

New York State CIO Council
Technology Committee

**Principles Governing
The New York State
Information Technology
Enterprise Architecture**

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1. Introduction

"New York State is the nation's high-tech leader and no state is doing more than New York to make government more accessible and responsive to its citizens through the development of innovative, user-friendly technology programs. By continuing to invest in our high-tech infrastructure, New York will continue to lead the nation in the use of technology to make government function as efficiently as possible for the people it serves and help us fulfill our goal of creating one million new jobs by the end of the decade." **Governor George E. Pataki**

1.1. Genesis of This Document

In November 2002, New York State Chief Information Officer James Dillon formed the CIO Council, comprised of the senior IT leadership of State agencies, authorities, public benefit corporations and local governments. The CIO Council has several standing committees, including Leadership, Fiscal/Procurement, Human Resources, Security, Strategic Planning, Intergovernmental Communications, and Technology. More information about the CIO Council and its committee membership can be found on the Chief Information Officer's Web site at <http://www.cio.state.ny.us/ciocouncil.htm>. The Technology Committee of the CIO Council authored this document with significant guidance from Dr. Michael Mittleman, Deputy NYS CIO.

The *New York State Information Technology Strategic Plan*¹ developed by the Office of the CIO, which defines Enterprise Architecture as a key result area and which identifies developing an Enterprise Architecture policy as one of its goals, provided further impetus for this document.

1.2. Scope of this Document

This document represents a first step in the definition of the New York State Information Technology Enterprise Architecture. In the remainder of this document, we present a conceptual framework for Enterprise Architecture (EA) that breaks the overall architecture into its major component areas. Then for each component area, we define a set of guiding principles and discuss the implications of following these principles for our information technology environment and practices. Together, the guiding principles define a vision for the EA.

The guiding principles were developed by the Technology Committee after reviewing information from several sources, including an initial statement of principles developed by Dr. Mittleman, reviews of Enterprise Architecture plans from other states and the federal government, architecture blueprints from the National Association of State Chief Information Officers (NASCIO), and consultation with Enterprise Architecture experts from the Meta Group and Gartner IT consulting firms.

1.3. Subsequent Documents

¹ New York State Information Technology Strategic Plan, Office of the Chief Information Officer, May 2003.

We have deliberately chosen to keep this document relative short and focused on general principles. However, this will be followed by other documents that will help New York State achieve its vision for an effective Enterprise Architecture. In particular, the Technology Committee plans to issue the following additional documents:

- An EA assessment tool, that will provide a checklist for proponents of new systems as well as examples to help illustrate the principles;
- A description of the governance structure and process to ensure that these EA principles are followed;
- A description of the process that will be used for developing technology standards to be incorporated into the EA;
- A plan for the transition of existing non-compliant systems to adherence to the EA principles.

1.4. Current Challenges

“The dogmas of the quiet past are inadequate to the stormy present.”
Abraham Lincoln, December 1, 1862

Lincoln’s declaration, made in the Civil War, embodied an essential truth about discontinuous change: rarely does the need for a significant shift in thinking arise during times of peace and prosperity. Innovation more often finds root in the rocky soil of strife and economic challenge.

With regard to information technology, we find ourselves in challenging times. Past successes and significant investment in infrastructure have made New York a leader in public-sector information technology (IT). At the same time, fiscal constraints, an aging workforce, security concerns and ever-increasing demands for new, improved and better government services have created a very different and challenging environment. Like Lincoln, New York’s IT executives face a future in which the solutions of the past will not prove effective.

1.5. Enterprise Architecture Defined

Gartner provides a concise definition of information technology EA². It is a framework that:

- Brings order into the otherwise chaotic world of information systems;
- Places restrictions on the design and development of IT systems, aiming to balance freedom and constraint for the benefit of the Enterprise as a whole;
- Takes the form of design guidelines and preferred technical approaches that evolve over time as priorities change;
- Enables IT professionals to be more productive, and;
- Helps ensure that IT systems are flexible enough to adapt quickly to new business conditions and requirements.

² Roger Wolfe and Marcus Bloesch, *IT Architecture Matters*. Stamford: Gartner, Inc., 2002, 3.

The benefits of EA are considerable. Standardization and sharing of platforms and development tools can:

- Decrease the amount of hardware and software necessary to operate the Enterprise, making possible further efficiencies in purchasing, maintenance, and licensing;
- Reduce the variety of skills required by IT professionals within the Enterprise, promoting greater flexibility of staff deployment and mitigating the effect of skills loss due to “aging-out” of the workforce, and;
- Facilitate greater information-sharing and interoperability within the Enterprise, leading to operational efficiency and improved service delivery.

