types to be deployed in GENI. Dollar numbers are in 1000s. Expense and capital costs, taken from the Conceptual Design Stage PEP, are included for each node type.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.1.1	Flexible Edge Devices	20,585	4,740	4,740	1,625	4,740	4,740
1.2.1.2	Customizable High-Speed Routers	14,534	3,326	3,546	3,114	2,274	2,274
1.2.1.3	Optical Switches (D-OS & ROADMs)	39,928	8,415	6,690	7,490	9,668	7,665
1.2.1	Subtotals	75,047	16,481	14,976	12,229	16,682	14,679
	Contingency						
	Totals						

Table 2.3: Cost estimates for principal node devices to be installed in GENI Facility during the Construction Stage (from CDS-PEP Budget). Numbers include aggregated expense and capital costs for each node platform type.

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				

• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.4A: Basis of expense cost for expenses related to construction of principal nodes to be deployed in the GENI Facility (from CDS-PEP Budget)

Capital Elements	Unit Prices	# Units	Installation Expense	Training	Total
Flexible Edge Devices		200			
Customizable High-Speed Routers		26			
Dynamic OSs		17?			
ROADMs		5			

Table 2.4B: Basis of capital cost for node platforms to be constructed and deployed during the GENI construction stage (2009-2013). Estimated costs taken from CDS-PEP of January 10, 2006.

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.1.1 Flexible Edge Devices
Responsible Manager: FED Task Manager/Leader (TBD)
Construction Cost Target: \$20,585,000 (CDS-PEP)
Project Account Number: TBD

The Flexible Edge Devices (FED) WBS element encompasses the work to be performed during GENI Facility construction to assemble, laboratory test, and deliver 200 FEDs to edge sites of the GENI Facility during the construction stage.

DELIVERABLES

- 100 Flexible Edge Devices constructed, lab tested, delivered to field and connected to GENI backbone network by end year-1 of construction stage. These FEDs required to support basic level of virtualization as defined in FED Requirements & Specifications
- 100 additional Flexible Edge Devices constructed, lab tested, delivered to field, and connected to GENI backbone network by end year-2 of construction stage. FEDs continue to support basic level of virtualization.
- Renewal of 100 Flexible Edge Devices in each of years 3 and 4. New software supports fine-grain resource allocation, lower levels of virtualization, increased hardware heterogeneity, and optimized packet-forwarding performance.
- *Other deliverables to be specified by WG responsible for FED requirements & specifications*

COMPONENTS

The Flexible Edge Device WBS element consists of the following major subassemblies:

- 1.2.1.1.1 Device Engineering and Assembly
- 1.2.1.1.2 Component Manager Software
- 1.2.1.1.3 Subsystems Integration and Testing
- 1.2.1.1.4 Distribution, Installation, and On-Site Testing

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the WBS elements associated with the engineering, assembly, deployment, and testing of Flexible Edge Devices:

- Task Manager (Flexible Edge Devices)
- Engineer TBD (Hardware Configuration)
- Engineers TBD (Software Engineering)
- Technicians TBD (Subsystems Integration and Testing)
- Support TBD (Administrative)

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for Flexible Edge Devices, including lab testing, delivery to the field with assembly and on-site testing, but not in-field commissioning-level testing.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.1.1.1	Device Engineering & Assembly						
1.2.1.1.2	Component Manager Software						
1.2.1.1.3	Subsystems Integration & Testing						
1.2.1.1.4	Distribution, Installation & Testing						
1.2.1.1.5	TBD by WG						
1.2.1.1.6	TBD by WG						
1.2.1.1.7	TBD by WG						
#	<i>Etcetera</i>						
1.2.1.1	Subtotals	20,585	4,740	4,740	1,625	4,740	4,740
	Contingency	TBD					
	Totals						

Table 2.5: Shows cost breakdown for Flexible Edge Devices to be deployed to 200 sites in the GENI Facility during five-year construction period (2009-2013).

BASIS OF COST

Expense Elements	# Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director		350			
• Area Office Managers		250			
• Task Manager/Leader		250			

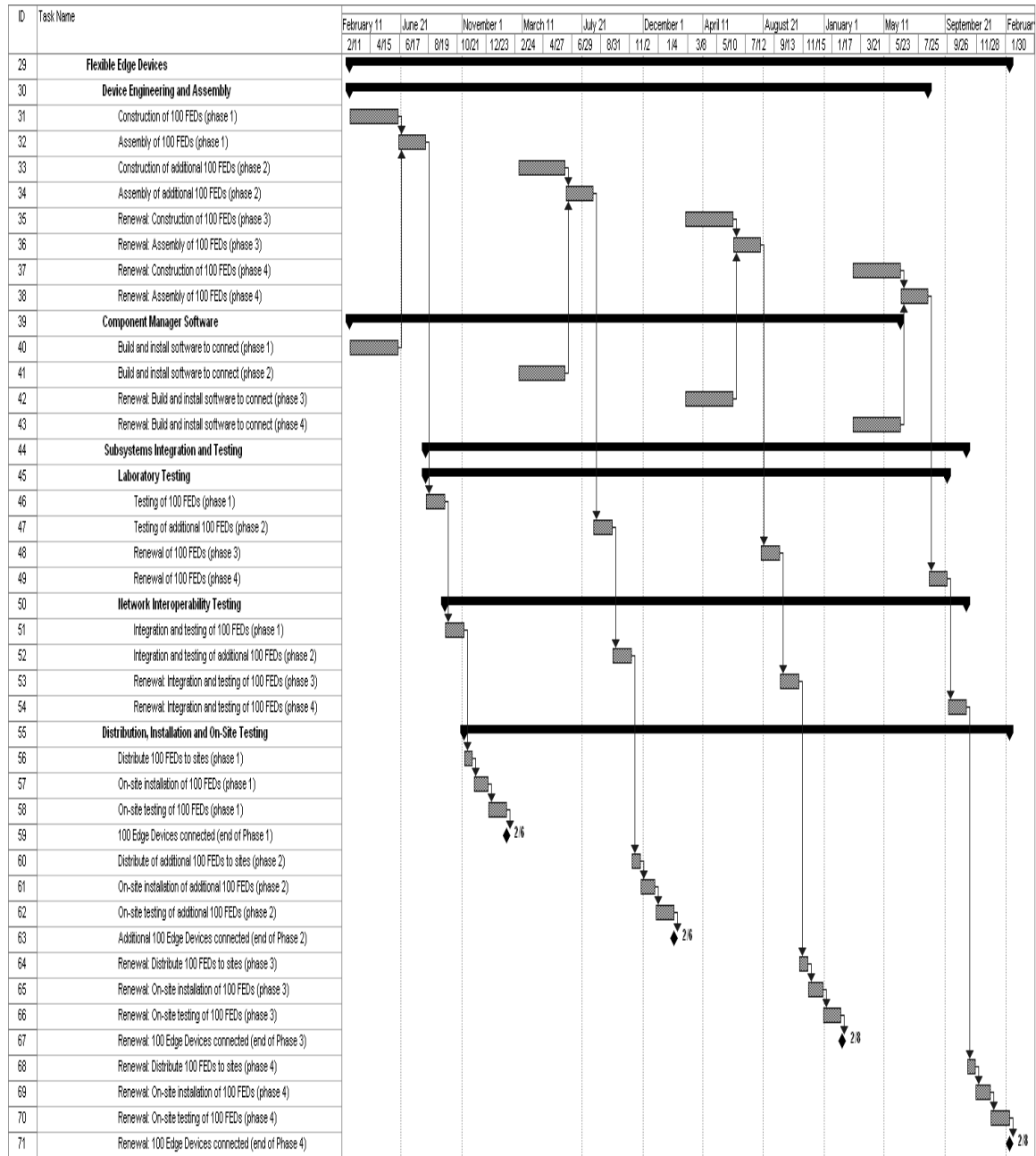
• Senior Engineer		250			
• Contract Labor		150			
• Jr. Engineer or Tech.		150			
• Administrator		100			
Materials & Supplies					
•					
Travel					
• Installation sites					
Shipping	400			200	80
Other					

Table 2.6A: Shows basis of cost used in Conceptual Design Stage to estimate the potential cost of Flexible Edge Devices for the GENI Facility (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Total (K\$)
PC Cluster Platforms	30	200	750		
Cluster Renewal	30	200	750		

Table 2.6B: Basis of cost for capital items required in the construction of Flexible Edge Devices during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE



WBS Element: 1.2.1.2 Customizable High-Speed Routers
Responsible Manager: Task Manager - CHSR (TBD)
Construction Cost Target: \$14,534K (CDS-PEP)
Project Account Number: TBD

The Customizable High-Speed Router WBS element encompasses the work to be completed during GENI construction to build, laboratory test, and deliver twenty-six (26) customizable high-speed router platforms to the field for installation in the GENI Facility.

DELIVERABLES

- Construct, test, and deliver 26 server chassis with general-purpose processors blades to 26 different sites by end of year-1 GENI construction
- Upgrade 13 customizable high-speed routers in year-3 construction with additional blades employing FPGAs, network processors, and new line cards.
- Upgrade 13 additional high-speed routers in year-5 construction with additional blades employing new technology, such as FPGAs, network processors, and new line cards.
- *Other deliverables TBD during planning by WG*

COMPONENTS

The Customizable High-Speed Router WBS element consists of the following major components:

- 1.2.1.2.1 Platform Engineering and Construction
- 1.2.1.2.2 Component Manager Software
- 1.2.1.2.3 Subsystems Integration and Testing
- 1.2.1.2.4 Distribution, Installation, and On-Site Testing of Routers
- 1.2.1.2.5 *Other components to be added, as appropriate*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the engineering, construction, and delivery of the customizable high-speed routers to the GENI Facility:

- Project Manager (TBD)
- Task Manager (Customizable High-Speed Routers)
- Engineers TBD (Router Hardware)
- Engineers TBD (Router Software)
- Technicians TBD (Router Assembly, Integration, Lab Testing)

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for each work element in the Customizable High-Speed Router WBS. Cost numbers are in 1000s of dollars and include both expense (OPEX) and capital (CAPEX).

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.1.2.1	Device Engineering & Assembly						
1.2.1.2.2	Component Manager Software						
1.2.1.2.3	Subsystems Integration & Testing						
1.2.1.2.4	Distribution, Installation & Testing						
1.2.1.2.5	TBD by WG						
1.2.1.2.6	TBD by WG						
1.2.1.2.7	TBD by WG						
#	<i>Etcetera</i>						
1.2.1.2	Subtotals	14,534	3,326	3,546	3,114	2,274	2,274
	Contingency						
	Totals						

Table 2.7: Cost structure for construction of 26 Customizable High-Speed Routers during the GENI construction stage, including delivery to field sites. Does not include network-wide testing related to commissioning

BASIS OF COST

Expense Elements	# Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director		350			
• Area Office Managers		250			
• Task Manager/Leader		250			

• Senior Engineer		250			
• Contract Labor		150			
• Jr. Engineer or Tech.		150			
• Administrator		100			
Materials & Supplies					
•					
Travel					
• Installation sites					
Shipping	400			200	80
Other					

Table 2.8: Basis of cost for customizable high-speed routers to be constructed during the GENI construction stage (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Total (K\$)
TBD					

Table 2.6B: Basis of cost for capital items required in the construction of Customizable High-Speed Routers during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use Microsoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.1.3 Optical Switches
Responsible Manager: Task Manager/Leader (TBD), Optical Switches
Construction Cost Target: \$39,928,000 (CDS-PEP)
Project Account Number: TBD

The Optical Switches WBS element encompasses the work to be performed during the construction stage of GENI to build Dynamic Optical Switches (D-OS) to be installed in the GENI Facility. The work also includes procurement and deployment of five Reconfigurable Optical Add-Drop Multiplexers (ROADMs) in the Facility.

