Final Report

MOBILE TRANSACTION GATEWAY

To

State of Ohio

Department of Administrative Services

Columbus, Ohio 43215

Battelle
The Business of Innovation

Information Control Corporation

August 2004

This report is a work prepared for the State of Ohio Government by Battelle. In no event shall either the State of Ohio Government or Battelle have any responsibility or liability for any consequences of any use, misuse, inability to use, or reliance on the information contained herein, nor does either warrant or otherwise represent in any way the accuracy, adequacy, efficacy, or applicability of the contents hereof.

TABLE OF CONTENTS

Page

TABLE OF CONTENTS III

EXECUTIVE SUMMARY 5

1.0 Background 5
2.0 Highlights of the Requirements Assessment 6
2.1. Purpose 6
2.2 Approach 6
2.3 Assumptions 6
2.4 Findings 7
2.5 Associated Deliverables 16
3.0 Highlights of the "Concept Architecture" 17
3.1 Purpose 17
3.2 Approach 17
3.3 Assumptions 17
3.4 Findings 18
3.5 Associated Deliverables 24
4.0 Highlights of the Business Case 25
4.1 Purpose 25
4.2 Approach 25
4.3 Assumptions 27
4.4 Findings 28
4.5 Associated Deliverables 29
5.0 Recommendations 31
6.0 Conclusions 32

APPENDIX 34

Appendix A: Acronyms 34

LIST OF TABLES

Table 1. Participation by Session 7
Table 2. Representation by Session by Organization 8
Table 3. Process Type Frequency 12

LIST OF FIGURES

Figure 1: Process by Status by Department 9
Figure 2: Process by Priority by Department 10

Figure 3: Process by Type by Department 11
Figure 4: MTG Electronic Data Collection Dependency Diagram 15
Figure 5: MTG Architecture, Layered View 18
Figure 6: Integrated Services on Microsoft Platform 21
Figure 7: Integrated Services on Open Source/J2EE Platform 22
Figure 8: Generic Deployment Model 23
Figure 9. Discounted Cash Flow for Adobe Forms 28
Figure 10. Discounted Cash Flow for Smart Client Implementation 29

EXECUTIVE SUMMARY

1.0 Background

This report summarizes the results and recommendations of the Mobile Transaction Gateway (MTG), Requirements Assessment, Conceptual Architecture, and Business Case Analysis. These deliverables were produced as a result of the MTG data collection and analysis conducted between June 3 and August 13, 2004. This activity had the following objectives:

- Identify organizational processes that do or would benefit from mobile capabilities
- Analyze these processes to define business requirements
- Define a supporting architecture and vendor implementation(s)
- Build a business case for a pilot deployment

Battelle and Information Control Corporation (ICC) received this request for services from the Ohio Department of Administrative Services (DAS) for a requirements assessment and proof-of-concept that would determine the scope and cost of a mobile transaction gateway pilot.

2.0 Highlights of the Requirements Assessment

2.1. Purpose

The objectives of the requirements assessment were fourfold:

- To define the business requirements of the Ohio mobile workforce, business partners and citizenry, based on the input of participating departments and agencies
- To provide a basis for the definition of a "concept architecture" to meet the needs of a business case and pilot implementation of MTG
- To provide a set of criteria for evaluating competing solutions
- To provide an input into the business case for a pilot implementation

2.2 Approach

2.2.1 Data Collection and Analysis

Data for MTG was gathered through two group sessions and follow-up interviews. The JAD sessions enjoined twenty-five (25) stakeholders and knowledge-workers from six (6) departments with resources from Battelle and ICC to collaborate on an inventory of State-of-Ohio mobile user needs and business requirements. The sixty-seven (67) scenarios describing various mobile applications that had been collected in these sessions were then analyzed for similarities and differences and clustered into ten (10) different process types. This clustering procedure was used to reduce the raw data to a manageable set of patterns that could be validated and refined via use case and dependency analysis. It also provided a classification scheme for aggregating scenarios for frequency and distribution across departments.

2.2.2 Use Case and Dependency Analysis

The process types were then modeled via use case analysis for an enumeration of functional requirements and constraints. Use case situation diagrams were built to identify contextual dependencies (upstream and downstream systems).

2.2.3 Relationship Matrix

The MTG business requirements were then mapped to various non-behavioral requirements derived from government standards and industry solutions, with supplemental qualifications being provided through subsequent interviews with stakeholders to arrive at a requirements set.

2.3 Assumptions

The following assumptions were made for the definition of the MTG requirements assessment and architecture:

a. Wireless networking capability is provided through a network-of-networks including both commercial and proprietary implementations managed through OIT (directly or indirectly).

b. Wireless network services, per se, are beyond the scope of this deliverable, and are being addressed through ongoing activities of OIT Service Delivery to select vendors and negotiate contractual agreements.

c. In line with various State initiatives, MTG recommendations assume a consolidated and centralized computing infrastructure for enterprise shared services.

d. Common services and infrastructure will provide greater scalability, flexibility, reliability, disaster-recovery, re-usability, and cost savings for customers

e. As patterned activities generalized from the data set of sixty-seven processes identified in the JAD sessions, the process-types are sufficiently representative to provide a valid (though not necessarily exhaustive) set of requirements

f. In the case of MTG, the focus is limited to data transmission/management capabilities. Voice requirements have been excluded from the analysis.

g. The requirements should provide guidance for these processes which can be used by the sponsor when evaluating potential solutions, vendor tools, and additional needs.

2.4 Findings

The considerable number of processes and activities identified in the process inventory indicate a ready perception on the part of stakeholders to identify potential applications of mobile strategies and infrastructure.
The aggregation of these processes into more inclusive categories and the subsequent frequency analysis helps to set priorities for subsequent systems and cost analysis, and pilot planning.

The number of participating agencies and potential applications forced some changes in format resulting in more enumeration than drill-down. However, this had the benefit of providing a larger and more representative inventory of needs. Patterns were readily apparent.

2.4.1 Quantitative Summary

- Participants readily identified a range of applications for mobile/wireless enablement for a total of sixty-seven (67) such processes or activities
- Of these, the majority (76%) were envisioned, while a minority (15%) were planned, or in some current state of mobile-enablement (10%)
- Priority was somewhat skewed with a majority ranked as medium or low priority
- Processes in the inventory could be grouped and typed demonstrating common business process/activity patterns across departments, thus indicating common requirements and solutions
- Multiple process types recommend themselves as candidates for further analysis and pilot planning because of their pervasiveness and common workflow

2.4.1.1 Participation

Twenty-five (25) individuals participated in the two different sessions, twenty (20) representing State of Ohio Departments. The first session was roughly twice as large as the second and justified the division into two separate working groups.