Clearly, these are strong arguments in favor of Enterprise Architecture. At the same time, EA is not without risk and must be developed carefully. The Gartner Group identifies several challenges to successful EA implementation:

“IT architectures that can’t keep pace with changes in the Enterprise can be more of a hindrance than a help. Because their benefits are difficult to isolate and costs have a habit of spiraling, architectures are hard to justify. By sacrificing local autonomy in favor of overall synergy, IT architectures frequently give rise to political tension.”³

In short, development of an Enterprise Architecture may not be a necessary course of action for an Enterprise enjoying Lincoln’s “quiet past.” But it will be a necessary undertaking in the “stormy present” characterized by fiscal constraint, workforce change, and increased service-delivery requirements.

1.6. What is the Enterprise?

“Think, plan and execute in terms of the Enterprise and its standards.”

Dr. Michael Mittleman, Deputy CIO, State of New York

The position of Chief Information Officer for the State of New York was established by Executive Order 117, issued by Governor Pataki on January 28, 2002. Embodied within the order is a definition of the Enterprise to which the principles outlined in this document apply:

- All state agencies, departments, offices, divisions, boards, bureaus, commissions and other entities over which the Governor has executive power
- State University of New York and City University of New York
- All public benefit corporations the heads of which are appointed by the Governor; and
- The business and administrative functions of such universities common to State government.⁴

³ Ibid.

⁴ Executive Order 117, issued by Governor Pataki on January 28, 2002, full text of which is available at: Office of the New York State Chief Information Officer, “State of New York - Executive Order no. 117,” home page on-line; available from <http://www.cio.state.ny.us/execord117.htm> ; Internet; accessed 14 April 2003.

From a practical viewpoint, the Enterprise is comprised of agencies that interact with each other and whose business processes often share common characteristics. Agencies within the Enterprise also interact with external constituencies, including other governmental and private-sector organizations. As these interactions become increasingly electronic, common standards for information technology that will apply to the entire Enterprise become necessary to ensure consistent, reliable and adaptive operations.

Various external entities, though not formally part of the Enterprise as defined above, nevertheless interact with the State and are thus affected by the standards and practices adopted by New York State for its EA. These include local- and federal-government agencies (e.g. social service agencies operated by county governments or the federal Social Security Administration) and private- or public-sector business partner organizations that provide services to the state-government Enterprise (e.g. web hosting vendors and disaster-recovery contractors).

1.7. What is an Enterprise System?

If the scope of systems that can be considered Enterprise-level is too narrow, there will not be a true Enterprise technology nor will EA goals be achieved. On the other hand, if the definition of an Enterprise system is too expansive, it will slow down the delivery of those systems.

At the outset, a good start on understanding when a system “rises” to the Enterprise level is if it affects more than one Enterprise entity (e.g. more than one state agency) or external entity (e.g. multiple county agencies). In those cases, such a system is no longer the preserve of a single agency. Given the nature of government, this view necessarily incorporates many systems.

However, even for systems used by a single agency, Enterprise standards, components, services and technologies will still be relevant. The development of such systems will benefit from a wider Enterprise view that promotes commonalities in construction, documentation and technological approaches.

1.8. How will the Enterprise Architecture be used?

An EA is, in some sense, a statement of philosophy. Like all philosophies, it must begin with assumptions about the present state and the desired future state. Central to development of IT architecture is a shared understanding of the needs of the Enterprise. Chief Information Officer James Dillon has clearly articulated several of these needs:

“There is a compelling case that can be made for setting and enforcing standards. Some operational functions in state agencies are ubiquitous. Understandably, these functions would benefit from having a similar feel and look to promote information sharing, increase usability and reduce IT maintenance costs.

Without careful consideration of standardization, the otherwise positive moves toward open architecture and web based e-government solutions will create problems and excessive costs. Without standards, common civil service titles, combined with current

hiring practices, promotions and transfers across agencies will result in increased training costs and lower efficiency levels.

Our common goal must be - and will be - to further Governor Pataki's agenda to improve government service to New York State's citizens through technology. Standards will help us achieve greater efficiencies internally which can then be passed directly on to the taxpayers."⁵

There is a widespread understanding among New York State government IT leaders that, as one CIO stated, "What needs to be done on the Enterprise level is what each agency has had to do for itself over the past decade or more." The Technology Committee is confident that agencies will see that they can be more effective in almost every sense if they re-envision their own specific information technology priorities through the lens of an overall New York State Enterprise Architecture.

Thus, New York State's Enterprise Architecture for information technology will:

- Support the business and program priorities of state government;
- Reduce the total cost of ownership of information systems and the processes they support;
- Reduce the complexity of our technology environment;
- Increase the flexibility and responsiveness of systems to the changing needs of the State's residents;
- Facilitate increased interoperability;
- Provide a stable and scalable platform for delivery of government services; and
- Capitalize on the State's existing investments in applications and technology.