DELIVERABLES

- Deployment of five ROADM optical switches in five different GENI Facility PoPs in year-1 construction
- Develop two different D-OS platform types by end year-3; select winning platform design and develop this switch, with deployment of 17 switches in as many PoPs by end year-4 construction
- Integrated control software into D-OS switches and deploy for support of virtualization in years 4 and 5
- *More detailed deliverables required in the OS area; to be developed by Backbone WG*

COMPONENTS

The Dynamic Optical Switch WBS element consists of the following major components:

- 1.2.1.3.1 Type-1 and Type-2 D-OS Devices
- 1.2.1.3.2 Component Manager Software
- 1.2.1.3.3 D-OS Device Type Selection
- 1.2.1.3.4 D-OS Construction and Testing
- 1.2.1.3.5 Optical Switch Distribution, Installation, and On-Site Testing
- 1.2.1.3.6 *Other components TBD by WG responsible for this WBS element*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the completion of WBS elements associated with Optical Switches:

- Project Manager (TBD), GENI Project
- System Architect TBD (Dynamic Optical Switch Development)
- Task Manager TBD (Type-1 D-OS Development)
- Task Manager TBD (Type-2 D-OS Development)

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for Optical Switches to be installed in the GENI Facility during the construction stage.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.1.3.1	Type-1 and Type-2 D-OS Devices						
1.2.1.3.2	Component Manager Software						
1.2.1.3.3	D-OS Device Type Selection						
1.2.1.3.4	D-OS Construction & Testing						
1.2.1.3.5	OS Distribution, Installation & Testing						
1.2.1.3.6	TBD by WG						
1.2.1.3.7	TBD by WG						
#	<i>Etcetera</i>						
1.2.1.3	Subtotals	39,928	8,415	6,690	7,490	9,668	7,665
	Contingency						
	Totals						

Table 2.9: Shows cost breakdown structure for construction and deployment of optical switches in the GENI Facility during the construction stage (2009-2013)

BASIS OF COST

Expense Elements	# Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director		350			
• Area Office Managers		250			
• Task Manager/Leader		250			

• Senior Engineer		250			
• Contract Labor		150			
• Jr. Engineer or Tech.		150			
• Administrator		100			
Materials & Supplies					
•					
Travel					
• Installation sites					
Shipping	400			200	80
Other					

Table 2.10: Basis of cost for construction of Dynamic Optical Switches to be deployed in the GENI Facility during the construction stage (2009-2013)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Total (K\$)
Commercial ROADMs					
Dynamic – OS No. 1					
Dynamic – OS No. 2					
Others TBD					

Table 2.6B: Basis of cost for capital items required in the construction of Optical Switches during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.2 Facility Management Software
Responsible Manager: Project Manager & Chief Architect (TBD)
Construction Cost Target: \$113,405K (CDS-PEP)
Project Account Number: TBD

The Facility Management Software WBS element encompasses the work during the construction stage that will develop and deliver the management software that integrates the various subsystems of the GENI Facility, and enables researchers to easily use the Facility for their work.

DELIVERABLES

- Build and deliver the GENI Management Core (GMC) software to GENI Facility. First installation in year-1 construction; updates in years-2,3. GMC developer ensures inter-working with component manager software produced by network element builders.
- Build and deliver working infrastructure and underlay software services, including provisioning, information plane, resource brokers, development tools, security and others TBD. First services available in year-2. Additional services in years 3-5, identified by user-researchers of GENI Facility in construction.
- Build and provide instrumentation services software to network element builders in a manner consistent with network element development schedules.
- *Other deliverables, or substitutes to the above, to be developed during planning by the responsible WGs*

COMPONENTS

The Facility Management Software WBS element consists of the following major components:

- 1.2.2.1 GENI Management Core (GMC) Software
- 1.2.2.2 Infrastructure Services Software
- 1.2.2.3 Underlay Services Software
- 1.2.2.4 Instrumentation Software
- 1.2.2.4 *Other components to this WBS TBD during planning by responsible WGs*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the development, construction, testing, and delivery of Facility Management software:

- Chief Architect (TBD), Overall Task Management
- Task Manager (TBD), GMC Software
- Task Manager (TBD), Infrastructure Services

- Task Manager (TBD), Underlay Services
- Task Manager (TBD), Instrumentation Software

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for the major work elements in the Facilities Management Software WBS.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.2.1	GENI GMC Software						
1.2.2.2	Infrastructure Services Software						
1.2.2.3	Underlay Services Software						
1.2.2.4	Instrumentation Software						
1.2.2.5	<i>Etcetera</i>						
1.2.2	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

This table focuses on expense items. If you have capital items as well, please build an appropriate table for this as well (see other sections that have this extra table).

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			

• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.2.1 GENI Management Core (GMC) Software
Responsible Manager: TBD
Construction Cost Target: \$9,300K (CDS-PEP)
Project Account Number: TBD

The GENI Management Core Software WBS element encompasses the work during the construction stage that builds, tests and deploys the GMC software. This software instantiates slices across a collection of GENI components (e.g., routers, switches, etc.), and remotely manages these.

DELIVERABLES

- To be specified by the WG leader responsible for GMC software
- WG leader and team also develop six component areas below with a new WBS element page for each.

COMPONENTS

The GENI Management Core Software WBS element consists of the following major components:

- 1.2.2.1.1 Slice Manager
- 1.2.2.1.2 Resource Controller
- 1.2.2.1.3 Auditing Archive
- 1.2.2.1.4 Web Front End
- 1.2.2.1.5 GMC Subsystems Integration and Testing
- 1.2.2.1.6 *These components to be adjusted as appropriate by WG responsible for GMC*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the development, construction, testing, and deployment of the GMC software:

- Chief Architect (TBD, GENI)
- Task Manager (TBD), Overall GMC Build
- Software Engineer (TBD), Slice Management Software
- Software Engineer (TBD), Resource Controller Software
- Software Engineer (TBD), Web Front End Software
- Software Engineer (TBD), Software Subsystems Integrations & Test

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for the major work element in the GMC Software WBS. This is an example table. Please alter it as needed to meet the requirements of this WBS element.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.2.1	GENI GMC Software						
1.2.2.2	Infrastructure Services Software						
1.2.2.3	Underlay Services Software						
1.2.2.4	Instrumentation Software						
1.2.2.5	<i>Etcetera</i>						
1.2.2	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

This table focuses on expenses and not capitalized items. If you have items that will be capitalized, please generate a similar basis of cost for capital.

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			

• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.2.2 Infrastructure Services Software
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$47,735K (CDS-PEP)
Project Account Number: TBD

The GENI Infrastructure Services Development WBS element encompasses the work during the construction stage that builds, tests, and deploys Infrastructure Services software. *[We define four services, but expect users to propose new and more powerful services as they gain experience with GENI]*

DELIVERABLES

- The deliverables to be developed by the WG for 1.2.2.2 and its subtask components (below), taking into account both what is to be delivered and when (be specific to the quarter of year; these dates will have to be rectified with other dependent WGs).

COMPONENTS

The GENI Infrastructure Services Software WBS element consists of the following major components, including a cost item as yet undefined to account for user-proposed new services development throughout the GENI construction stage:

- 1.2.2.2.1 Provisioning Services
- 1.2.2.2.2 Information Plane
- 1.2.2.2.3 Resource Broker
- 1.2.2.2.4 Development Tools
- 1.2.2.2.5 Other Infrastructure Services

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel will have primary responsibility for the development, testing, and deployment of Infrastructure Services software:

- Task Manager (TBD), Infrastructure Services Development
- Software Engineers (TBD), Provisioning Service Software
- Software Engineers (TBD), Information Plane Software
- Software Engineers (TBD), Resource Broker Software
- Software Engineers (TBD), Development Tools Software TBD
- Research Users (TBD), Other Infrastructure Services Software

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for major tasks to be completed in the Infrastructure Services Software WBS. Build a similar table for capitalized equipment if necessary.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.2.2.1	Provisioning Services						
1.2.2.2.2	Information Plane						
1.2.2.2.3	Resource Broker						
1.2.2.2.4	Development Tools						
1.2.2.2.5	<i>Other Infrastructure Services</i>						
1.2.2.2	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

Please add a similar table for capital basis of cost if appropriate

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.2.3 Underlay Services Software
Responsible Manager: Task Managers (TBD)
Construction Cost Target: \$47,735K (CDS-PEP)
Project Account Number: TBD

The GENI Underlay Services Software WBS element encompasses the work that builds, tests and deploys the Underlay Services software for the GENI Facility.

DELIVERABLES

- Specific deliverables to be developed by the WG members responsible for defining these services. These must be as specific as possible and have dates for delivery to the quarter year anticipated.

COMPONENTS

The GENI Underlay Services Software WBS element consists of the following major components, including a cost item as yet undefined to account for user-proposed new underlay services built throughout the GENI construction stage:

- 1.2.2.3.1 Security Service
- 1.2.2.3.2 Topology Service
- 1.2.2.3.3 File Naming Service
- 1.2.2.3.4 Legacy Internet Service
- 1.2.2.3.5 Other Underlay Services

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the WBS elements involving the development, testing, and deployment of Underlay Services software in the GENI Facility:

- Task Manager (TBD), Underlay Services
- Software Engineers (TBD), Security Service Software
- Software Engineers (TBD), Topology Service Software
- Software Engineers (TBD), File Naming Service Software
- Software Engineers (TBD), Legacy Internet Service Software TBD
- Research Users (TBD), Other Underlay Services

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for major tasks in the Underlay Services Software WBS.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.2.3.1	Security Service						
1.2.2.3.2	Topology Service						
1.2.2.3.3	File Naming Services						
1.2.2.3.4	Legacy Internet Services						
1.2.2.3.5	<i>Other Underlay Services</i>						
1.2.2.3	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					

• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.2.4 Instrumentation Software
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$8,635K (CDS-PEP)
Project Account Number: TBD

The GENI Instrumentation Software WBS element encompasses the work that builds, tests and deploys Instrumentation software to the GENI Facility.

DELIVERABLES

- Deliverables to be developed for WBS element 1.2.2.4 by the WG responsible for this element and its sub-elements. Must include due date for each deliverable, estimated to the quarter of year.

COMPONENTS

The GENI Instrumentation Software WBS element consists of the several major components; three are identified here. Additional instrumentation software modules are expected to be proposed by facility users and developed as required and appropriate during construction:

- 1.2.2.4.1 Data Collection Software
- 1.2.2.4.2 Data Archiving Software
- 1.2.2.4.3 Data Analysis Software
- 1.2.2.4.4 Other Instrumentation Software

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the development, testing, and deployment of Instrumentation Software:

- Task Manager (TBD), Instrumentation Software
- Software Engineer (TBD), Data Collection Software
- Software Engineer (TBD), Data Archiving Software
- Software Engineer (TBD), Data Analysis Software
- Research Users (TBD), Other Instrumentation Software

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for major work tasks in the Instrumentation Software WBS.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.2.4.1	Data Collection Software						
1.2.2.4.2	Data Archiving Software						
1.2.2.4.3	Data Analysis Software						
1.2.2.4.4	Other Instrumentation Software						
1.2.2.4	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					

• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.3 Network Assembly and Management
Responsible Manager: TBD
Construction Cost Target: \$68,278K (CDS-PEP)
Project Account Number: TBD

The GENI National Assembly and Management WBS element encompasses the work during the construction of GENI that is required to connect the component nodes and subnet technologies into an end-to-end facility and to provide on-going management of the GENI Facility during construction.