Table 1. Participation by Session

Count of Session	
Session	Total
All	5
6/3/2004	14
6/10/2004	6

Grand Total	25

2.4.1.2 Representation

Participating departments were well-represented with a range of internal agencies and working groups (e.g., IT) as was the case for DAS, DOC, DPS, or by sending fewer, but very knowledgeable parties like ODH, DOD, and DNR.

Table 2. Representation by Session by Organization

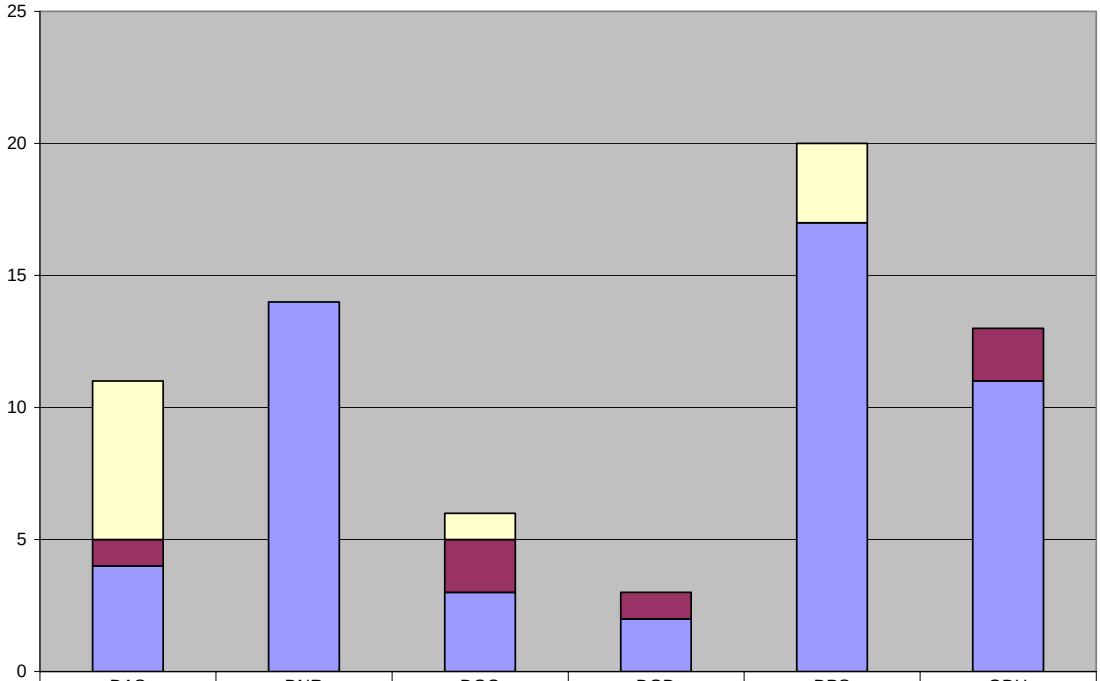
Count of Dept.	Session			
Dept.	All	6/3/2004	6/10/2004	Grand Total
DAS	2	2	1	5
DNR		1		1
DOC		5		5
DPS		6		6
ICC	2		1	3
ODH			3	3
Battelle	1			1
DOD			1	1
Grand Total	5	14	6	25

2.4.1.3 Status

Participants readily identified a range of applications for mobile/wireless for a total of sixty-seven (67) such processes or activities. Of these, the majority (76%) were envisioned, while a minority (15%) were planned, or in some current state of mobile deployment (10%). DPS cited the greatest number of potential applications (20), followed by DNR (14), ODH (13), DAS (11), DOC (6), and DOD (3).[1]

1 It should be noted that the list of processes produced by each department was completely volunteristic and constitutes a convenience sample. The inventory is neither probabilistic nor exhaustive. See *Qualifications*.

Figure 1: Process by Status by Department



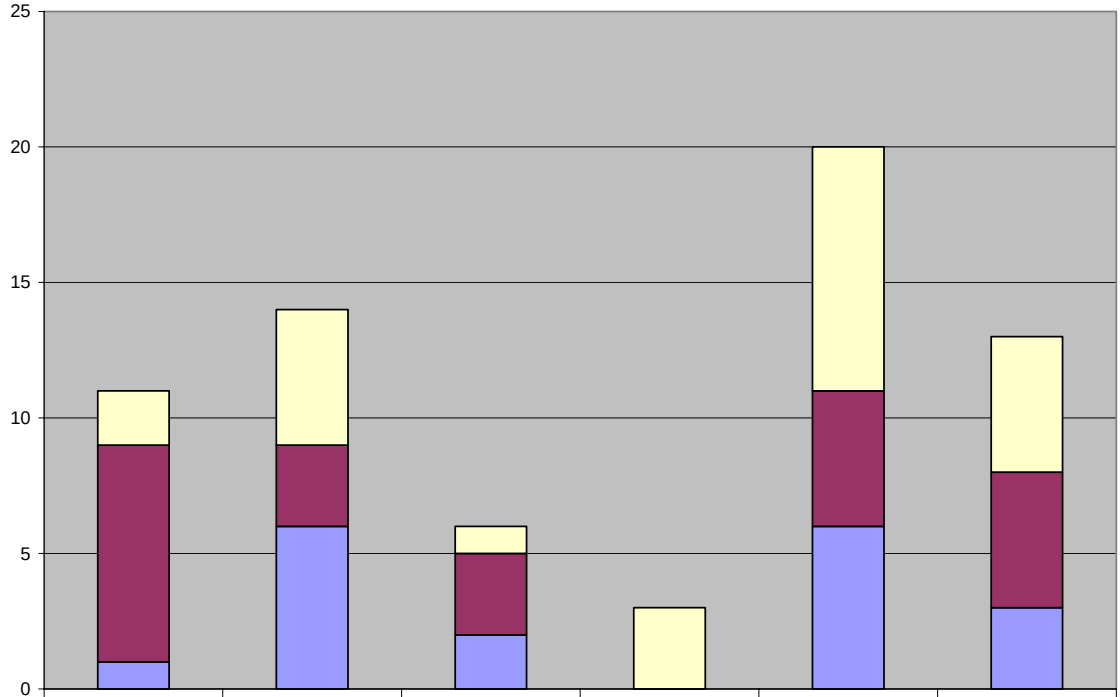
	DAS	DNR	DOC	DOD	DPS	ODH
Planned	6		1		3	
Existing	1		2	1		2
Envisioned	4	14	3	2	17	11

2.4.1.3 Priority

Priority was slightly skewed from high (27%) to intermediate (36%) and low (37%) priority. Priority was an assignment relative to each department. Where this measure was in question or not explicitly defined by department representatives, priority was assigned according to a rule proposed by DNR:

- High priority to activities involving public safety
- Intermediate priority to those enabling communication and scheduling
- Low priority for enabling processes currently supported via paper processes