1.9. Major Elements of the Enterprise Architecture

In the course of developing this document, the Technology Committee reviewed several different schemes for defining Enterprise Architecture structure. While at present there is no widely agreed-upon standard set of definitions, there are many areas of overlap across the various schemes. Most include as major architecture elements a set of guiding principles, business and industry 'drivers' that necessitate an Enterprise Architecture, architecture domain areas (each with its own sub-architecture), and processes for managing the architecture. The Technology Committee developed its own conceptual framework which captures these same elements. According to our framework, the major elements of the Enterprise Architecture are:

- Enterprise Goals (business drivers)
- Enterprise Architecture Domains (sub-architectures)
- Enterprise Architecture Management (governance and core processes).

⁵ Ibid., "Message from the Chief Information Officer," home page on-line; available from <http://www.cio.state.ny.us/ciomessage.htm>; Internet; accessed 14 April 2003.

In the sections below, we define and discuss guiding principles for each major architecture element.

2. Enterprise Architecture Goals and Associated Principles

This section defines the principles associated with two primary goals – maximizing cost-effectiveness and reducing complexity - that are fundamental “business drivers” impelling us to implement Enterprise Architecture.

2.1. Cost Effectiveness

Principle 1: The Enterprise Architecture will maximize the cost-effectiveness of its information technology efforts.

The Enterprise will strive to reduce procurement, development, integration, and support costs associated with duplicative architectures and obsolete or unused technologies by providing a common architecture that is flexible, reusable and cost effective across the Enterprise. Migration of existing Enterprise applications to the common architecture will be gradual, with consideration given to cost and available budgets.

Future Enterprise applications and technologies will leverage New York State’s existing Enterprise technology assets (e.g., NYENET, State Data Center) where available and applicable. Opportunities for additional cost savings and operational efficiencies through further centralization of IT resources and functions will be explored. For instance, it may be cost-effective to centralize the administration of servers used for Enterprise Applications. Decisions concerning further centralization of resources should be based on the results of formal analyses and empirical data on total cost of ownership (see section 4.2.4 below) and impact on the agencies including in the Enterprise.

2.2. Reduced Complexity

Principle 2: The Enterprise Architecture will reduce the complexity of New York State’s information technology environment.

Especially complex technology solutions – for example, “spaghetti code” or wildly diverse hardware platforms – make change especially difficult, if for no other reason than the fear of breaking the whole complex mess by changing some small inter-related part of it. As complexity is reduced, the ability of the Enterprise to adapt and change is increased. Reduced complexity should also reduce the cost of products and their support through the leverage of Enterprise-wide buying power.

As a practical matter, this principle implies the need to impose and maintain the discipline to reduce the number of platforms, configurations, and products in the Enterprise, thereby reducing training and support requirements.

3. Enterprise Architecture Domains and Associated Principles

3.1. Multi-tiered Structure

Principle 3: The Enterprise Architecture will be multi-tiered to maximize flexibility, adaptability and stability.

In a multi-tiered model, the overall Enterprise Architecture consists of several distinct but highly interrelated layers, each of which can be conceptualized as having its own distinct architecture. The Technology Committee has adopted the following taxonomy for the major domains of the Enterprise Architecture:

- Information Architecture;
- Business Process Architecture;
- End-User Architecture;
- Infrastructure Architecture (enabling hardware, software, network, storage), and;
- Security Architecture (protection and authentication).

We discuss each of these domains separately below.

3.2. Information Architecture

The information architecture deals with the modeling and use of the information assets of the Enterprise. “Information assets” includes both the information needed by the Enterprise to carry out its business functions, and also the information generated by the Enterprise. An overall goal for the information architecture is to maximize the utility of these information assets.

3.2.1. Information is an Enterprise Asset

Principle 4: The Enterprise Architecture will facilitate information sharing across the Enterprise to enhance and accelerate decision-making.

Information itself is an Enterprise asset. Government decisions and services are better if they are based on the appropriate use of information. Thus, the EA needs to facilitate the use of information by decision makers and program staff. It needs to protect information from loss and corruption. Data elements need to have compatible definitions and consistent coding across the Enterprise. The capacity must exist to share data appropriately across the Enterprise, however, always within the boundaries established by law (e.g. HIPAA privacy protections).

A traditional Enterprise asset management strategy is well understood and implemented for the various physical inventories found in an Enterprise. Where traditional asset management falls short is in recognizing that information is as much an Enterprise asset as any of the physical equipment. By addressing information as a valuable Enterprise asset at the outset, decision-

making, technology investment, and Enterprise-wide access to information can be accommodated.

Following this principle will require identification and authentication of information assets as well as a unified information asset management system. The information assets will need to be structured for easy access and management without compromises in security, privacy, and confidentiality.

Systems must be designed, acquired, developed, or enhanced such that data can be shared and integrated across the Enterprise and with our partners to the extent permitted by law. This will require the establishment of XML standards for common types of data records to facilitate information exchange.

3.2.2. Support for Data Warehousing

Principle 5: The Enterprise Architecture will support data warehousing and other information-centric end-user computing.