DELIVERABLES

- Assemble network nodes, core fiber plant, tail circuits, connections to legacy internet, and edge devices into a coherent, fully functional facility. First instantiation to be deployed by end year-1 of construction.
- Additions to GENI Facility as these are developed in construction years 2-5. Installation dates to be determined by Planning Team.
- Provide operations management of the GENI Facility during the five-year construction stage.
- *These deliverables need to be sorted out by the WG responsible for this WBS element*

COMPONENTS

The National Assembly and Management WBS element consists of four major components:

- 1.2.3.1 Backbone Assembly
- 1.2.3.2 Tail Circuit / Edge Site Assembly
- 1.2.3.3 Internet Exchange Assembly
- 1.2.3.4 Network Management during Construction
- 1.2.3.5 *Construct other components as appropriate*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the completion of WBS tasks involving development and deployment of the National Assembly and Management during Construction:

- Task Manager (TBD), National Assembly and Management
- Lead Engineer (TBD), Backbone Assembly
- Lead Engineer (TBD), Tail Circuit and Edge Site Assembly
- Lead Engineer (TBD), Internet Exchange Assembly
- Facility Operations Manager (TBD), Network Management during Construction

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost breakdown for major work tasks in the National Assembly and Management WBS.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.3.1	Backbone Assembly						
1.2.3.2	Tail Circuit/Edge Site Assembly						
1.2.3.3	Internet Exchange Assembly						
1.2.3.4	Network Management in Construction						
1.2.3.5	Other Components to be developed by WG						
1.2.3	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Please create an appropriate basis of cost for capitalized items in this WBS element.

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Facility Node Devices					
Wireless Subnets					
Network Assembly					
Totals					

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.3.1 National Backbone Assembly
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$29,121K (CDS-PEP)
Project Account Number: TBD

The National Backbone Assembly WBS element encompasses the work during construction required to establish a national fiber facility and to connect network nodes into a coherent backbone network during GENI construction.

DELIVERABLES

- Deliverables at this level to be developed by WG responsible for WBS 1.2.3.1 and its subtasks (below).

COMPONENTS

The National Backbone Assembly WBS element consists of five major components:

- 1.2.3.1.1 National Fiber and Core Bandwidth Implementation
- 1.2.3.1.2 Additional Core Bandwidth (Wavelengths)
- 1.2.3.1.3 Network Facilities Preparation
- 1.2.3.1.4 Backbone Node Deployment
- 1.2.3.1.5 Network Integration and Testing
- 1.2.3.1.6 Add other components as appropriate to this Task

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for deployment of the National Backbone:

- Project Manager (TBD), GENI Project
- Task Manager (TBD), Backbone Assembly
- Lead Engineer (TBD), Network and Node Deployment
- Test Engineers (TBD), Connectivity and Network Integration & Testing

CONSTRUCTION COST BREAKDOWN

The following table summarizes the construction cost and capital breakdown for each major work task in the National Backbone Assembly WBS.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.3.1.1	National Fiber and Core Bandwidth Implementation						
1.2.3.1.2	Additional Core Bandwidth (λs)						
1.2.3.1.3	Network Facilities Preparation						
1.2.3.1.4	Backbone Node Deployment						
1.2.3.1.5	Network Integration and Testing						
1.2.3.1.6	Others TBD						
1.2.3.1	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

The following tables contain information related to the basis of cost, both for expense items and for capitalized equipment.

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			

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• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Please create appropriate categories for this table, which should show the basis of cost for capitalized items associated with this WBS Element

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Facility Node Devices					

Wireless Subnets					
Network Assembly					
Totals					

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.3.2 Tail Circuits and Edge Site Assembly
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$23,032,000 (CDS-PEP)
Project Account Number: TBD

The Tail Circuits and Edge Site Assembly WBS element encompasses the work during GENI construction to deploy ingress nodes to the edge of the GENI network and to establish physical connectivity and circuits to the backbone facility from the network edge.

DELIVERABLES

- Deliverables to be developed by WG responsible for WBS 1.2.3.2 and subtasks that are related (below).

COMPONENTS

The Tail Circuit/Edge Site Assembly WBS element consists of the following major components:

- 1.2.3.2.1 Dark Fiber Lease w/ 155Mb/s Service
- 1.2.3.2.2 Connection of Existing Fiber w/ 45Mb/s Service
- 1.2.3.2.3 Pulled Fiber Deployment and 1-10 Gb/s Service
- 1.2.3.2.4 Connection of Existing Fiber with IP Services
- 1.2.3.2.5 New Connection Technologies Deployment TBD
- 1.2.3.2.6 Another other components that are appropriate to be added

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the deployment of the tail circuits and connection to edge sites:

- Project Manager (TBD), GENI Project
- Systems Engineering Manager (TBD), GENI Project
- Task Manager (TBD), Tail Circuit Deployment
- Installation Engineers (TBD), Tail Circuit Installations
- Edge Site Engineers (TBD), Edge Site Installations and Testing

CONSTRUCTION COST BREAKDOWN

This Table shows the cost breakdown during GENI construction for tail circuits and edge site assembly.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.3.2.1	Dark Fiber Lease w/ 155 Mb/s Service						
1.2.3.2.2	Connection of Existing Fiber @ 45 Mb/s						
1.2.3.2.3	Pulled Fiber Deployment 1-10 Gb/s						
1.2.3.2.4	Connection of Existing Fiber w/ IP Services						
1.2.3.2.5	New Connection Technologies						
1.2.3.2.6	Others TBD						
1.2.3.2	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

The following Tables contain information on the basis of cost, both for expense items and for capitalized equipment.

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Please create appropriate categories for this table, which should show the basis of cost for capitalized items associated with this WBS Element

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Facility Node Devices					
Wireless Subnets					
Network Assembly					

Totals					
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WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.3.3 Internet Exchange Assembly
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$11,005K (CDS-PEP)
Project Account Number: TBD

The Internet Exchange Assembly WBS element encompasses the work during the construction stage that is required to provide connectivity from the GENI backbone network to the legacy Internet. Two connection nodes are planned – one in the East and one in the West.

DELIVERABLES

- Deliverables at this level to be developed by WG responsible for WBS 1.2.3.3 and related subtasks (below).

COMPONENTS

The Internet Exchange Assembly WBS element consists of the following major components:

- 1.2.3.3.1 Connectivity at 45Mb/s
- 1.2.3.3.2 Connectivity at 155Mb/s
- 1.2.3.3.3 Connectivity at 1-10 Gb/s
- 1.2.3.3.4 *Add other components as required and appropriate*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the acquisition and deployment of connections to the legacy Internet for SONET and Ethernet services:

- Project Manager (TBD), GENI Project
- Task Manager (TBD), Internet Connectivity TBD
- Engineers TBD (Connection Engineering)
- Technician TBD (Connection Testing)

CONSTRUCTION COST BREAKDOWN

This Table shows the cost breakdown during GENI construction associated with the construction of Internet exchange assemblies in the East and in the West..

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.3.3.1	Connectivity to Internet @ 45 Mb/s						
1.2.3.3.2	Connectivity to Internet @ 155 Mb/s						
1.2.3.3.3	Connectivity to Internet @ 1-10 Gb/s						
1.2.3.3.4	Other Internet Connections TBD						
1.2.3.3	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

The following Tables contain information on the basis of cost, both for expense items and for capitalized equipment, as relate to the development of connections to the legacy Internet.

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Please create appropriate categories for this table, which should show the basis of cost for capitalized items associated with this WBS Element

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Facility Node Devices					
Wireless Subnets					
Network Assembly					

Totals					
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WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.3.4 Facility Management in Construction
Responsible Manager: TBD
Construction Cost Target: 5,120,000 (CDS-PEP)
Project Account Number: TBD

The Facility Management in Construction WBS element encompasses the work required to operate the GENI Facility during the construction stage. *[Note: this WBS element was previously for after-construction, but is represented here for the construction period only. MREFC will only fund operation during construction, not after. The initial cost estimate above was taken from the PEP for post-construction operation and needs to be reviewed]*

DELIVERABLES

- Provide facility operations management during the facility construction process, including coordination of ongoing construction and use of the facility by researchers.
- *A complete set of deliverables needs to be developed in detail for all of the various aspects of the construction stage involving the operation and management of the GENI Facility.*

COMPONENTS

- 1.2.3.4.1 Facilities Turn-up for Construction Stage Research
- 1.2.3.4.2 Upgrades and Revisions of Network Components
- 1.2.3.4.3 *TBD (and others as well)*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for operation of the GENI Facility during construction:

- Project Manager (TBD), GENI Project
- Network Operations Manager (TBD), GENI Facility
- Facilities Manager (TBD), GENI Facility
- Software Engineers (TBD), GENI Facility
- Hardware Engineers (TBD), GENI Facility
- Environmental & Safety Manager (TBD), GENI Facility

CONSTRUCTION COST BREAKDOWN

This Table shows the cost breakdown during GENI construction associated with the construction of Internet exchange assemblies in the East and in the West..

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.3.4.1	Initial Facilities Turn-up for Research						
1.2.3.4.2	Upgrades and Revisions of Facilities						
1.2.3.4.3	TBD						
1.2.3.4.4	TBD						
1.2.3.4	Subtotals						
	Contingency						
	Totals						

BASIS OF COST

The following Tables contain information on the basis of cost, both for expense items and for capitalized equipment, as relate to the operation of the GENI Facility during the Construction Stage.

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Please create appropriate categories for this table, which should show the basis of cost for capitalized items associated with this WBS Element

Capital Elements	Unit Prices	Number of Units	Installation Expense	Training	Total
Facility Node Devices					
Wireless Subnets					
Network Assembly					

Totals					
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WORK BREAKDOWN STRUCTURE AND SCHEDULE

Develop a schedule for the activities of this WBS Element and insert it here. See example in the Wireless Section of this WBS Dictionary. Please use MicroSoft Project if you possibly can. If not, then use what you can and we'll do the translation to MS Project. Of course, this schedule becomes more and more detailed as the level of the WBS Element deepens. Also, the time periods for completion of activities becomes shorter; you will have to decide what is a reasonable level of detail and time granularity for this WBS Element. Best to get the granularity down to about 3 months (or less) for the lowest level in this WBS Element.

WBS Element: 1.2.4 Wireless Subnets
Responsible Manager: Task Director (TBD)
Construction Cost Target: \$55,516,000 (CDS-PEP)
Project Account Number: TBD

The Wireless Subnets WBS element encompasses all work during the construction stage required to build, test, distribute and field test five types of wireless subnets for the GENI Facility. These subnets include: Urban Ad Hoc Subnets, Suburban Wide-Area Subnets, Cognitive Radio Subnets, Application-Specific Sensor Subnets, and Wireless Emulation Subnets.