Figure 2: Process by Priority by Department



	DAS	DNR	DOC	DOD	DPS	ODH
Low	2	5	1	3	9	5
Intermediate	8	3	3		5	5
High	1	6	2		6	3

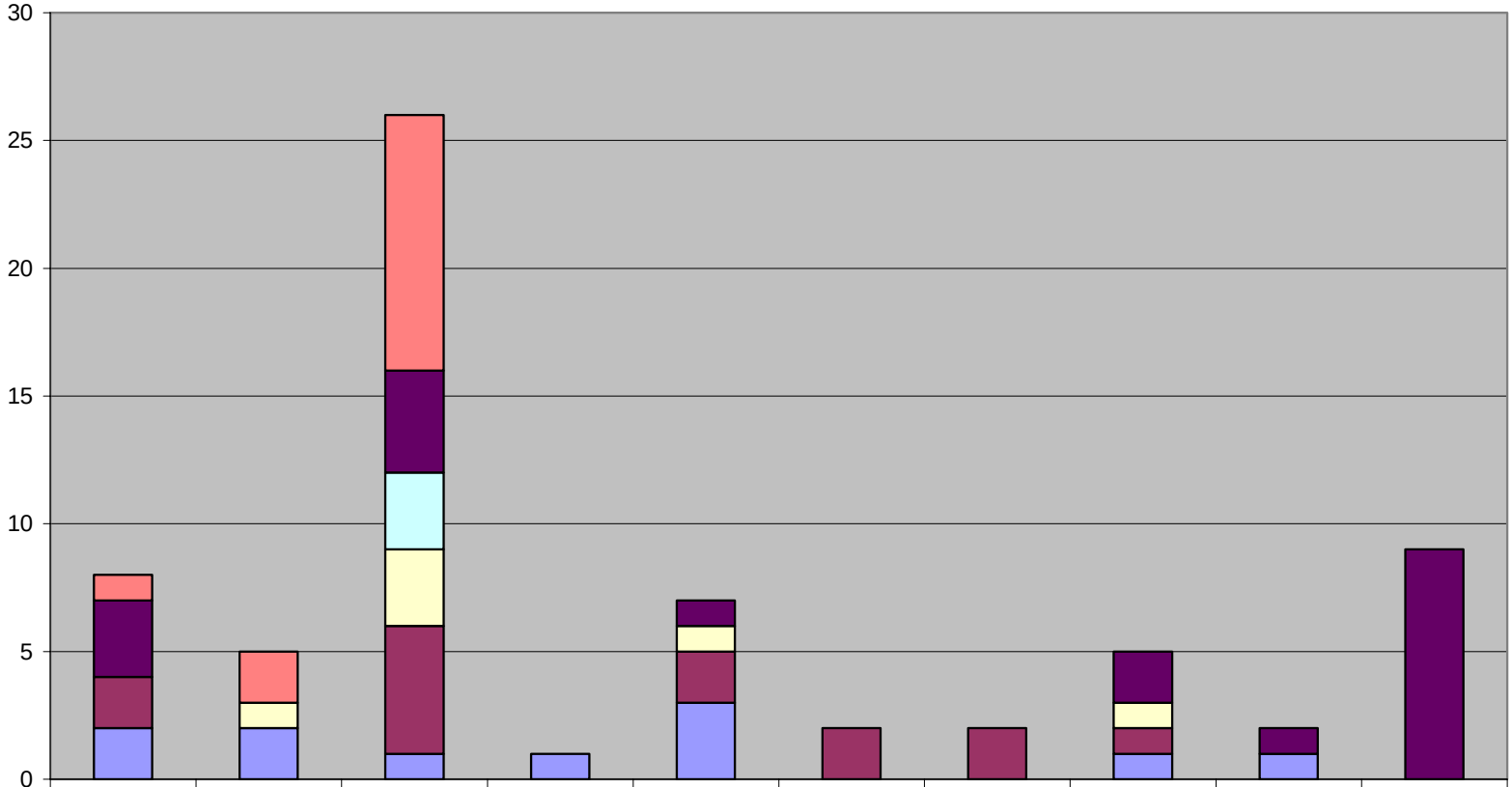
2.1.4.3 Typology and Aggregation

Activities and needs identified through the process inventory could be typed according to similarities and differences in business process/activity patterns involving inputs and outputs, rules and requirements, and goals. These patterns were used to define a preliminary typology of ten categories and include:

- Alerts
- Asset Management
- EMail
- Inspection/Audit
- Messaging
- Notification
- Real-time Connectivity
- Reference
- Remote Sensing
- Survey

Figure 3 provides a tabular break-down of process by department by process type. The chart depicts the relative prominence of each process type or category, as well as the degree to which that process type is pertinent to a given department and the set of all participating departments.

Figure 3: Process by Type by Department



	Alert	Asset Management	Inspection/Audit	Notification	Reference	Remote Sensing	Survey	Email/Schedules	Messaging	Real-time Connectivity
ODH	1	2	10							
DPS	3		4		1			2	1	9
DOD			3							
DOC		1	3		1			1		
DNR	2		5		2	2	2	1		
DAS	2	2	1	1	3			1	1	

Table 3. Process Type Frequency	
Type	Total
Inspection/Audit	38.81%
Real-time Connectivity	13.43%
Alerts	11.94%
Reference	10.45%
Asset Management	7.46%
Email/Schedules	7.46%
Remote Sensing	2.99%
Survey	2.99%
Messaging	2.99%
Notification	1.49%
Grand Total	100.00%

- *Inspection/Audit* is the most prominent process type (38%), and the most common. It is an activity that cuts across all departments, accounting for as many as ten applications (ODH). There was an average of 4.3 inspection/audit processes identified per department during these sessions.[2]
- *Real-time connectivity* is the next most prominent category (13%), but based on the information collected in these sessions, and this preliminary analysis, it applies chiefly to DPS.[3]
- *Alerts* account for 12% of the total and were mentioned by 4 of 6 departments in the context of public safety or the support of DPS infrastructure.
- *Reference,* or information access, accounts for 10% of mentions by four departments and was frequently cited as an adjunct to *Inspection/Audit* processes.
- *Asset Management* and *Email/Schedules*, two adjunct mobile work enablers, have next most frequent mention (both approx. 7%).
- The more specialized requirements and limited (but critical) applications for *Remote Sensing*, *Surveys*, and *Messaging* follow (all at 3%).
- The *Notification* class was least mentioned, but this is likely due to the minimal representation of citizen-consumer representation in these meetings, and the fact that, the strong representation of the mobile workforce allocated such communication to *Email* or *Messaging*.