The Information Architecture must support both online transaction processing (OLTP) and data warehousing applications. However, these two classes of applications require very different data models and make very different demands on database systems. On-line transaction processing focuses on quick updates of the data. Often, the speed of these updates can be dramatically slowed down by the processing generated by user queries. For this reason, it is best to separate the data warehouse from the OLTP. In so doing, we also provide for a more secure environment for both OLTP and data warehousing.

To successfully support data warehousing, the Enterprise must ensure that IT staff understand the different database design and performance requirements of OLTP and data warehouse applications, and that there are sufficient numbers of staff skilled in key data warehousing methodologies such as dimensional modeling, in which data models are partially de-normalized to facilitate easy end-user querying.

The Enterprise Architecture must include Enterprise-wide approaches to data warehousing, including methods for data warehousing that span agency boundaries as permitted by law in order to facilitate appropriate information sharing and integration, Enterprise-wide views of information assets, and elimination of unnecessary redundancies in data warehouse content, data storage, and end-user information product development. Recent advances in federated data warehousing, which allow for the integration through middleware of logically and physically disconnected data warehouse resources, should be investigated for their potential usefulness in this area in order to meet the operational demands of the Enterprise while at the same time ensuring privacy and confidentiality as required by law.

In addition to traditional methods for querying the data warehouse, publish-subscribe methods of access can increase the utility of data warehousing applications. Publish-subscribe methods include such features as automatic end-user notification of changes and updates to data warehouse content in areas of particular interest that they are authorized to access, and automatic

receipt of particular data warehouse reports that they are authorized to receive. These methods can avoid the need to have users make continual requests of the database in order to determine if anything has changed. Thus, publish-subscribe methods can help reduce the overall volume of end-user queries, and thereby mitigate potential performance degradation from increasing numbers of end-users. However, such methods must be implemented in ways that ensure there are no inadvertent unauthorized disclosures of protected information.

3.2.3. Enterprise Data Standards

Principle 6: The Enterprise Architecture will promote Enterprise-wide data standardization, reuse, interoperability, and information management across applications and agencies.

This principle implies the need for a central authority that maintains the standards to be used for such common data fields as name, address, etc. and also builds the appropriate meta-data that can enable the sharing of data. Industry data standards (e.g. HIPAA transaction standards in the health care arena) should be adopted whenever feasible to facilitate business transactions between local, state and national government entities and between government and the private-sector. A formal process for the development of Enterprise data standards should be established as part of overall Enterprise Architecture governance.

3.3. Business Process Architecture

The business process architecture deals with the goodness-of-fit fit between information systems and the business processes they are meant to facilitate. This includes business process analysis and, where appropriate and feasible, business process re-engineering. Goals include common solutions for business process needs shared by multiple entities within the Enterprise, development of business logic models and components that can be reused across multiple applications, and increasing the efficiency of Enterprise business processes.

3.3.1. Common Solutions

Principle 7: The Enterprise Architecture will facilitate common solutions for business processes and needs shared by multiple agencies.

Where there are common business processes across multiple agencies in the Enterprise, the Enterprise Architecture will facilitate the development of common solutions. This is in contrast to the traditional process of merely converting a set of physical requirements, without further analysis, into a delivered (silo) application. The key is the designer's understanding of the process in concept, not how the users label it. To use a simple example, a software component that allows for the scheduling of a generic resource at a particular date and time could be part of many applications, as diverse as scheduling people or machines or whatever the user has in mind.

In this view, the requirements for applications are built from the bottom-up, driven by business users, as before. However, the solutions are architected, in part, from a set of modular, but

Enterprise-level, components which can be used by any agency within the Enterprise. This should help accelerate software development, while keeping costs down.

Clearly, an inventory of these common solutions and components, as well as methodologies for maintenance of these components, will need to be established if this principle is to be achieved in practice. Appropriate mechanisms will need to be determined as part of overall EA governance.

3.3.2. Business Logic

Principle 8: The EA will facilitate Enterprise-wide business logic code reuse, smooth integration of Enterprise business processes, and maximum utility for end-users.

In so doing, the business process logic must be designed, acquired, developed, or enhanced such that processes can be shared and integrated across the Enterprise and with our partners.

As with other tiers, the implementation of business rules will employ reusable components across the Enterprise.

3.3.3. Business Process Analysis and Re-engineering

Principle 9: Business process re-engineering will be considered when defining requirements for new Enterprise applications.

Technology is a critical tool to empower public servants to continuously improve government services. However, the return on technology investment will be limited if all it does is to automate inefficient and ineffective business practices. We envision business process improvements that result from the optimization of both human and technology resources.

Business Process Reengineering (BPR) utilizing Information Technology as an automation tool will help reshape the way the Enterprise conducts business. Adopting a BPR model will reduce the total cost of ownership, increase efficiency, improve customer services, and reduce development times across the Enterprise.

All Enterprise systems development must begin with BPR as an essential predicate to systems design. To the extent that such systems affect multiple entities within the Enterprise, a common BPR model will be adopted to ensure all relevant business operations are reviewed and streamlined before development and design progresses”.