DELIVERABLES

- Build, test, distribute, and field test Urban Ad Hoc Subnets for GENI. Supervise connection to GENI, integrated network testing, and validation of specified functionality
- Build, test, distribute, and field test Suburban Wide-Area Subnets for GENI. Supervise connection to GENI, integrated network testing, and validation of specified functionality
- Build, test, distribute, and field test Cognitive Radio Subnets for GENI. Supervise connection to GENI, integrated network testing, and validation of specified functionality
- Build, test, distribute, and field test Application-Specific Sensor Subnets for GENI. Supervise connection to GENI, integrated network testing, and validation of specified functionality
- Build, test, distribute, and field test wireless Emulation Subnets for GENI. Supervise connection to GENI, integrated network testing, and validation of specified functionality
- Completion in a timely way the selection of subnet sites, access point installations, distribution of edge devices, and writing of component manager and control software.
- Others TBD by the Wireless Subnets WG

COMPONENTS

The Wireless Subnets WBS element consists of the following five components:

- 1.2.4.1 Urban *Ad Hoc* Subnets
- 1.2.4.2 Suburban Wide-Area Subnets
- 1.2.4.3 Cognitive Radio Subnets
- 1.2.4.4 Application-Specific Sensor Subnets
- 1.2.4.5 Wireless Emulation Subnets

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for deployment of wireless subnets in the GENI Facility:

- Project Manager (TBD), GENI Project Office
- Subnets Project Manager (TBD), GENI Project Office
- Task Manager (TBD), Urban Ad Hoc Subnets
- Task Manager (TBD), Suburban Wide-Area Subnets
- Task Manager (TBD), Cognitive Radio Subnets TBD
- Task Manager (TBD), Application-Specific Sensor Subnets
- Task Manager (TBD), Wireless Emulation Subnets

CONSTRUCTION COST BREAKDOWN

The following Table summarizes the construction cost breakdown for Wireless Subnets, including subnet device construction, laboratory testing, distribution to field sites, and on-site assembly and testing. Connection to the GENI backbone and commissioning are included under Sections 1.2.3 and 1.4, respectively. Dollars are in 1000s.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.4.1	Urban Ad hoc	16,449	7665	2196	2196	2196	2196
1.2.4.2	Suburban Wide Area	10,700	4180	1630	1630	1630	1630
1.2.4.3	Cognitive Radio	13,166	5766	1850	1850	1850	1850
1.2.4.4	Application-Specific Sensor Subnets	7,251	2143	1277	1277	1277	1277
1.2.4.5	Wireless Emulation	7,950	1850	1750	1450	1450	1450
1.2.4	Subtotals	55,516	21,604	8703	8403	8403	8403
	Contingency	TBD					
	Totals						

Table 2.xx: Construction cost breakdown for Wireless Subnets to be deployed to field sites in the GENI Facility during five-year construction period (2009-2013).

BASIS OF COST

The information in the following Tables was used to calculate the construction cost breakdown for Wireless Subnets.

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					

• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost in Conceptual Design Stage to estimate cost of Wireless Subnets in the GENI Facility (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	Units	Installation Expense (\$)	Training (K\$)	Total (K\$)
Urban Ad hoc node devices					5,642
Suburban Wide Area Devices					1,914
Cognitive Radio Devices					3,401
Application-Specific Sensor Devices					446
Emulation Subnet Devices					325

Table 2.xxB: Basis of cost for capital items required in the deployment of Wireless Subnets during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

The Table below shows the rolled up construction schedules for each of the five wireless subnets to be constructed and integrated with the GENI core network during the construction stage. Details of the schedules shown here are to be developed by the Wireless Subnets WG during this stage of planning.

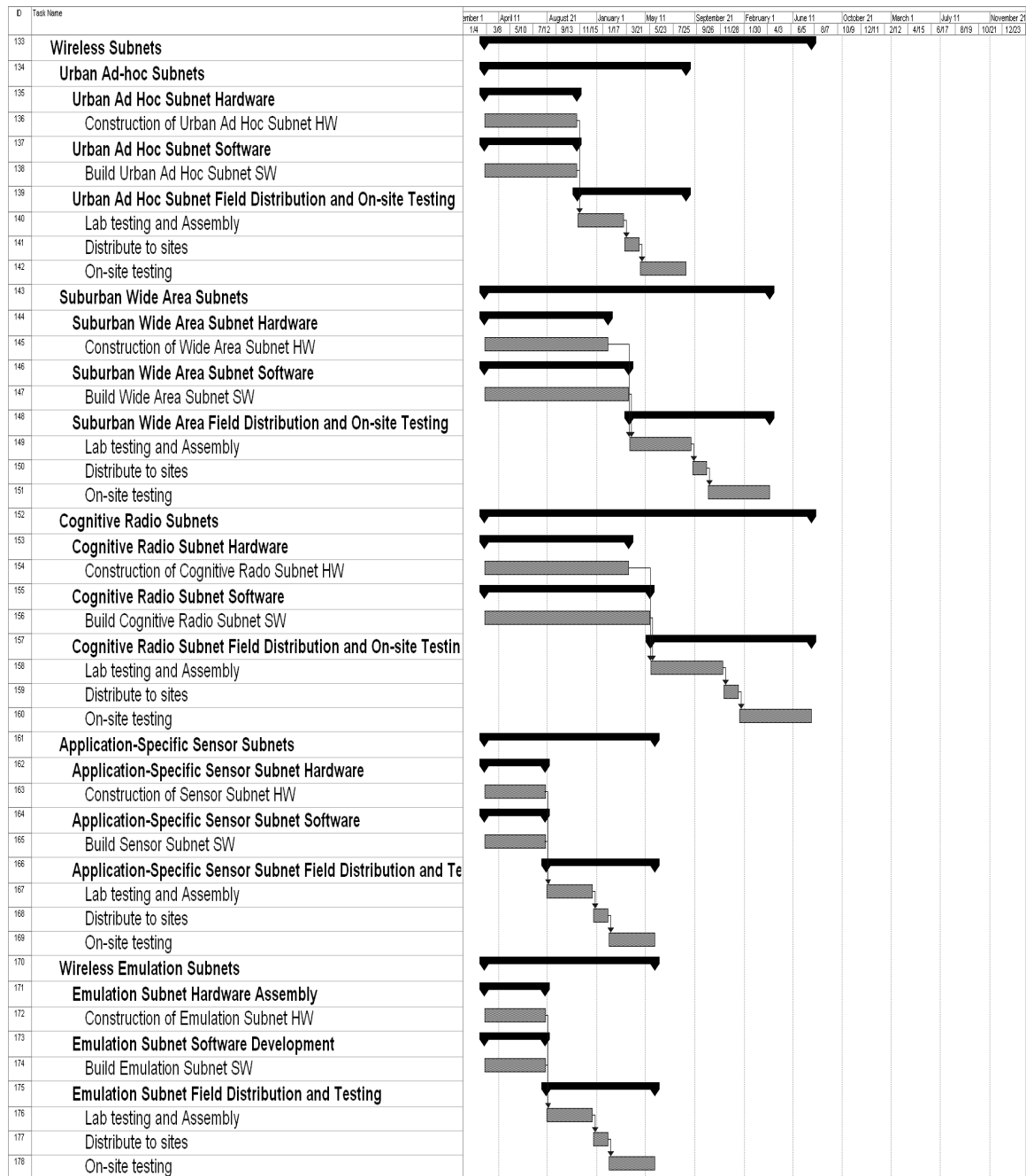


Table 2.xx: Rolled up schedules for construction of five wireless subnets during GENI construction

WBS Element: 1.2.4.1 Urban *Ad Hoc* Subnets
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$16,449 (CDS-PEP)
Project Account Number: TBD

The Urban *Ad Hoc* Subnets WBS element encompasses the work during GENI construction required to build, laboratory test, distribute, field assemble and test Urban *Ad Hoc* Subnets in the GENI Facility.

DELIVERABLES

- Build, test, deliver to selected field sites, assemble hardware and software and field test Urban *Ad Hoc* Subnet.
- TBD
- *Specific deliverables for WBS 1.2.4.1 to be developed by WG responsible for this WBS element and related subtasks as listed below*

COMPONENTS

The Urban *Ad Hoc* Subnets WBS element consists of the following components:

- 1.2.4.1.1 Urban *Ad Hoc* Subnet Hardware
- 1.2.4.1.2 Urban *Ad Hoc* Subnet Software
- 1.2.4.1.3 Urban *Ad Hoc* Subnet Field Distribution and On-Site Testing
- 1.2.4.1.4 *Add other components as appropriate*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for construction, lab testing, distribution, and on-site field testing of the Urban *Ad Hoc* Subnet:

- Project Manager (TBD), GENI Project Office
- Task Manager (TBD), Urban *Ad Hoc* Subnets
- Engineers (TBD), Hardware, Construction, Testing
- Engineers (TBD), Software, Development, Testing, Integration

CONSTRUCTION COST BREAKDOWN

The following Table summarizes the construction cost breakdown for Urban Ad Hoc Wireless Subnets, including subnet device construction, laboratory testing, distribution to field sites, and on-site assembly and testing. Connection to the GENI backbone and commissioning are included under Sections 1.2.3 and 1.4, respectively. Dollars are in 1000s.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.4.1.1	Subnet Hardware						
1.2.4.1.2	Subnet Software						
1.2.4.1.3	Subnet Distribution & On-Site Testing						
1.2.4.1.4	TBD						
1.2.4.1.5	TBD						
1.2.4.1	Subtotals	16,449	7665	2196	2196	2196	2196
	Contingency	TBD					
	Totals						

Table 2.xx: Cost breakdown for Wireless Subnets to be deployed to field sites in the GENI Facility during five-year construction period (2009-2013).

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			1,750
• Area Office Managers		250			
• Task Manager/Leader	4	250			5,000
• Senior Engineer	1	250			
• Contract Labor	0.67	150			100
• Engineer/Technician		150			
• Administrator		100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day	TBD			
• Conferences	Day	TBD			
• Project Meetings	Day	TBD			
Shipping					
• Node Elements	Unit	---			
Maintenance					
• Network Nodes	15%	---		3,807	3,807
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				150
Other Expenses				TBD	
• TBD					
Total Expenses					10,807

Table 2.xxA: Basis of cost in Conceptual Design Stage to estimate cost of Wireless Subnets in the GENI Facility (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
Network Platforms						403
RF Nodes						5,239
Other Capital						TBD
•						
•						
Total Capital						5,642

Table 2.xxB: Basis of cost for capital items required in the deployment of Urban Ad Hoc Subnets during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

This diagram currently shows tasks associated with the construction of wireless Urban Ad hoc Subnets at level four of the WBS. It will be modified by the Wireless Subnets WG following definition of tasks at Levels 5 and 6 during the present stage of planning.

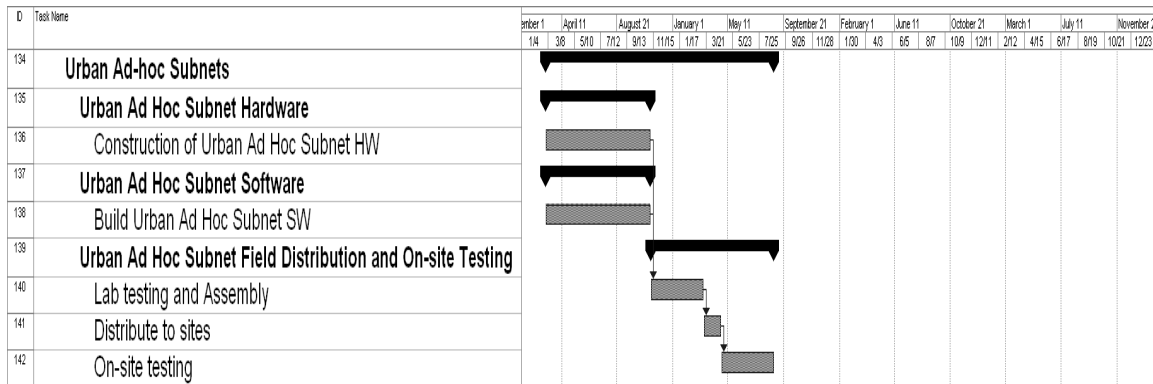


Table 2.yy: Rolled up schedule for construction of wireless Urban Ad Hoc Subnets during the GENI Construction Stage

WBS Element: 1.2.4.2 Suburban Wide Area Subnets
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$10,700,000 (CDS-PEP)
Project Account Number: TBD

The Suburban Wide Area Subnet WBS element encompasses the work during GENI construction required to build, laboratory test, deploy to a field site, and field-test a Suburban Wide Area Subnet in the GENI Facility.

DELIVERABLES

- Build, test, deliver to field site and field-test the hardware and software for a suburban wide area wireless subnet.
- Complete subnet assembly and on-site testing in field
- Etc.
- Etc.
- Details of deliverables for this WBS must be reviewed by the responsible WG. Final deliverables created by that WG.