Process Drill-down

The considerable number of participating agencies in these sessions forced some changes in format resulting in more enumeration of processes than drill-down. However, this had the benefit of providing a larger and more representative enumeration of needs making some patterns readily apparent. These patterns were captured in the process types which were further refined through the use case and dependency analysis.

2.4.2 Use Case Analysis

The process types were also modeled as use cases to arrive at a more complete set of functional requirements. The use case and dependency analysis resulted in further the identification of additional requirements and further refinement of the ten process types into a set of business requirements. These were assigned to higher-level organizational categories as follows:

1.1 Information Access	**Provide web content** to the mobile workforce, business partners and citizenry as appropriate to the user/customers' role, device, and configuration via the shared services of identity management and security, personalization and **content transformation.**

2 In other words, there may be many more in the field, but this was the information obtained in these sessions, and we don't have the sampling power to generalize beyond our data set. See *Discussion, Qualifications*.
3 Viewed at an infrastructural level, *Alerts* and *Messaging* assume real-time connectivity as well, but our categories are also distinguished by patterns of use and implied architectural requirements such as synchronous vs. asynchronous communication.

1.2 Application Access	**Provide on-line services** to the mobile workforce, business partners and citizenry as appropriate to the user/customers' role, device, and configuration via the shared services of identity management and security, personalization, content transformation, and **remote application access delivery mechanisms**.
2.0 Communication Services	**Provide communication services** to the mobile workforce, business partners and citizenry as appropriate to the user/customers' role, device, and configuration via the shared services of identity management and security, personalization, and content transformation with access to the following capabilities: ▪ Provide secure and reliable **alerts** including origination, propagation, and control capabilities to public safety and emergency management first and second responders and support organizations both within and across jurisdictions with possible extension of one-way alerting capability to citizens via wired and wirelessly enabled devices. ▪ Provide secure and reliable **instant messaging** and **chat conference** capabilities to public safety and emergency management first and second responders and support organizations both within and across jurisdictions. ▪ Provide **electronic mail and schedule** access to the State mobile workforce as appropriate to role. ▪ Provide timely **notifications** of impending State business to business partners and citizenry on a subscription basis appropriate to the user/customers' device and configuration.
3.0 Electronic Data Collection	Provide **roundtrip electronic data collection** capabilities to the mobile workforce, business partners and citizenry as appropriate to the user/customers' role, device, and configuration via the shared services of identity management and security, personalization, content transformation, document and workflow management. Specifically: ▪ Provide constituents with the ability to **request services** from a provider organization, via the elicitation and submission of structured data (and payments), with the issuance of receipts and/or tracking information for access to processing status. ▪ Provide the mobile workforce of inspectors, auditors, and caseworkers with the ability to **conduct round-trip electronic data collection and management for the range of compliance targets** such as mechanical systems, building or construction sites, service agencies, and grant applicants/recipients, including support for workflow for process management. ▪ Provide state employees with ability to do **systems-based inventory management both on- and off-line** (with synchronization capabilities) as required by context of

application (availability of network connectivity).

- Provide **automated data collection capabilities from remote field sensors**, specifically for field and stream gauges.

- Support collection of **field survey data on- or off-line** with synchronization capabilities.

4.0 Document Management

Provide **document portability and management solutions** to the mobile workforce, business partners, and citizenry as appropriate to the user/customers' role, device, and configuration via the shared services of identity management and security, personalization, content transformation (where appropriate[4]), and workflow to render the following:

- Provide the ability to obtain, consult, and manage (voluminous) state, federal, and proprietary codes, manuals, operational guidelines, and procedures in electronic formats on- or off-line.

- Support customer service through ready access to public documents, directions, instructions, and resources.

- Support the document lifecycle from inception through creation, review, redaction, storage, dissemination and destruction.

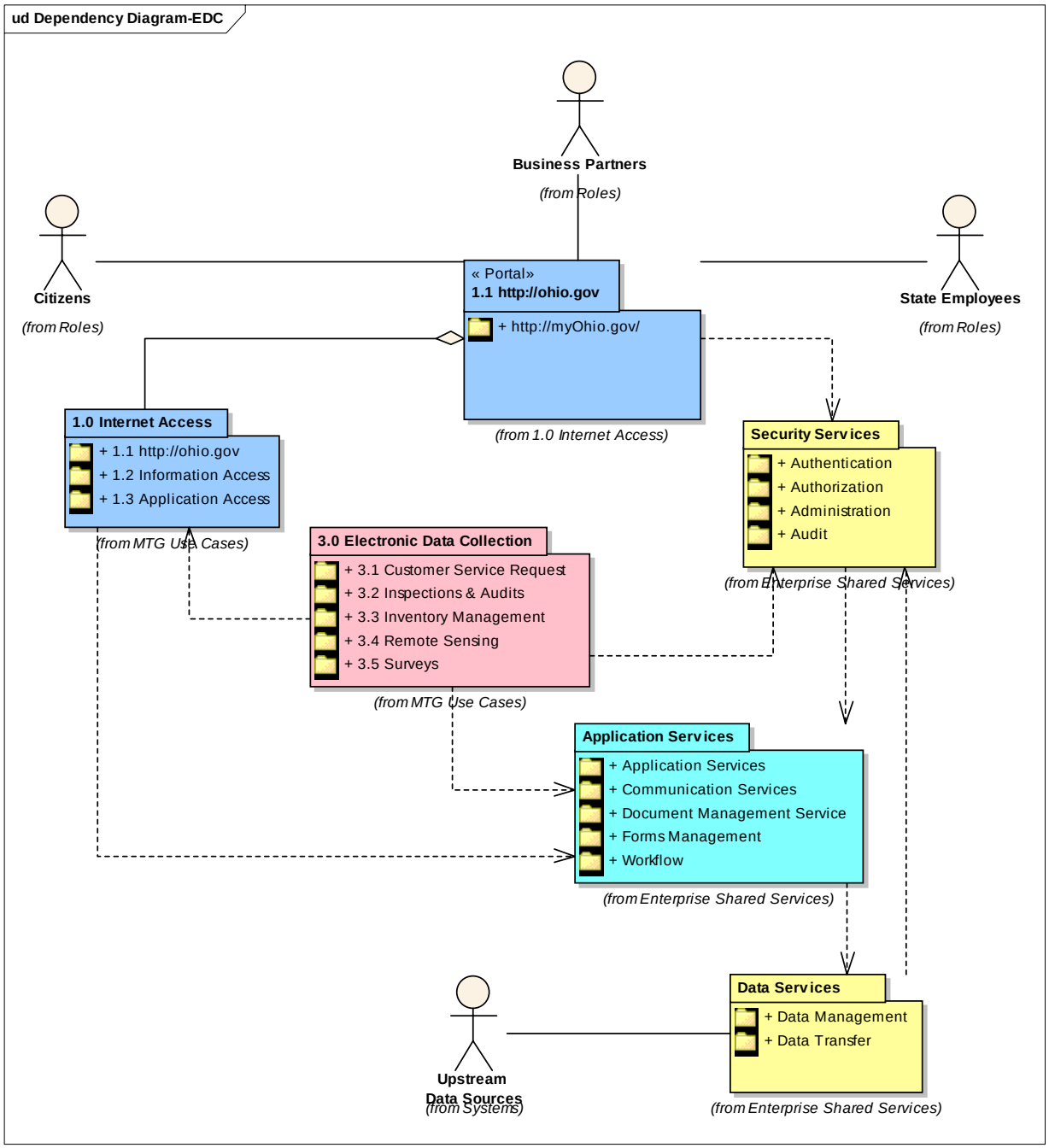
2.4.3 Dependency Analysis

Use cases were then placed into context and modeled as situation diagrams to define upstream and downstream dependencies as in Figure 4, an example of the context of electronic data collection (EDC). This analysis identified additional dependencies required for an enterprise shared services model including:

- Application Security Infrastructure
    - Common and extensible authentication
    - Role-based access control
    - Identity and policy management
    - Auditing
- Workflow Management
- Data transport/integration services
- Document management services

4 "Where appropriate" is an acknowledgement that the limitations of bandwidth, memory, and form factor may simply be insufficient to download and manage certain types of documents (i.e., cell phones do have limitations).

Figure 4: MTG Electronic Data Collection Dependency Diagram



2.4.4 Requirements Mapping

Further granularity was added to the analysis by mapping the functional requirements to various non-behavioral requirements, or quality attributes, such as security, usability, portability, quality of service and similar requirements in a workbook format allowing filtering on various categories of requirements or process types.

2.5 Associated Deliverables

Please see the associated architecture document:

- MTG JAD Summary.doc
- MTG Requirements Assessment.doc
- MTG Relationship Matrix.xls

3.0 Highlights of the "Concept Architecture"

3.1 Purpose

The purpose of the "concept architecture" was to provide a high-level specification of supporting infrastructure to address key requirements of MTG, and to support a mapping of components and vendor solutions as inputs to the business case.

3.2 Approach

The outputs of the requirements assessment were evaluated to define the architecture for MTG. This involved the following steps:

1. Separate domain and functional capabilities identified in the requirements analysis into tiers of responsibility (client, wireless service provider, network interface, enterprise shared services, departments, etc.).
2. Map these responsibilities onto industry standard architectures for key requirements.
3. Decompose these architectures into sub-types and their supporting components.
4. Map and evaluate supporting vendor solutions and options.
5. Propose an MTG infrastructure and variants to meet the needs of a pilot.

Four primary views of this architecture were constructed:

- **Architectural Layer View**
  - Separates domain and functional capabilities into tiers of responsibility
  - Scopes analysis
- **Module Decomposition View**
  - Describes solutions to meet principal MTG requirements
  - Identifies elements as modules or sub-systems
  - Presents architecture, sub-types, and implementation options
- **Module Implementation View**
  - Provides a mapping of commercial off-the-shelf vendor solutions to core elements of the MTG architecture via layered views
  - Identifies concrete building blocks to provide cost estimations for business case analysis
- **Deployment View**
  - Describes a pilot implementation

3.3 Assumptions

a. The analysis and recommendation assumes a strategy of shared services and consolidated infrastructure, with the understanding that scalability, flexibility, reliability, disaster-recovery, re-usability, and, ultimately cost savings are facilitated by such an assumption.

b. No particular assumptions have been made in this analysis about the existence of licenses and obligations of the state to particular vendors, or conversely, of vendors' agreements with the state.

c. Wireless network services, per se, are beyond the scope of this analysis, and are being addressed through ongoing activities of OIT Service Delivery to select vendors and negotiate contractual agreements.

d. Network architecture will be defined in cooperation with OIT network services in support of the pilot.

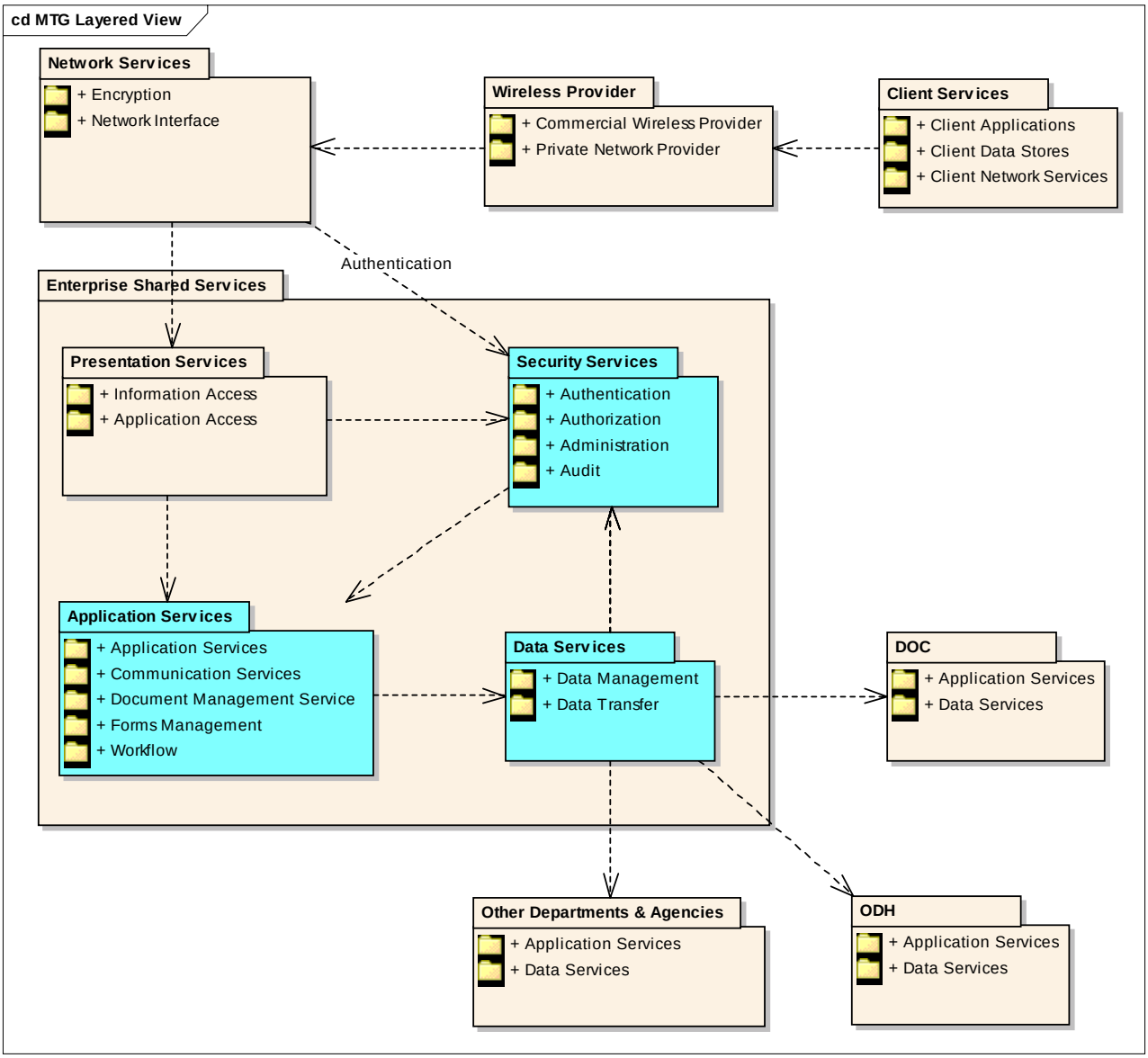
e. Mobile applications will be purchased, built, or otherwise acquired to allow state personnel or citizens to interact with internal systems via vendor packaged mobile clients, or via XML or SOAP interfaces for data interaction.