3.4. End-User Architecture

The End-User Architecture deals with the interface and interaction between Enterprise technology and the end-user. Goals include user-interface consistency across applications, in keeping with system requirements, and user-interface designs that maximize usability.

3.4.1. Standard Look And Feel

Principle 10: Enterprise applications will be designed with a standard “look and feel” to facilitate ease of use, software design simplification, and branding.

As with other layers of the architecture, the presentation layer will make use of standardized, reusable components. Standardized presentation layer components will provide Enterprise Applications with a common, consistent end-user interface. The benefits of this approach in the presentation layer are similar to those in other architecture layers: it allows for the upgrade, exchange, and reuse of products with minimal retooling or disruption to the overall environment. It encourages deeper functionality and reduces training time, since users are more likely to have experience with the component from other applications.

3.4.2. Standard Set of Information Technology Tools and Services

Principle 11: The Enterprise Architecture will define standards for basic information technology tools and services (e.g., email, voicemail, internet access) that employees should have available to them, consistent with available resources and job functions.

Employees across the Enterprise who perform relevant job functions should be given access to training tools and/or facilities to all basic services/applications, to the extent permitted by available resources. This will allow for greater volume discounts to be realized by the entire Enterprise, as well as having a larger pool of similarly trained users. It will also allow for an easier integration of new employees into agencies.

3.4.3. Thin Client Solutions

Principle 12: The Enterprise Architecture will employ server-based thin client solutions requiring only network access and a web browser for end-user access wherever such solutions are technically appropriate.

Through the use of server-based applications, thin client technologies (especially web-based clients), portals, and gateways, organizations can reduce the cost and complexity of all IT functions, making it easier to implement, deploy, manage, and monitor Enterprise applications and information resources. Server-based architecture provides the ability to rollout new applications and upgrades to the entire organization simultaneously.

3.5. Infrastructure Architecture

The infrastructure architecture addresses the underlying enabling hardware, software and network that support Enterprise applications. It also addresses the communications between architecture layers and between systems.

3.5.1. Interoperability

Principle 13: The EA will promote interoperability and integration across Enterprise applications.

The more applications are interoperable, the more likely it is that the Enterprise can respond flexibly and inexpensively to new user requirements. By its nature, interoperability also enhances integration across the Enterprise, thus enabling the Enterprise to provide better, more coordinated services to the public.

3.5.2. Partitioning and Decoupling Of Application Components

Principle 14: The EA will favor solutions that are highly partitioned, modular in design, that are comprised of components that are maximally decoupled, and that use standards-based messaging protocols for communication between external and internal systems.

An essential part of any strategy to reduce complexity and enhance flexibility in an Enterprise Architecture is to break down the traditional monolithic systems and to reduce as much as possible the extent of the coupling of different components. In this way, any internal change or improvement in a component will not require massive changes in software to be found elsewhere in the Enterprise.

The use of message-based communications is an especially useful tactic in the integration of legacy, silo systems into the Enterprise. This allows for the creation of a thin layer that wraps the legacy application, providing a more modern means for other software components to communicate with that application. Then the legacy system can be replaced in an orderly fashion, without that change causing further impact on the Enterprise.

Such an approach makes possible the use of efficient, user-friendly techniques. In particular, we would encourage the use of publish-subscribe, rather than continual request-reply, modes of data acquisition by the user (see section 3.2.2 above).

This kind of modular implementation will allow for the upgrade, exchange, and reuse of products with minimal retooling or disruption to the overall environment. Modularity will reduce the complexity and upgrade time of IT assets while providing the Enterprise with geographical independence, skill-leveraging, and improved functionality.

The implications of this approach include:

- A culture of reuse and sharing of code and components must be further nurtured within the Enterprise.

- Enterprise-wide component management will become a core competency.
- Design reviews will become an integral part of IT decision-making.
- Modular components will be shared across organizational boundaries, to the maximum extent permissible.

3.5.3. Uniform Standards

Principle 15: The EA will establish uniform standards for Enterprise technology.

Standardization will facilitate consistency and uniformity across applications. It will simplify software design, reduce application development time, facilitate learning, improve system maintenance and support, and promote information-sharing among organizations within the Enterprise, and thus reduce total cost of ownership. By fostering the development of the same “look and feel” across the Enterprise, standardization will enhance end-user friendliness and satisfaction, and contribute to the identity of the Enterprise.

As part of this effort, existing IT platforms must be identified and documented and compared to Enterprise-wide configuration standards, which in turn must be established. A review process must be developed for setting standards, reviewing and revising them periodically, and granting exceptions where appropriate.

3.5.4. Standard Configurations

Principle 16: The EA will define a small number of standardized, easily-reproducible system configurations for deployment across the Enterprise.