COMPONENTS

The Suburban Wide Area Subnet WBS element consists of the following components:

- 1.2.4.2.1 Suburban Wide Area Subnet Hardware
- 1.2.4.2.2 Suburban Wide Area Subnet Software
- 1.2.4.2.3 Suburban Wide Area Subnet Field-site Delivery and Testing
- 1.2.4.2.4 *Add other components as required*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for construction, lab testing, and assembly/testing of a suburban wide area subnet at an appropriate field site:

- Project Manager (TBD), GENI Project
- Wireless Subnets Manager (TBD), GENI Project Office
- Task Manager (TBD), Suburban Wide Area Subnets
- Hardware Engineers (TBD), Hardware Construction and Testing
- Software Engineers (TBD), Software Development, Integration, Testing

CONSTRUCTION COST BREAKDOWN

The following Table summarizes the construction cost breakdown for Suburban Wide Area Subnets, including subnet device construction, laboratory testing, distribution to field sites, and on-site assembly and testing. Connection to the GENI backbone and commissioning are included under Sections 1.2.3 and 1.4, respectively. Dollars are in 1000s.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.4.2.1	Subnet Hardware						
1.2.4.2.2	Subnet Software						
1.2.4.2.3	Subnet Distribution & On-Site Testing						
1.2.4.2.4	TBD						
1.2.4.2.5	TBD						
1.2.4.2	Subtotals	10,700	4180	1630	1630	1630	1630
	Contingency	TBD					
	Totals						

Table 2.xx: Cost breakdown for Suburban Wide Area Subnets to be deployed to field sites in the GENI Facility during five-year construction period (2009-2013).

BASIS OF COST

Expense Elements	# Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (K\$)	Totals (K\$)
Personnel					
• Sr. Managers/Directors	1	350			1,750
• Task Manager/Leader		250			
• Senior Engineers	4	250			5,000
• Contract Labor	3.5	150			520
• Jr. Engineer or Tech.	0	150			
• Administrator	0	100			0
Materials & Supplies				TBD	

• TBD					
Travel	0				0
• Field Sites				TBD	
Shipping					
• To Sites				36	36
Field Sites					
• Node/Site Expenses				150	150
• Leases of Node Sites				0	0
• Connections				20	20
• NRE				50	50
Maintenance					
• Node Sites/Equipment			15%	1,260	1,260
Other Expenses				TBD	
Total Expenses					8,786

Table 2.xxA: Basis of cost for Suburban Wide Area Subnets to be deployed in GENI Facility during the Construction Stage (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
AP Platforms						626
BTS Platforms						1,185
Control Center						103
Other Capital						TBD
•						
•						
Total Capital						1,914

Table 2.xxB: Basis of cost for capital items required in the deployment of Suburban Wide Area Subnets during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

This diagram currently shows tasks associated with the construction of wireless Suburban Wide Area Subnets at Level 4 of the WBS. It will be modified by the Wireless Subnets WG following definition of tasks at Levels 5 and 6 during the present stage of planning.

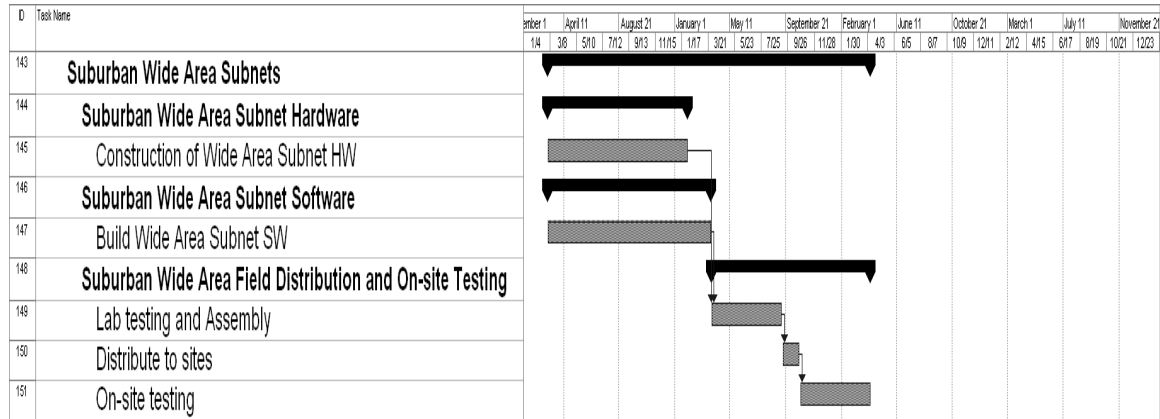


Table 2.yy: Rolled up schedule for construction of wireless Suburban Wide Area Subnets during the GENI Construction Stage

WBS Element: 1.2.4.3 Cognitive Radio Subnets
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$13,166,000 (CDS-PEP)
Project Account Number: TBD

The Cognitive Radio Subnet WBS element encompasses the work required to build, lab test, field assemble, and field test a Cognitive Radio Subnet in the GENI Facility.

DELIVERABLES

- Deliver and assemble hardware and software for a cognitive radio subnets
- Complete subnet field installation and related on-site field testing
- Etc.
- Details of deliverables for this WBS must be reviewed by responsible WG.

COMPONENTS

The Cognitive Radio Subnet WBS element consists of the following components:

- 1.2.4.3.1 Cognitive Radio Subnet Hardware Development
- 1.2.4.3.2 Cognitive Radio Subnet Software Development
- 1.2.4.3.3 Cognitive Radio Subnet Field Assembly and Test
- 1.2.4.3.4 *Add other components as required*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for construction, testing, distribution to field site, re-assembly and on-site testing of the Cognitive Radio Subnet for the GENI Facility:

- Subnets Manager (TBD, GENI Project Office)
- Task Manager (TBD), Cognitive Radio Subnets
- Hardware Engineers TBD
- Software Engineers TBD
- Technicians (TBD), Cognitive Radio Node Installations

CONSTRUCTION COST BREAKDOWN

The following Table summarizes the construction cost breakdown for Cognitive Radio Subnets, including subnet device construction, laboratory testing, distribution to field sites, and on-site assembly and testing. Connection to the GENI backbone and commissioning are included under Sections 1.2.3 and 1.4, respectively. Dollars are in 1000s.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.4.3.1	Subnet Hardware						
1.2.4.3.2	Subnet Software						
1.2.4.3.3	Subnet Distribution & On-Site Testing						
1.2.4.3.4	TBD						
1.2.4.3.5	TBD						
1.2.4.3	Subtotals	13,166	5,766	1,850	1,850	1,850	1,850
	Contingency	TBD					
	Totals						

Table 2.xx: Cost breakdown for Cognitive Radio Subnets to be deployed to field sites in the GENI Facility during five-year construction period (2009-2013).

BASIS OF COST

Expense Elements	# Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (K\$)	Totals (K\$)
Personnel					
• Sr. Managers/Directors	1	350			1,750
• Task Manager/Leader		250			
• Senior Engineers	4	250			5,000
• Contract Labor	2.3	150			350
• Jr. Engineer or Tech.	0	150			
• Administrator	0	100			0
Materials & Supplies				TBD	

• TBD					
Travel	0				0
• Field Sites				TBD	
Shipping					
• To Sites				TBD	
Field Sites					
• Node/Site Expenses					150
• Leases of Node Sites					
• Connections					
• NRE				265	265
Maintenance					
• Node Sites/Equipment			15%	2,250	2,250
Other Expenses				TBD	
Total Expenses					9,765

Table 2.xxA: Basis of cost for Suburban Wide Area Subnets to be deployed in GENI Facility during the Construction Stage (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
CR Client Nodes						2,525
CR Network Nodes						473
Infrastructure HW						403
Other Capital						TBD
•						
•						

Total Capital						3,401
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Table 2.xx B: Basis of cost for capital items required in the deployment of Cognitive Radio Subnets during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

This diagram currently shows tasks associated with the construction of wireless Cognitive Radio Subnets at Level 4 of the WBS. It will be modified by the Wireless Subnets WG following definition of tasks at Levels 5 and 6 during the present stage of planning.

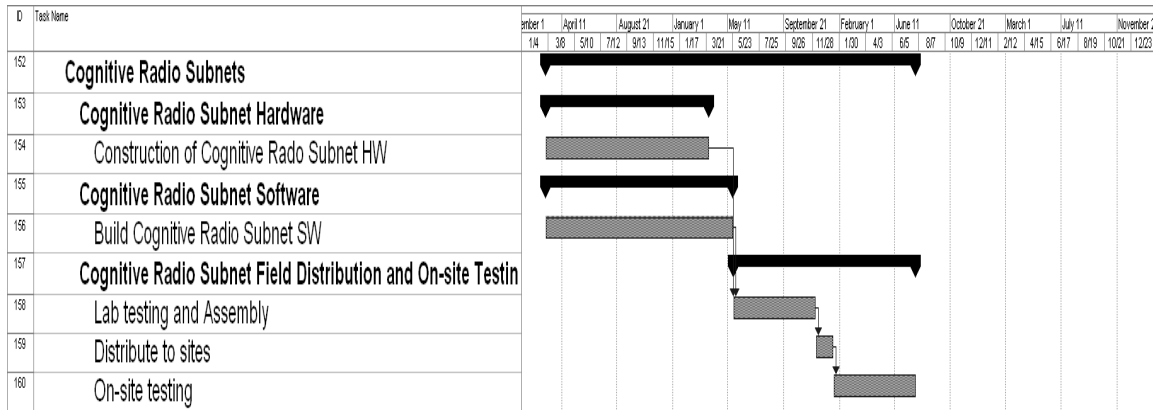


Table 2.yy: Rolled up schedule for construction of wireless Cognitive Radio Subnets during the GENI Construction Stage

WBS Element: 1.2.4.4 Application-Specific Sensor Subnet
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$7,251,000 (CDS-PEP)
Project Account Number: TBD

The Application-Specific Sensor Subnet WBS element encompasses the work during the GENI construction stage required to construct, lab test, deliver to site, reassemble and field test Application-Specific Sensor Subnets for the GENI Facility.

DELIVERABLES

- Construct, test, deliver, re-assemble and field-test hardware and software for an Application-Specific Sensor Subnet
- Others TBD
-
- *Details of deliverables for this WBS must be reviewed by responsible WG.*

COMPONENTS

The Application-Specific Sensor Subnet WBS element consists of the following components:

- 1.2.4.4.1 Application-Specific Sensor Subnet Hardware
- 1.2.4.4.2 Application-Specific Sensor Subnet Software
- 1.2.4.4.3 Application-Specific Sensor Subnet Field Assembly and Test

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the construction, testing, distribution, assembly, and field-testing of elements for an Application-Specific Sensor Subnet:

- Subnets Manager (TBD), GENI Project Office
- Task Manager (TBD), Application-Specific Sensor Subnet
- Engineers (TBD), Software
- Technician (TBD), Sensors
- Technicians (TBD), Gateways

CONSTRUCTION COST BREAKDOWN

The following Table summarizes the construction cost breakdown for Application-Specific Sensor Subnets, including subnet device construction, laboratory testing, distribution to field sites, and on-site assembly and testing. Connection to the GENI backbone and commissioning are included under Sections 1.2.3 and 1.4, respectively. Dollars are in 1000s.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.4.4.1	Subnet Hardware						
1.2.4.4.2	Subnet Software						
1.2.4.4.3	Subnet Distribution & On-Site Testing						
1.2.4.4.4	TBD						
1.2.4.4.5	TBD						
1.2.4.4	Subtotals	7,251	2,143	1,277	1,277	1,277	1,277
	Contingency	TBD					
	Totals						

Table 2.xx: Cost breakdown for Application-Specific Sensor Subnets to be deployed to field sites in the GENI Facility during construction period (2009-2013).