3.4 Findings

3.4.1 Architectural Layer View

A layered view decomposes the MTG architecture into tiers of domain and functional responsibility as depicted in Figure 5.

Figure 5: MTG Architecture, Layered View



These packages may be described as follows:

Client Services	Addresses services and components that must be installed/deployed on the client device.
Wireless Providers	The third-party commercial wireless (Verizon, Sprint, Cingular, Nextel, etc.) or private network (MARCS) provider of connectivity and data services to the client as sub-contracted or maintained by DAS/OIT.
Network Services	These are State of Ohio network services that address all termination/peering points with commercial wireless and Internet service providers, as well as, network firewalls, load-balancing, content switching, routing, and network security, including VPN termination, where applicable. The availability of network services is a key assumption of MTG.
Enterprise Shared Services	This is the aggregation point of MTG services, and assumes their consolidation into an enterprise architecture leveraging shared services, including: **Presentation Services** – Assumes a configurable web interface as the integration point for web content and on-line services as personalized for a user according to role-based access controls. **Application Services** – These include the range of middle-tier services including support for the execution of application business logic, communication and collaboration, forms and document management services, and workflow -- where lightweight workflows are an integral part of mobile application interaction with backend systems. **Security Services --** Secure gateway services supports extensible authentication for both users and devices, and role-based access control to enable users with differential access to information and applications. Directory-based identity management supports both user and policy administration. Delegated administration and user self-registration and credential management are supported as required. Encryption is supported as required by the application, and security audit trails are maintained in-line with industry best practices. **Data Services –** Addresses the need for locally-persisted data in support of various application services and web content management based on database and files systems. At the design's core is an interaction bus which will allow disparate information systems to interact using a common vocabulary -- XML. This bus may be implemented with several different technology stacks such as .NET, J2EE, or other technical platforms. The key to this approach is that the bus becomes the center of interaction between all applications.
DOC, ODH, and Other	These are the client departments of enterprise shared services (where

Departments	DOC and ODH are identified as examples) with their respective, department-owned, data and applications. The success of MTG shared services rests on a successful strategy of integrating data and workflow across these departments. To facilitate this, adapters will be purchased, modified, or built to connect legacy systems. The goals for these adapters are to ensure that existing applications require little or no modification in order to interface with the MTG.

3.4.2 Module Implementation Views

These views provide mappings of commercial off-the-shelf vendor solutions to core elements of the MTG architecture via layered views, and were used to provide cost estimates for the business case analysis. Two variants were modeled.

3.4.2.1 MTG Integrated Services: Microsoft Platform

Figure 6 summarizes a combined solution of electronic forms and smart client deployment. It recognizes the fact that, while many applications may be successfully addressed via forms-based data collection and processing, others will be sufficiently complex to require formidable application development. It defines a deployment of both Adobe PDF/XDP based forms services, as well as an infrastructure to support Microsoft Smart Client technology.

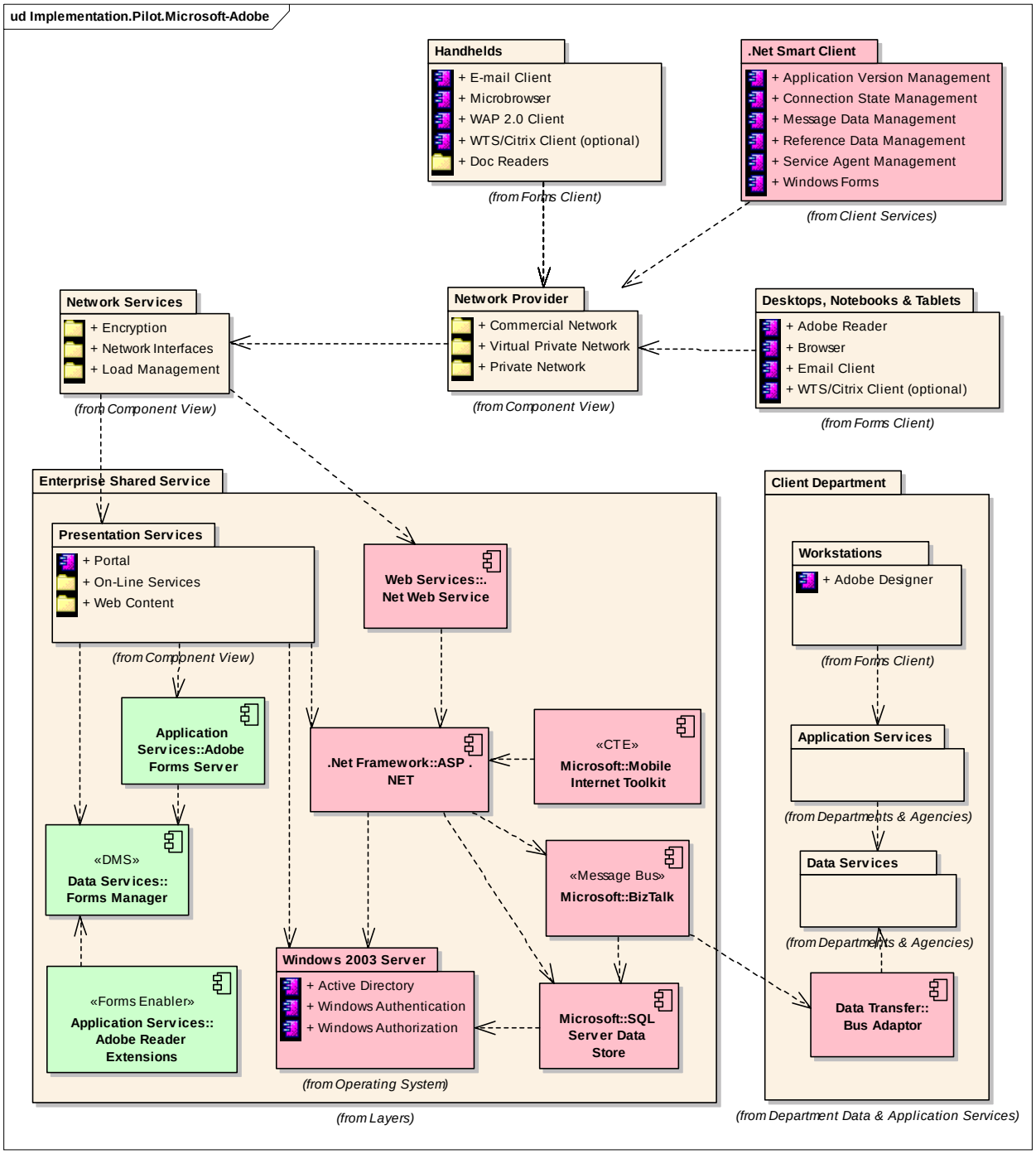
- An Adobe Reader Extensions Document Server is used to enable PDF/XDP forms capabilities as previously described. The Adobe Forms Server is deployed to support the population and extraction of data from forms.