Establishing configurations that are easily reproduced will cut down on costs associated with support and maintenance as well as simplifying training and knowledge transfer. This will also mean that any proposed changes must function correctly and consistently throughout the entire organization. Consistent configurations will help provide a similar look and feel to end-users, as well as being able to support users of all ability levels, from novice to expert.

This principle also makes possible the end-to-end systems management that is a necessary part of reliable delivery of technology services to our users. This will require a change in some decision-making standards. For example, we will deploy applications on uniformly configured servers. Proprietary software used in standardized system configurations will be maintained at vendor-supported version levels. For these reasons, there may be an initial increase in capital investment.

In the short run, this means that we will strive to replace multiple, non-standard configurations with a smaller number of consistent configurations. In the long run, this means that we plan for the retirement and replacement of obsolete platform components and configurations.

3.5.5. Scalability

Principle 17: Enterprise applications and infrastructure will be scalable in size, capacity, and functionality.

Scalable components will better adapt to the changing needs of the Enterprise and will be less likely to impede its growth. Scalability, in effect, will serve to improve Enterprise-wide integration, maximize resource utilization, and minimize duplication and application redundancy.

3.5.6. Statewide Network Backbone

Principle 18: The NYeNET will be used as a statewide network backbone for Enterprise applications and services.

This will foster greater collaboration and sharing of data between different agencies and entities.

Among the implications of this principle:

- Need to implement a robust, unified directory services capability.
- May require higher speed networks and higher bandwidth networks.
- Will require the interconnection of distributed LANs.
- Need to create connections from legacy systems to client/server and Internet applications.

3.6. Security Architecture

3.6.1. Conformance with Statutory Requirements and Policy

Principle 19: Enterprise systems will adhere to all applicable security, confidentiality, and privacy policies and statutes.

This helps to safeguard confidential and proprietary information, as well protects its integrity. It enhances public trust and the proper stewardship over public information. In addition to the technical requirements of security, education on issues of privacy and confidentiality must become a routine part of normal business processes.

3.6.2. Enterprise-wide Authentication

Principle 20: The EA will use a single method of user authentication to control access to Enterprise applications and services.

The security framework will eliminate multiple IDs/passwords, substituting a single login (user authentication via a common LDAP directory service). User authentication will be augmented to include dual-factor methods (e.g. RSA tokens, smart cards, biometrics, and certificates) for sensitive applications where such extra measures are necessary to achieve the required level of security.

3.6.3. Universality and Flexibility

Principle 21: The EA will support variable, application-specific security and data retention requirements.

Security and data retention requirements will vary with the type of information and the Enterprise Architecture must support these various requirements. The types of information a system builds, edits and/or displays will dictate its security requirements. No matter what type of data, systems should be designed with security as an integral part.

An application should make use of rights assigned by the user login to the environment rather than building access controls within itself. Because of the continued existence of legacy systems, the security framework should be designed so that can be retrofitted to these older applications.

4. Enterprise Architecture Management and Associated Principles

EA management includes the decision-making structures and processes needed to govern the overall Enterprise Architecture and the development and procurement of Enterprise systems. This section describes the governing structure to achieve the Enterprise Architecture and also the core day-to-day processes that must be managed in keeping with EA principles.

4.1. Governance

4.1.1. The Need for Governance

Principle 22: The EA will be planned and managed through a formal governance process.

Architecture support and review structures shall be used to ensure that the integrity of the architecture is maintained as systems and infrastructure are acquired, developed and enhanced.

A structured review process will be needed to ensure that information systems comply with the IT Architecture and related standards, and also to determine the appropriateness of any proposed exceptions to EA standards. Processes incorporating these EA principles must be developed for all application procurement, development, design, and management activities – building upon the current “Intent to Purchase” reviews, but not limited to that process.

The compliance process must allow for the introduction of new technology and standards, and also for the vetting and approval where appropriate of exceptions to standards. Conceptual Architecture and Technical Domain principles should be used as evaluation criteria for purchasing as well as developing software.

4.1.2. Architecture Review Process

Principle 23: The EA will include an Enterprise-level architecture review process, which will include representatives of agencies that vary in size, responsibility, and location, to oversee the alignment of Enterprise systems with the EA.

This review process will evaluate the impact of new and continuing systems activities against the Enterprise Architecture principles. For example, the review process will assess the extent to which a proposed solution leverages and possibly enhances existing, already available, components.

Findings and recommendations from the review process will be provided to the NYS CIO, who is ultimately responsible for the determination of whether a project significantly conforms to the EA.

4.1.3. Business Continuity Planning

Principle 24: Appropriate disaster recovery and business continuity plans will be implemented to ensure the stability and integrity of Enterprise applications and information assets.

Systems must be categorized according to their level of importance for Enterprise business continuity. For those that are Enterprise-critical, fault tolerance and recovery protocols must be incorporated into the planning and design of the system. Similarly, work site recovery plans must be developed and implemented. These should prioritize Enterprise-critical systems.