BASIS OF COST

Expense Elements	# Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (K\$)	Totals (K\$)
Personnel					
• Sr. Managers/Directors	0.5	350			875
• Task Manager/Leader		250			
• Senior Engineers	4	250			5,000
• Contract Labor	1.8	150			270
• Jr. Engineer or Tech.	0	150			
• Administrator	0	100			
Materials & Supplies				TBD	

• TBD					
Travel	0				0
• Field Sites				TBD	
Shipping					
• To Sites				TBD	
Field Sites					
• Node/Site Expenses					
• Leases of Node Sites					
• Connections				20	20
• NRE				130	130
Maintenance					
• Node Sites/Equipment			15%	510	510
Other Expenses				TBD	
Total Expenses					6,805

Table 2.xx A: Basis of cost for Application-Specific Sensor Subnets to be deployed in GENI Facility during the Construction Stage (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
Sensor H/W						250
Gateway H/W						176
Support Computers						20
Other Capital						TBD
Total Capital						446

Table 2.xx B: Basis of cost for capital items required in the deployment of Application-Specific Sensor Subnets during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

This diagram currently shows tasks associated with the construction of wireless Application-Specific Sensor Subnets at Level 4 of the WBS. It will be modified by the Wireless Subnets WG following definition of tasks at Levels 5 and 6 during the present stage of planning.

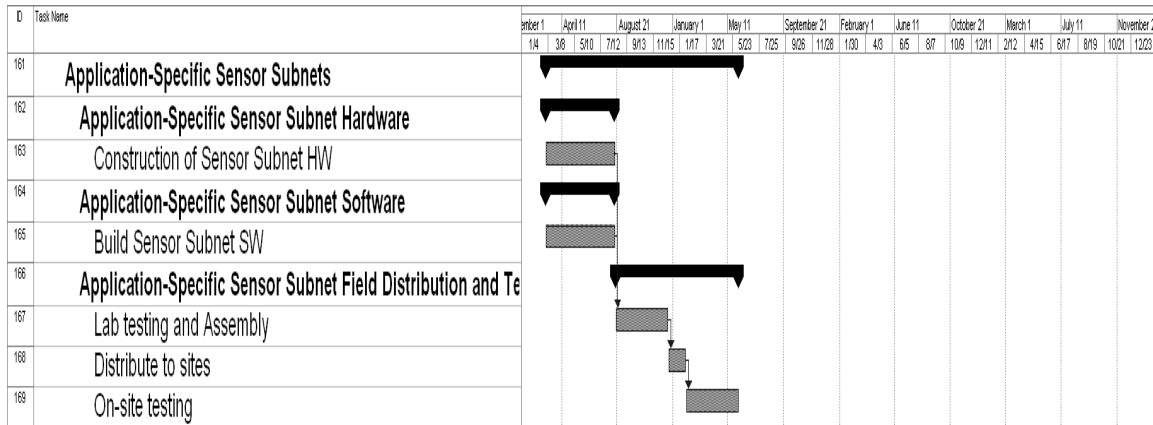


Table 2.yy: Rolled up schedule for construction of wireless Application-Specific Sensor Subnets during the GENI Construction Stage

WBS Element: 1.2.4.5 Wireless Emulation Subnet
Responsible Manager: Task Manager (TBD)
Construction Cost Target: \$7,950,000 (CDS-PEP)
Project Account Number: TBD

The Emulation Subnet Development WBS element encompasses the work during the GENI construction period that will be required to construct, test, and deploy a Wireless Emulation Subnet for the GENI Facility.

DELIVERABLES

- Deliver and assemble hardware and software for a Wireless Emulation Subnet
- Complete subnet field installation and connections to GENI Facility
- Complete testing of subnet across the GENI Facility; achieve subnet acceptance.
- Details of deliverables for this WBS must be reviewed by responsible WG.
- *Develop appropriate deliverables for this section*

COMPONENTS

The Application-Specific Sensor Subnet WBS element consists of the following components:

- 1.2.4.5.1 Emulation Subnet Hardware Assembly
- 1.2.4.5.2 Emulation Subnet Software Development
- 1.2.4.5.3 Emulation Subnet Field Assembly and Test
- 1.2.4.5.4 *Add components as required*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the construction, testing, and delivery of the Emulation Subnet components to a field site to connect to GENI:

- Project Manager (TBD), GENI Project
- Task Manager (TBD), Wireless Emulation Subnets
- Software Engineers (TBD), Software Production
- Technician (TBD), Software Testing and Integration

CONSTRUCTION COST BREAKDOWN

The Table below summarizes the construction cost breakdown (both expense and capital) for a wireless Emulation Subnet, including subnet device construction, laboratory testing, distribution to field sites, and on-site assembly and testing. Connection to the GENI backbone and commissioning are included under Sections 1.2.3 and 1.4, respectively. Dollars are in 1000s.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.2.4.5.1	Subnet Hardware						
1.2.4.5.2	Subnet Software						
1.2.4.5.3	Subnet Distribution & On-Site Testing						
1.2.4.5.4	TBD						
1.2.4.5.5	TBD						
1.2.4.5	Subtotals	9,300	1945	1805	1805	1940	1805
	Contingency	TBD					
	Totals						

Table 2.xx: Cost breakdown for Wireless Emulation Subnets to be deployed to field sites in the GENI Facility during construction period (2009-2013).

BASIS OF COST

Expense Elements	# Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (K\$)	Totals (K\$)
Personnel					
• Sr. Managers/Directors	1	350			1750
• Task Manager/Leader		250			
• Senior Engineers	4	250			3,750
• Contract Labor	5	150			750
• Jr. Engineer or Tech.	0	150			
• Administrator	0	100			
Materials & Supplies				TBD	

• TBD					
Travel	0				0
• Field Sites				TBD	
Shipping					
• To Sites				TBD	
Field Sites					
• Node/Site Expenses					
• Leases of Node Sites				750	750
• Connections					
• NRE				100	100
• Access Bandwidth				250	250
Maintenance					
• Node Sites/Equipment					
Other Expenses				TBD	
Total Expenses					7,350

Table 2.xxA: Basis of cost for Wireless Emulation Subnets to be deployed in GENI Facility during the Construction Stage (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
Computers						600
Other Capital						TBD
Total Capital						600

Table 2.xxB: Basis of cost for capital items required in the deployment of Wireless Emulation Subnets during the GENI Construction Stage

WORK BREAKDOWN STRUCTURE AND SCHEDULE

This diagram currently shows tasks associated with the construction of wireless Emulation Subnets at Level 4 of the WBS. It will be modified by the Wireless Subnets WG following definition of tasks at Levels 5 and 6 during the present stage of planning.

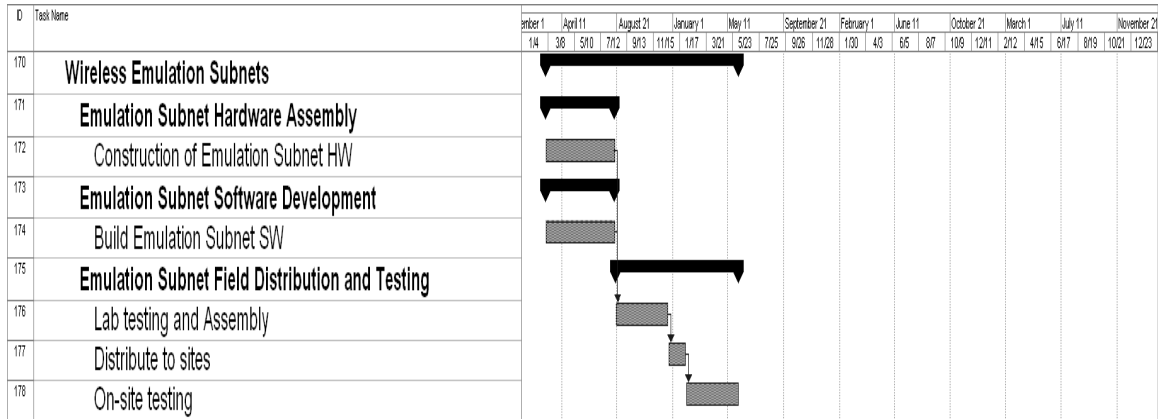


Table 2.yy: Rolled up schedule for construction of wireless Emulation Subnets during the GENI Construction Stage

WBS Element: 1.3 Systems Engineering
Responsible Manager: Systems Engineering Manager (TBD)
Construction Cost Target: TBD
Project Account Number: TBD

The Systems Engineering WBS element encompasses the work during GENI construction in systems engineering that will be required to deploy the GENI Facility. This includes: all fiber plant engineering (core, tail circuits, and connections to the legacy internet), engineering of network nodes to receive GENI network platforms, assurances that environmental, safety and related standards are met, and that all documentation is maintained. Systems engineering also includes assuring that contractors meet the requirements and specifications of their construction contracts.

DELIVERABLES

- Timely completion of all network engineering, including core fiber plant, tail circuits, connections to the legacy internet and edge devices
- Engineering of all individual node offices for installations of GENI network platforms
- Safety and environmental engineering to meet all required regulations and standards
- Maintenance of documents and records related to network requirements, specifications, installations, and similar
- Validation of compliance with requirements and specifications by facility contractors
- *Other deliverables to be added or substituted for the above during planning*

COMPONENTS

The Systems Engineering WBS element consists of the following components:

- 1.3.1 Requirements and Specifications Management
- 1.3.2 Fiber Plant Engineering
- 1.3.3 Equipment Installation Engineering
- 1.3.4 Standards, Safety, Environmental Engineering
- 1.3.5 Network Documentation Operations

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for Systems Engineering WBS elements:

- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for Systems Engineering at this point. This will be developed during the present planning period before Preliminary Design/Readiness Stage.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.3.1	Requirements & Specifications Mgmt.						
1.3.2	Network Engineering						
1.3.3	Node & PoP Installations Engr'ing						
1.3.4	Standards, Safety & Environmental Engr.						
1.3.5	Network Documentation Ops.						
1.3.6	<i>Others as required</i>						
1.3	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			

• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost for activities required to support Systems Engineering functions (developed during second part of CDS)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
Computers						
Other Capital						

•						
•						
Total Capital						

Table 2.xx.B: Basis of cost for capital items required by Systems Engineering to deploy the GENI Facility (costs developed during extension of CDS)

WORK BREAKDOWN STRUCTURE AND SCHEDULE

Currently, there are no WBS elements in the PEP that describe the Systems Engineering function in enough detail to provide related schedules or costs. This is a task during the next phase of planning.

WBS Element: 1.3.1 Requirements & Specifications Mgmt.
Responsible Manager: Systems Engineering Manager (TBD)
Construction Cost Target: TBD
Project Account Number: TBD

The Requirements & Specifications Management WBS element encompasses the work required during GENI construction to ensure that requirements and specifications for GENI Facility performance and functionality are met by Facility construction contractors. This WBS element develops and executes the testing and inspection processes required to ensure that the technical components of contractor deliverables have been properly executed before finished work is accepted.

DELIVERABLES

- Develop acceptance criteria and tests for contractor deliverables based on requirements and specifications provided to contractors at contract initiation.
- Carry out acceptance testing of deliverables provided by contractors; determine pass/fail and recommend acceptance or not to GENI management
- Maintain records of all acceptance testing, system and platform requirements, and pass/fail decisions contract
- *Other deliverables to be specified by GENI Planning Group during planning stages*

COMPONENTS

The Requirements and Specification Management WBS element consists of the following components:

- Components TBD during planning stages

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Facility Commissioning WBS elements:

- Project Manager (TBD), GEMI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Task Manager (TBD), Requirements & Specifications Management Task
- Others TBD

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Requirements and Specifications Management WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.3.1.1	TBD						
1.3.1.2	TBD						
1.3.1.3	TBD						
1.3.1.4	TBD						
1.3.1	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				

• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost in Conceptual Design Stage to estimate cost of Wireless Subnets in the GENI Facility (from CDS-PEP)

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for this function. It is expected that this will be developed during the current planning stage before Readiness.