- Smart Client web services are deployed to support the transfer of data to and from device-based smart clients.

- Database and directory services are used in common and leverage the security services of the Microsoft Windows 2003 platform. Forms data would be stored in a SQL server (or other database), along with BizTalk routing and task state data. SQL Server 2000 would be recommended as the pilot repository for purposes of BizTalk integration, XML forms conversion.

- The use of BizTalk is a possible solution to the support of workflow and data transport to and from client agencies. Adaptors would need to be configured for client data extraction and upload. Pilot planning activities must take these tasks into account. More robust data transport and workflow solutions could be substituted following the completion of a more complete assessment of enterprise data integration needs.

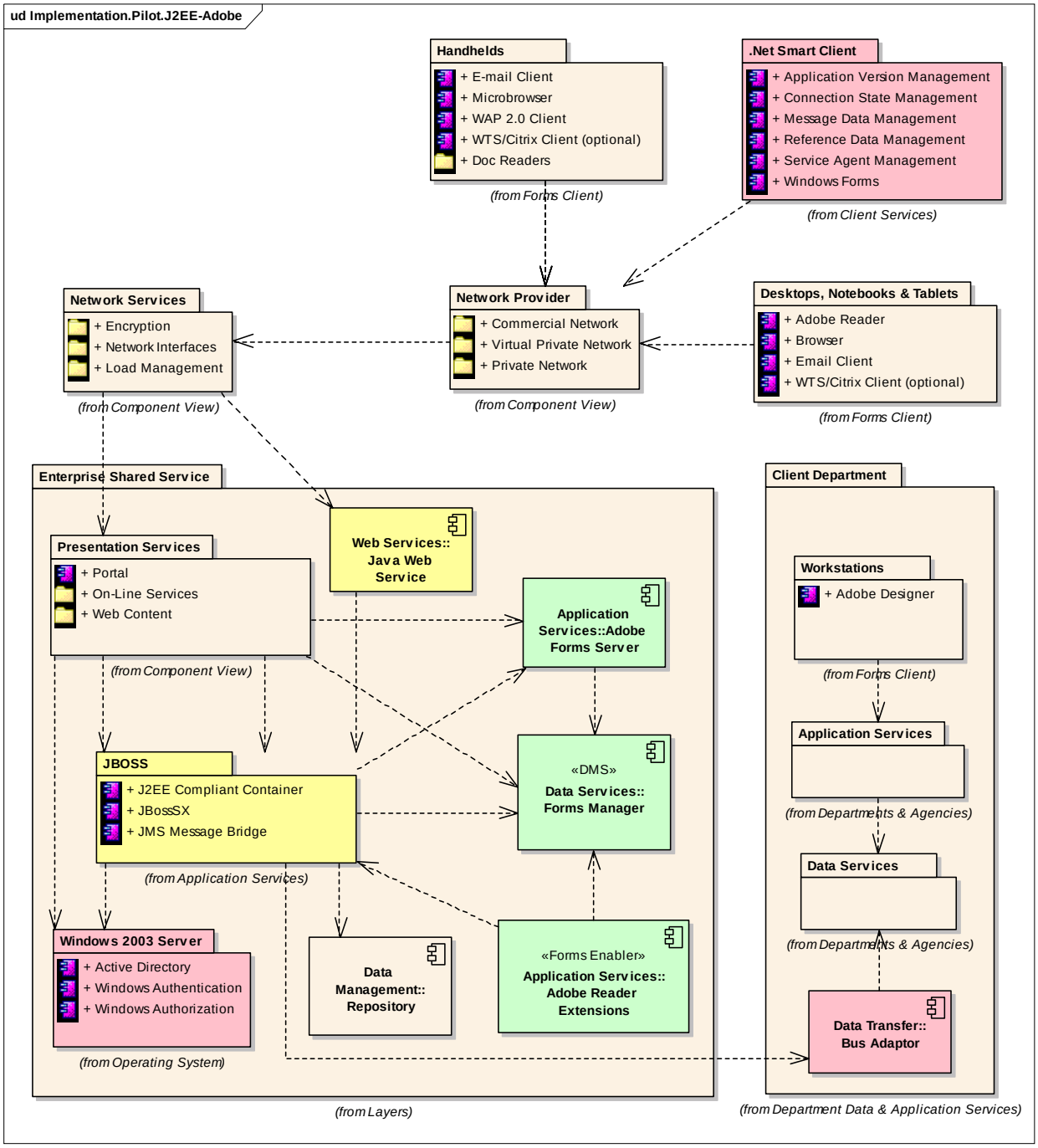
Figure 6: Integrated Services on Microsoft Platform



3.4.2.2 MTG Integrated Services: J2EE Platform

The Following model provides similar functionality via electronic forms and smart client technology on an open-source Linux/J2EE platform. Functional capabilities are preserved, but the alternative implementation provides a lower cost solution, and one that is potentially more flexibly integrated into non-Microsoft legacy infrastructure. It is provided as a point of comparison.