4.1.4. Evaluation of New Technologies

Principle 25: The EA will be continuously reviewed to assess the potential impact, positive and negative, of advances in technology and industry trends.

The integrity of the architecture will be maintained, but the implementation reviewed as technology evolves. Compliance to the EA principles must allow for the introduction of new technology and standards. An adoption process, incorporating conceptual and technical concerns, should be developed and followed for the introduction of any new technology standard. Caution should be used when acquiring any newly developed products or technologies, especially when we do not have control over the source code or design.

A necessary corollary to this principle is that there will be a periodic review of technologies that have become obsolete and need to be phased out.

4.2. Systems Development

4.2.1. End-user Involvement

Principle 26: Relevant business area experts will be included in application development/acquisition teams, and end-users will be consulted throughout the application lifecycle.

Success within most agency-based initiatives has always required collaboration between the program management, program specialists and IT staff. The business area or program experts are those stakeholders that are best equipped to provide feedback throughout the development process. Their involvement in any development team is thus essential. Clearly, participation in development teams requires both a time and energy investment in communication between the team members. This requires methods of communication and patterns of work that facilitate ongoing collaboration between end-user communities and IT staff.

Joint teams of technology and business experts present a unique challenge when those teams arise from different organizations. Determination of an overall project management process that incorporates the needs and priorities of each involved organization is especially important to the success of multi-agency initiatives.

The general increase in the use of previously built components described elsewhere in this document would make it easier for end-users to envision the system they will be using and to suggest improvements. This stands in contrast with the elaborate paper requirements process that preceded a long period of development for monolithic systems in the past.

4.2.2. Enterprise Impact Analysis

Principle 27: All decisions concerning acquiring, developing, and enhancing systems will include an analysis of the relative impact of the decision on the Enterprise.

Applications and information are valuable State assets and must be protected. Enterprise business impact analysis will yield valuable information to assist IT decision makers in planning, acquiring, designing, developing, enhancing, and recovering systems, thereby ensuring the alignment of technology decisions with the mission of the Enterprise while protecting the integrity of applications and information.

4.2.3. Total Cost of Ownership

Principle 28: The Enterprise will adopt a total cost of ownership (TCO) model for information technology.

Consideration of the total costs of ownership -- including those in affected agencies -- associated with a system over its entire life span will result in significantly more cost effective system choices and will enable improved accuracy in the planning and budget decision-making across the Enterprise. Incomplete consideration of TCO can lead to idiosyncratic and “silo” solutions that became ineffective in a short time period.

The Enterprise must agree upon a TCO model. The model should include the costs of acquisition, development, support, enhancements, training, operations, disaster recovery and retirement against the costs of flexibility, scalability, ease of use, and reduction of integration complexity.

However, the TCO alone must not be used as the sole criterion for technology decisions. The TCO model should be used to inform the decision process, in conjunction with other criteria, including fit with business and legal requirements, and impact on overall Enterprise Architecture.

4.2.4. Intermediate Deliverables

Principle 29: The EA will promote solutions for large projects that include intermediate deliverables for end-users.

Governmental IT initiatives are frequently large endeavors, with timetables often measured in years. “Big Bang” approaches to project delivery often fail because problems are not identified until it is too late in the life cycle to correct. Creative use of intermediate deliverables will reduce the incidence of project failure, improve communications between the customer and the supplier, and build momentum that can only enhance project success.

Identifying meaningful intermediate deliverables, particularly when deploying projects that interface with legacy systems, is a challenging task. Ensuring that this process does not slow down the process of deployment is an activity that must be monitored closely by both customer and the project team.

A well planned and implemented architecture will make it easier to provide frequent deliverables because of its use of pre-existing components and foundation in common patterns across the Enterprise.

4.2.5. Software Engineering Practices

Principle 30: Enterprise applications will be developed using software engineering practices that are consistent with accepted industry standards.

The principles outlined in this document will require consistent commitment across the Enterprise. Adhering to industry-accepted software engineering practices is a necessary part of this discipline. It also reduces training costs and improves quality assurance. In the longer run, it can provide the basis for benchmarks and other measurements.

It is essential that appropriate engineering practices be described and promulgated as part of the EA, along with training of staff in these practices as required and consistent with available resources. Similarly, all third party developers will be expected to follow compatible industry-standard practices.

4.2.6. Use of Industry-proven Technology

Principle 31: Enterprise applications and infrastructure will use commercially viable, industry-proven, widely-used technology to the maximum extent possible.

Use of industry-proven, widely-used technology allows for easier access to affordable skills and a large base of proven software solutions. It can reduce risk, and helps ensure robust product support. Wherever practical, the Enterprise should strive to implement commercial-off-the-shelf technology as a first preference over completely custom applications.

4.2.7. Open Standards

Principle 32: The EA will favor products and solutions that use open standards to facilitate interoperability between applications, systems and organizations.