WBS Element: 1.3.2 Fiber Plant Engineering
Responsible Manager: Systems Engineering Manager (TBD)
Construction Cost Target: TBD
Project Account Number: TBD

The Fiber Plant Engineering WBS element encompasses the work required to engineer the fiber (and wire) connectivity of the GENI Facility, including the network core, termination fibers, and connections to the legacy Internet.

DELIVERABLES

- Based on engineering designs for the core fiber backbone, connections to the legacy Internet, tail circuit connections to edge nodes of the GENI Facility, and specific RFP responses to fiber plant construction, develop test procedures that will validate vendor construction against GENI requirements and specifications
- Supervise construction and installations of the GENI fiber plant in all of its component parts.
- Conduct tests on all components of the installed fiber plant to ensure that plant construction contractors meet GENI requirements and specifications have met requirements and specifications
- Based on fiber/wire plant tests, recommend pass/fail acceptance to GENI senior management.
- Maintain records of all acceptance testing, system and platform requirements, and pass/fail decisions contract
- *Other deliverables to be specified by GENI Planning Group during planning stages*

COMPONENTS

The Requirements and Specification Management WBS element consists of the following components:

- 1.3.2.1 Components TBD during planning stages
- 1.3.2.2 Etc.

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Fiber Plant Engineering WBS elements:

- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Task Manager (TBD), Fiber Plant Engineering
- Others TBD

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Requirements and Specifications Management WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.3.2.1	TBD						
1.3.2.2	TBD						
1.3.2.3	TBD						
1.3.2.4	TBD						
1.3.2	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				

• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost in extended Conceptual Design Stage to estimate cost of Fiber Plant Engineering for GENI in construction stage

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
•						
•						
Total Capital						

Table 1.3xx: Basis of cost for capital equipment required during Construction Stage to carry out Systems Engineering on GENI

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for this function. It is expected that this will be developed during the current planning stage before Readiness.

WBS Element: 1.3.3 Equipment Installation Engineering
Responsible Manager: Systems Engineering Manager (TBD)
Construction Cost Target: TBD
Project Account Number: TBD

The Equipment Installation Engineering WBS element encompasses the work required to engineer and construct equipment spaces in GENI Facility PoPs and other nodes for installation of network platforms, such as switches, routers, multiplexers, and similar devices. This WBS element includes in-PoP testing of the installed equipment for appropriate connectivity, but not functional or performance testing of the platforms themselves.

DELIVERABLES

- Develop equipment installation and facilities plans with detailed engineering drawings for all equipment installations in each node site (core and edge) included in the GENI Facility
- Support equipment installations by equipment developers to ensure compliance with local practice as well as state, federal, and local regulations and relevant laws
- Develop and conduct tests in PoP/node sites to ensure proper installation by contractors
- Issue acceptance/denial of each installation based on requirements and specifications provided to contractors
-
- *Other deliverables to be specified by GENI Planning Group during planning stages*

COMPONENTS

The Equipment Installation Engineering WBS element consists of the following components:

- 1.3.3.1 Components TBD during planning stages
- 1.3.3.2 Etc.

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Equipment Installation Engineering WBS elements:

- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Task Manager (TBD), Equipment Installation Engineering
- Others TBD

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Equipment Installation Engineering WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.3.3.1	TBD						
1.3.3.2	TBD						
1.3.3.3	TBD						
1.3.3.4	TBD						
1.3.3	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					

• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.3.xx A: Basis of cost in extended Conceptual Design Stage to estimate cost of Equipment Installation Engineering for GENI in construction stage

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
Total Capital						

Table 1.3xx B: Basis of cost for capital equipment required during Construction Stage to carry out Systems Engineering on GENI

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for this function. It is expected that this will be developed during the current planning stage before Readiness.

WBS Element: 1.3.4 Standards, Safety, Environmental Eng'ing
Responsible Manager: Systems Engineering Manager (TBD)
Construction Cost Target: TBD
Project Account Number: TBD

The Standards, Safety, and Environmental Engineering WBS element encompasses the work required to meet all safety, environmental, and related standards requirements of the local, state, or federal government in the installation of equipment in the GENI Facility, or in the design and construction of the Facility itself, including all components of the outside plant.

DELIVERABLES

- Acquire and maintain documentation related to laws, regulations, local practice, etc., for safety and environmental engineering of facilities such as network nodes, fiber plant, edge sites, ...
- Develop requirements for installation of the GENI Facility in all of its component parts so that they meet all safety and environmental standards local to the installations
- Provide engineering designs in collaboration with other parts of the Systems Engineering Office and local site management for installations of GENI equipments and related facilities
- Support equipment installations by equipment developers to ensure compliance with local practice as well as state, federal, and local regulations and relevant laws
- Recommend acceptance/denial of each installation based on safety and environmental requirements
-
- *Other deliverables to be specified by GENI Planning Group during planning stages*

COMPONENTS

The Standards, Safety, and Environmental Engineering WBS element consists of the following components:

- 1.3.4.1 Components TBD during planning stages
- 1.3.4.2 Etc.

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Standards, Safety and Environmental Engineering WBS elements:

- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Task Manager (TBD), Standards, Safety and Environmental Engineering
- Others TBD

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Standards, Safety and Environmental Engineering WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.3.4.1	TBD						
1.3.4.2	TBD						
1.3.4.3	TBD						
1.3.4.4	TBD						
1.3.4	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				

• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xx A: Basis of cost in extended Conceptual Design Stage to estimate cost of Standards, Safety and Environmental Engineering for GENI during construction

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
•						
•						
Total Capital						

Table 1.3xx B: Basis of cost for capital equipment required during Construction Stage to carry out Systems Engineering on GENI

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for this function. It is expected that this will be developed during the current planning stage before Readiness.

WBS Element: 1.3.5 Network Documentation Operations
Responsible Manager: Systems Engineering Manager (TBD)
Construction Cost Target: TBD
Project Account Number: TBD

The Network Documentation Operations WBS element encompasses the work required during GENI construction to acquire and preserve documentation related to the design and engineering of the GENI Facility.

DELIVERABLES

- Construct a documentation and records maintenance system for GENI Facility engineering records
- Appropriately index and file all engineering records for easy retrieval and sharing with the GENI community and others, as appropriate
- Maintain all records in the original versions as well as all revisions, updates, changes, etc., including dates of changes, authorizations for change, etc.
-
- *Other deliverables to be specified by GENI Planning Group during planning stages*

COMPONENTS

The Standards, Safety, and Environmental Engineering WBS element consists of the following components:

- 1.3.5.1 Components TBD during planning stages
- 1.3.5.2 Etc.

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Network Documentation Operations WBS elements:

- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Task Manager (TBD), Network Documentation Operations
- Others TBD

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Network Documentation Operations WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.3.5.1	TBD						
1.3.5.2	TBD						
1.3.5.3	TBD						
1.3.5.4	TBD						
1.3.5	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				

• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost in extended Conceptual Design Stage to estimate cost of Network Documentation Operation for GENI during construction

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
Total Capital						

Table 1.3xxB: Basis of cost for capital equipment required during Construction Stage to carry out Systems Engineering on GENI

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for this function. It is expected that this will be developed during the current planning stage before Readiness.

WBS Element: 1.4 Facility Commissioning
Responsible Manager: Project Manager (TBD)
Construction Cost Target: TBD
Project Account Number: TBD

The Facility Commissioning WBS element encompasses the work required to commission the GENI Facility for research and educational use. Commissioning will occur in three stages: 1) initial commissioning for limited operations after the first year of construction, 2) mid-construction commissioning to incorporate new technologies, performance and functionality added during the first two years of construction, and 3) final facilities commissioning for continuing operation of GENI following construction.

DELIVERABLES

- Complete comprehensive test plan for evaluation of field-installed and fully integrated wireless subnets against documented Requirements and Specifications
- Complete initial commissioning of ready-to-use GENI Facility at end of first year of construction. Qualify for research and education use.
- Complete mid-term construction commissioning of GENI Facility for continued research
- Complete final commissioning of GENI Facility at end of construction stage and prior to hand-off for full-time operation
- *Other deliverables to be specified by GENI Planning Group during planning stages*

COMPONENTS

The Facility Commissioning WBS element consists of the following components:

- 1.4.1 Initial Use Commissioning
- 1.4.2 Mid-Construction Commissioning
- 1.4.3 Final Facility Commissioning

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Facility Commissioning WBS elements:

- Project Director (TBD), GENI Project
- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Chief Engineer (TBD), Systems Engineering Office

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Facilities Commissioning WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.4.1	Initial Use Commissioning						
1.4.2	Mid-Construction Commissioning						
1.4.3	Final Facility Commissioning						
1.4	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				

• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost in Conceptual Design Stage to estimate cost of Wireless Subnets in the GENI Facility (from CDS-PEP)

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
•						
•						
Total Capital						

Table 1.4xxB: Basis of cost for capital equipment required during Construction Stage to carry out Construction Stage Commissioning of GENI

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for Facility Commissioning. It is expected that this will be developed during the current planning stage before Readiness.

WBS Element: 1.4.1 Initial Use Commissioning
Responsible Manager: Project Manager, GENI Project Office
Construction Cost Target: TBD
Project Account Number: TBD

The Initial Use Commissioning WBS element encompasses the work required to commission the GENI Facility at the end of the first year of construction. This commissioning process will evaluate and commission only those features of the Facility planned for first-year installation.

DELIVERABLES

- Complete test plan appropriate to first commissioning of GENI Facility
- Complete commissioning of GENI Facility based on installed functionality and performance for initial research and education use
- *Other deliverables to be defined by GENI Planning Group and appropriate WG Leaders*

COMPONENTS

The Initial Use Commissioning WBS element consists of the following components:

- 1.4.1.1 Initial Research Use Requirements
- 1.4.1.2 Facility Test Plan for Initial Use
- 1.4.1.3 Facility Testing
- 1.4.1.4 Facility Commissioning for Initial Use
- 1.4.1.5 Other components as required

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Initial Use Commissioning WBS elements:

- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Chief Engineer (TBD), Systems Engineering Office
- Test Engineers (TBD), Systems Engineering Office
- Others TBD

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Initial Use Commissioning WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.4.1.1	Initial Research Use Requirements						
1.4.1.2	Facility Test Plan Construction						
1.4.1.3	Facility Testing						
1.4.1.4	Commissioning for Initial Use						
1.4.1.5	Others TBD						
1.4.1	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost in the extension of the Conceptual Design Stage to estimate cost of Initial Use Commissioning of the GENI Facility

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
•						
•						

Total Capital						
----------------------	--	--	--	--	--	--

Table 1.3xxB: Basis of cost for capital equipment required during Construction Stage to carry out Construction Stage GENI Commissioning for Research Use

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for Initial Use Commissioning, but this is expected to occur at or before completion of the first year of Facility construction.

WBS Element: 1.4.2 Mid-Construction Commissioning
Responsible Manager: Project Manager, GENI Project Office
Construction Cost Target: TBD
Project Account Number: TBD

The Mid-Construction Commissioning WBS element encompasses the work required to commission the GENI Facility at approximately the midpoint of its construction. This commissioning process will evaluate and commission those features, functions, and performance characteristics of the Facility schedule for mid-point operations.

DELIVERABLES

- Construct plan for mid-construction stage commissioning of GENI Facility
- Carry out mid-construction stage commissioning of GENI Facility for continued research and education
- *Other deliverables to be defined by GENI Planning Group and WG Leader responsible for this project component*

COMPONENTS

The Mid-Construction Commissioning WBS element consists of the following components:

- 1.4.2.1 Mid-Construction Use Requirements
- 1.4.2.2 Mid-Construction Test Plan
- 1.4.2.3 Facility Testing – Mid Construction
- 1.4.2.4 Facility Commission for Mid Construction Use
- 1.4.2.5 *Other components as required*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Initial Use Commissioning WBS elements:

- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Chief Engineer (TBD), Systems Engineering Office
- Test Engineers (TBD), Systems Engineering Office

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Mid-Construction Commissioning WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.4.2.1	Mid-Construction Use Requirements						
1.4.2.2	Mid-Construction Test Plan						
1.4.2.3	Facility Testing – Mid Construction						
1.4.2.4	Commissioning for Mid-Construction Use						
1.4.2.5	Others TBD						
1.4.2	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost in the extension of the Conceptual Design Stage to estimate cost of Mid-Construction Use Commissioning of the GENI Facility

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
•						
•						

Total Capital						
----------------------	--	--	--	--	--	--

Table 1.4xxB: Basis of cost for capital equipment required during Construction Stage to carry out Construction Stage GENI Commissioning for Research Use

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for Mid-Construction Use Commissioning, but this is expected to occur at or before the end of the third year of construction.

WBS Element: 1.4.3 Final Facility Commissioning
Responsible Manager: Project Manager, GENI Project
Construction Cost Target: TBD
Project Account Number: TBD

The Final Facility Commissioning WBS element encompasses the work required to complete final commissioning of the GENI Facility as the last step of construction before releasing the Facility for continuing operation.

DELIVERABLES

- Complete definition of final acceptance criteria for GENI Facility
- Develop comprehensive test plan for final commissioning that thoroughly tests compliance with acceptance criteria
- Carry out testing of GENI Facility for hand-over to full-time operations. This step to including testing by the GENI Systems Engineering Office and by an independent, third party not previously engaged in the construction of the Facility.
- *Others TBD by GENI Planning Group and WG Leaders*

COMPONENTS

The Final Facility Commissioning WBS element consists of the following components:

- 1.4.3.1 Final Acceptance Criteria
- 1.4.3.2 Test Plan, Procedures, Exit Reporting
- 1.4.3.3 Final Facility Testing by GENI Systems Engineering
- 1.4.3.4 Final Facility Testing by External Testing Group
- 1.4.3.5 Final Reporting
- 1.4.3.6 Transition to Operations

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Final Facility Commissioning WBS elements:

- Chair (TBD), Computer Community Consortium
- Project Director (TBD), GENI Project
- Chief Architect (TBD), Technical Advisory Board
- Project Manager (TBD), GENI Project Office
- Systems Engineering Manager (TBD), Systems Engineering Office
- Chief Engineer (TBD), Systems Engineering Office
- Contracted Testing Organization (TBD)

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Final Facility Commissioning WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.4.3.1	Final Acceptance Criterion						
1.4.3.2	Test Plan, Procedures, Exit Reporting						
1.4.3.3	Final Facility Testing by GENI Systems Engineering						
1.4.3.4	Final Facility Testing by Contracted Test Group						
1.4.3.5	Final Reporting						
1.4.3.6	Transition to Operations						
1.4.3	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			

• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost to estimate cost of Final Commissioning of the GENI Facility at the end of the Construction Stage

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						

•						
•						
•						
Total Capital						

Table 1.4xxB: Basis of cost for capital equipment required during Construction Stage to carry out Construction Stage GENI Commissioning for Research Use

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a detailed schedule for Final Facilities Commissioning.

WBS Element: 1.5 Science Support
Responsible Manager: TBD
Construction Cost Target: TBD
Project Account Number: TBD

The Science Support WBS element encompasses the work during the Construction Stage to manage and coordinate user research on GENI. It includes various processes for the selection, monitoring, and analysis of research results that might be incorporated in GENI design enhancements during construction. *This work does not include research planning to be completed during the various planning stages prior to the start of construction.*

DELIVERABLES

- *Deliverables to be determined by Research Coordination WG during GENI planning stages.*

COMPONENTS

The Science Support WBS element consists of the following components:

- 1.5.1 Construction Stage Final Research Selection
- 1.5.2 Research Experiment Plans and Definitions Review
- 1.5.3 Research Policies and Governance for Research Use During Construction
- 1.5.4 Selection of Research Users during Construction Stages
- 1.5.5 Monitoring of Research Use by GENI
- 1.5.6 Research Report Evaluations for Research Users
- 1.5.7 *Others TBD during planning stages by Research Coordination WG*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Science Support WBS elements:

- Chair (TBD), Computer Community Consortium
- Project Director (TBD), GENI Project
- Chief Architect (TBD), Technical Advisory Board
- Chair (TBD), Research Coordination Working Group
- *Others TBD during planning*

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Final Facility Commissioning WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.5.1	Selection of Research for Construction Stage						
1.5.2	Research Experiment Plans and Definitions Review Process						
1.5.3	Research Policies and Governance for Research Use in Construction Stages						
1.5.4	Selection of Research Users during Construction Stages						
1.5.5	Monitoring of Research Use by GENI Organization						
1.5.6	Research Report Analysis						
1.5.7	Others TBD						
1.5	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			

• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			
Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 2.xxA: Basis of cost to estimate cost of Final Commissioning of the GENI Facility at the end of the Construction Stage

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
•						
•						
Total Capital						

Table 1.5xxB: Basis of cost for capital equipment required during Construction Stage to support Science Support activities associated with Research Use of GENI

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a detailed schedule for Final Facilities Commissioning.

WBS Element: 1.6 Education and Outreach
Responsible Manager: Manager (TBD), GENI Education & Outreach
Construction Cost Target: TBD
Project Account Number: TBD

The Education and Outreach WBS element encompasses the work required during GENI construction to provide education concerning GENI and its use. Such education to be provided to multiple communities, including: high school and university students; the general public to make it aware of GENI and what it will do for science and the future of the Internet. This task will also provide training on the operation and use of GENI for construction-stage research and education users.

DELIVERABLES

- *Deliverables to be determined by Education & Outreach WG during planning stages. These deliverables to be for construction stage GENI use and education only. MREFC funds just the construction stage components that are required for construction of GENI.*

COMPONENTS

The Education and Outreach WBS element consists of the following components:

- 1.6.1 Scientific Community Education
- 1.6.2 Public Outreach Education
- 1.6.3 Classroom Education
- 1.6.4 Research User Training
- 1.6.5 *Others TBD during planning*

DEPENDENCIES

- In this space, please begin to list the dependencies on other parts of the project that will influence the schedule and completion of the work described in this WBS Element
- These will include deliverables, tasks, activities that must be completed by others before work on this WBS Element can be started or completed
- As we move forward in the planning cycle, these dependencies will be worked into the overall schedule; we'll make adjustments to start and stop times based on dependencies

RESOURCES

The following personnel have primary responsibility for the Science Support WBS elements:

- Chair (TBD), Computer Community Consortium
- Project Director (TBD), GENI Project
- Chair (TBD), Education & Outreach Working Group
- Project Manager (TBD), GENI Project Office

CONSTRUCTION COST BREAKDOWN

There is no construction cost breakdown for the Final Facility Commissioning WBS element at this time. This will be developed during the present planning period.

WBS	Cost Elements	Total	2009	2010	2011	2012	2013
1.6.1	Scientific Community Education						
1.6.2	Public Outreach Education						
1.6.3	Classroom Education and Training						
1.6.4	Research User Training						
1.6.5	Others TBD						
1.6	Subtotals						
	Contingency	TBD					
	Totals						

BASIS OF COST

Expense Elements	Units	Salary/Wage (Loaded) (K\$)	Non-Wage Expenses (K\$)	Other Expenses (\$)	Totals (K\$)
Personnel					
• Sr. Manager/Director	1	350			
• Area Office Managers	1	250			
• Task Manager/Leader	1	250			
• Senior Engineer	1	250			
• Contract Labor	1	150			
• Engineer/Technician	1	150			
• Administrator	1	100			

Materials & Supplies					
• Office Supplies	Var.				
• Office Equipment	Var.				
• Technical	Var.				
Travel					
• PoP/Subnet/Edge Sites	Day				
• Conferences	Day				
• Project Meetings	Day				
Shipping					
• Node Elements	Unit				
Maintenance					
• Network Nodes	15%				
Network & Nodes					
• Bandwidth	Mb/s				
• Connections (OCx, IP)	Mb/s				
• Site Leases	TBD				
• Facilities Preparation	S.F.				

Table 1.6.xx A: Basis of cost to estimate cost of Education and Public Outreach during the Construction Stage of GENI

Capital Elements	Unit Prices (K\$)	# Units	Installation Expense (\$)	Training (K\$)	Other Expense (K\$)	Total (K\$)
• TBD						
•						
Total Capital						

Table 1.6.xx.B: Basis of cost for capital equipment required during Construction Stage to support Education and Public Outreach work, with emphasis on training for GENI use during construction

WORK BREAKDOWN STRUCTURE AND SCHEDULE

There is not as yet a schedule for the Education & Outreach WBS element

Bibliography

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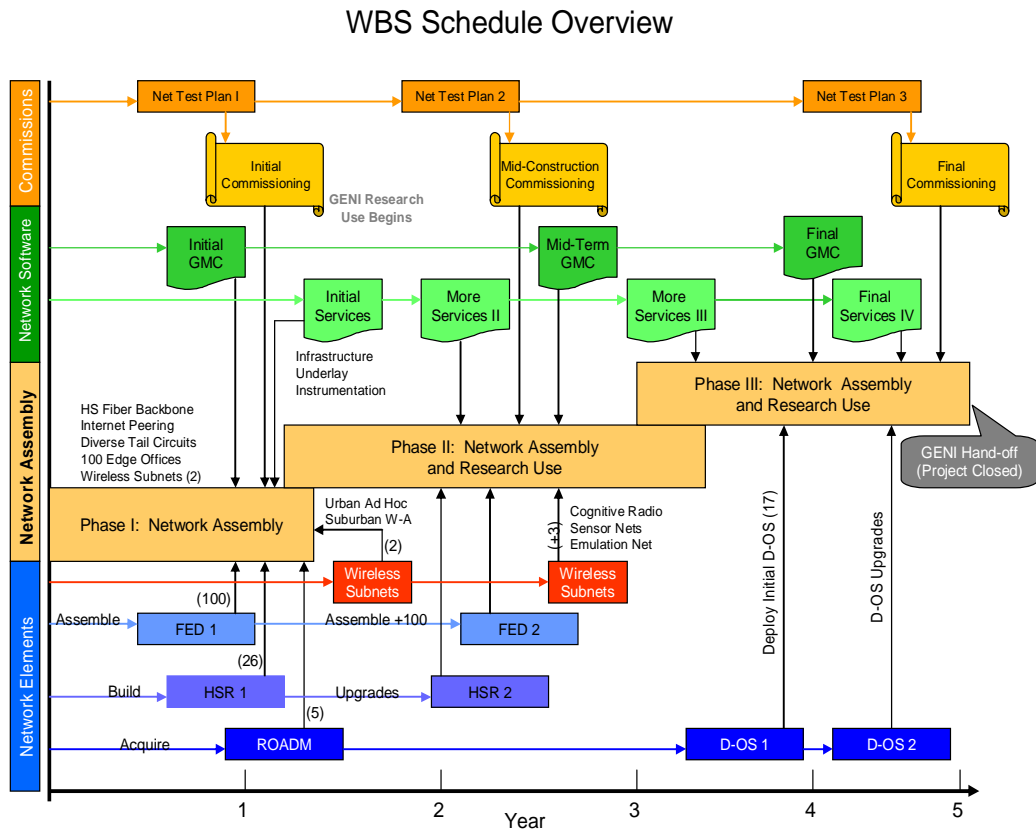
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Appendix A: WBS Schedule Overview

The diagram below represents a partial view of the overall schedule of work to be completed during the GENI construction stage. In particular, it represents three stages of the Facility development and the contributing elements of the WBS necessary to complete of these stages.



Appendix B: Construction Flow Diagram

GENI Construction Flow Diagram