Open standards are technology specifications that are publicly available and affirmed by an industry-recognized standards body. The use of open standards that allow for interoperability between applications and vendor-specific products is essential for the Enterprise Architecture to be successful. Requiring that products selected for Enterprise systems support open standards will also help ensure the flexibility and adaptability of the EA.

5. Summary: Themes Emerging from the Guiding Principles

A number of themes underlie and connect the Enterprise Architecture guiding principles discussed in this document. Together, these themes encapsulate the overall vision for the New York State Enterprise Architecture recommended the Technology Committee, and provide a succinct list of the major objectives underlying this initiative and which the establishment and maintenance of an Enterprise Architecture should enable. They are listed below:

- Simplification;
- Reduced total cost of ownership;
- Interoperability;
- Compliance with open standards;
- Component-based development;
- Information sharing;
- Development of data standards;
- Security;
- Scalability;
- Focus on business needs, and;
- Business partner involvement.

Appendix I - List of Guiding Principles

Enterprise Architecture Goals

1. The EA will maximize the cost-effectiveness of its information technology efforts.
2. The EA will reduce the complexity of New York State's information technology environment.

Enterprise Architecture Domains

3. The EA will be multi-tiered to maximize flexibility, adaptability and stability.

Information Architecture

4. The EA will facilitate information sharing across the Enterprise to enhance and accelerate decision-making.
5. The EA will support data warehousing and other information-centric end-user computing.
6. The EA will promote Enterprise-wide data standardization, reuse, interoperability, and information management across applications and agencies.

Business Process Architecture

7. The EA will facilitate common solutions for business processes and needs shared by multiple agencies.
8. The EA will facilitate Enterprise-wide business logic code reuse, smooth integration of Enterprise business processes, and maximum utility for end-users.
9. Business process re-engineering will be considered when defining requirements for new Enterprise applications.

End-User Architecture

10. Enterprise applications will be designed with a standard "look and feel" to facilitate ease of use, software design simplification, and branding.
11. The EA will define standards for basic information technology tools and services (e.g., email, voicemail, internet access) that employees should have available to them, consistent with available resources and job functions.
12. The EA will employ server-based thin-client solutions that require only network access and a web browser for end-user access wherever such solutions are technically appropriate.

Infrastructure Architecture

13. The EA will promote interoperability and integration across Enterprise applications.
14. The EA will favor solutions that are highly partitioned, modular in design, comprised of maximally decoupled components, and that use standards-based messaging for communication between external and internal systems.
15. The EA will establish uniform standards for Enterprise technology.
16. The EA will define a small number of standardized, easily-reproducible system configurations for deployment across the Enterprise.
17. Enterprise applications and infrastructure will be scalable in size, capacity, and functionality.
18. The NYeNET will be used as a statewide network backbone for Enterprise applications and services.

Security Architecture

19. Enterprise systems will adhere to all applicable security, confidentiality, and privacy policies and statutes.
20. The EA will use a single method of user authentication to control access to Enterprise applications and services.
21. The EA will support variable, application-specific security and data retention requirements.

Enterprise Architecture Management

Governance

22. The EA will be planned and managed through a formal governance process.
23. The EA will include an Enterprise-level architecture review process, which will include representatives of agencies that vary in size, responsibility, and location, to oversee the alignment of Enterprise systems with the EA.
24. Appropriate disaster recovery and business continuity plans will be implemented to ensure the stability and integrity of Enterprise applications and information assets.
25. The EA will be continuously reviewed to assess the potential impact, positive and negative, of advances in technology and industry trends.

System Development

26. Relevant business area experts will be included in application development/acquisition teams, and end-users will be consulted throughout the application lifecycle.
27. All decisions concerning acquiring, developing, enhancing, and outsourcing systems will include an analysis of the relative impact of the decision on the Enterprise.
28. The Enterprise will adopt a total cost of ownership model for information technology.
29. The EA will promote solutions for large projects that include intermediate deliverables for end-users.
30. Enterprise applications will be developed using software engineering practices that are consistent with accepted industry standards.
31. Enterprise applications and infrastructure will use commercially viable, industry-proven, widely-used technology to the maximum extent possible.
32. The EA will favor products and solutions that use open standards to facilitate interoperability between applications, systems and organizations.

Appendix II – NYS CIO Technology Committee Members

Chip Felton, Co-Chair	Office of Mental Health
Norm Jacknis, Co-Chair	Westchester County
Tom Corrado	Commission on the Quality of Care
Michael Drake	Liquor Authority
Dennis Eccleston	Power Authority
Thomas Herzog	Division of Parole
Ellen Kattleman	Office for Technology
John Kinnicutt	Racing & Wagering Board
Stephen Nelson	Insurance Fund
Peter Poletto	Office for Technology
Joanne Riddett	Thruway Authority
Brian Scott	Department of Health
Robert Vasko	Office of Mental Retardation & Developmental Disabilities
Robert Vitello	Office of the Attorney General
Don Wells	Department of Transportation
David Young	Energy Research & Development Authority