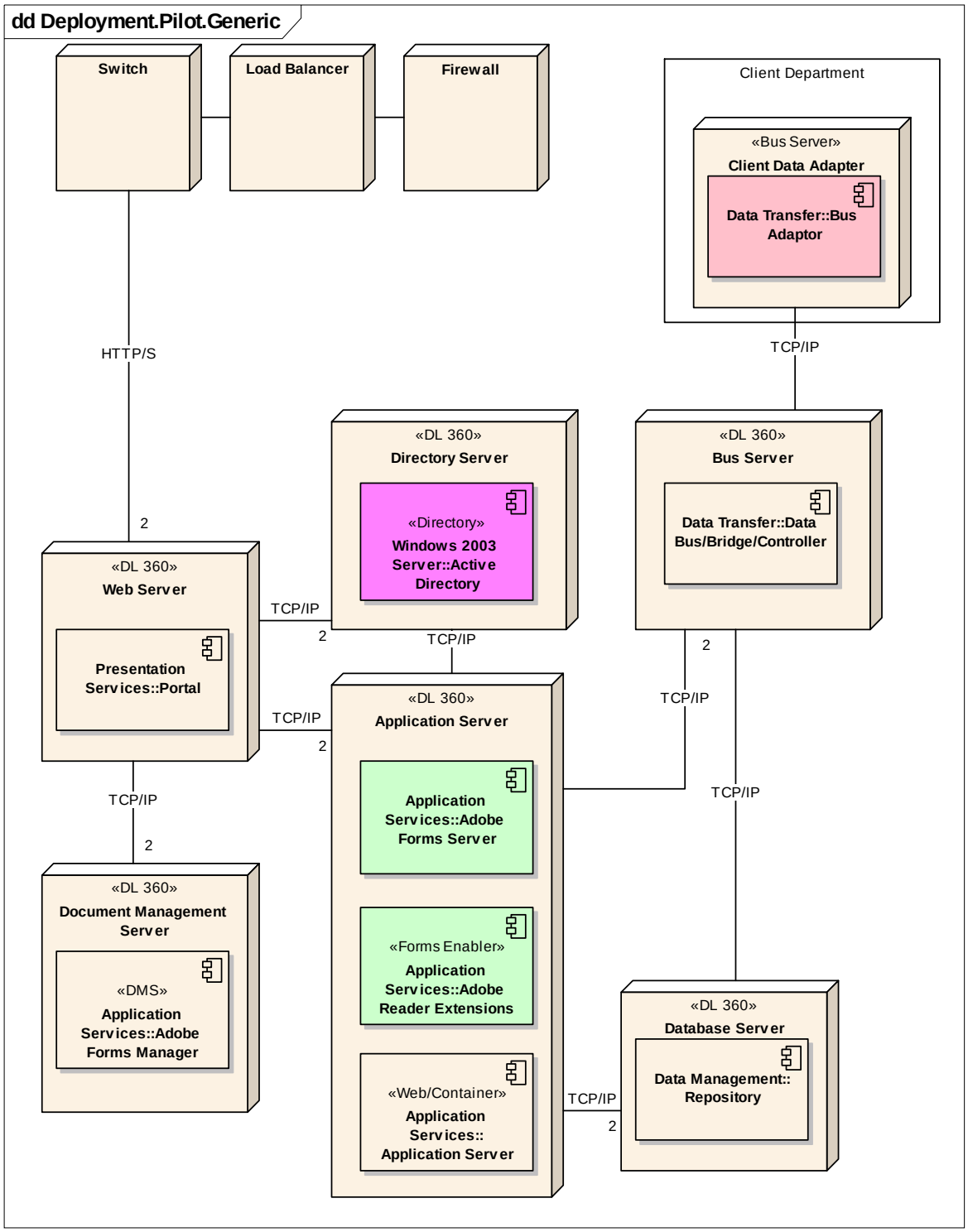
Figure 7: Integrated Services on Open Source/J2EE Platform



3.4.3 Deployment View

These implementation models can be mapped to the generic deployment view depicted in Figure 8.

Figure 8: Generic Deployment Model



This deployment view describes an implementation of the pilot architecture on clustered HP ProLiant DL 360 servers. Each server is configured with 2 3.4 GHz Xeon processors, 2 GB's of memory, and 2 mirrored 146 GB 10,000 RPM SCSI. Hardware configurations would be adjusted using performance data gathered during load testing and during the pilot.

All equipment resides behind existing firewall and network security infrastructure. HTTP/S traffic is the only traffic accepted from external sources. Internally, the servers communicate using standard TCP/IP.

Six clusters are hosted centrally. The web presentation / portal cluster provides web presentation services for all applications. An application server cluster hosts the Adobe Form Server, Adobe Reader Extensions Server, and .Net or J2EE application server. Document management services are provided by a cluster running Adobe Forms Manager. Separate clusters host the data repository and the data bus services.

Each client department will locally host a bus adapter to enable access to their data. The bus adapter may be located on existing hardware, or on hardware installed for the pilot. Operating system requirements may vary depending on the implementation selected for the pilot.

Information from these three models is a primary input to the investment assumptions of the business case.

3.5 Associated Deliverables

Please see the associated architecture document: *MTG Architecture.doc*

4.0 Highlights of the Business Case

4.1 Purpose

The purpose of the business case was to demonstrate the economic viability of the MTG Gateway and pilot according to the following objectives and constraints:

- Within the limited time-frame of the analysis, identify those high-value implementations which would off-set the cost of the MTG pilot while delivering significant value for customers
- Develop a credible business case by articulating realistic assumptions
- Provide a reasonable estimate of initial investments and recurring costs for both infrastructure and individual applications
- Build one or more valid models
- Quantify the cost-savings
- Provide qualifications as appropriate

4.2 Approach

The following approach was used to make the business case both tractable and credible.

1. Select implementations with potentially high return based on readily quantifiable process improvements, frequency, and commonality.

   For this we chose the Electronic Data Collection process types of *Service Requests* and *Inspections & Audits*. The former was chosen because of its broad impact to all constituents – citizens, business partners, and employees – the latter, because of its high frequency of mention in the JAD sessions (GT 50% of applications/scenarios) and its impact (100% of participating departments).

2. Model baseline manual and automated processes.

   For each process type we've modeled a series of process sequences for both a manual (or semi-automated) process flow, and for a fully automated process assuming the Adobe Forms or Microsoft Smart Client architectures. The key differences between these flows are to be found in electronic dissemination, submission, and data capture of the data/template, and the transmission times.

3. Identify predictor and criterion variables.

   At root, the business cases assume a simplified activity-based costing model. The predictor variables are the process steps and associated durations and wait times. The criterion variables for these activities are (a) work-time (the cumulative time required for process execution exclusive of wait time) and (b) cycle-time (the roundtrip execution time inclusive of wait time). In addition, numerous variables determining the costs of the pilot infrastructure and implementations were conservatively estimated (see (5), below) as inputs to the analysis.

   The financial model targets the net present value (NPV) as the ultimate criterion for evaluating an investment decision for MTG, where the decision is based on a comparison of continuing present operations for processes as they are today, versus an investment in MTG, appropriately

discounted, to automate and mobilize EDC for these same idealized processes, for a net gain or loss per the analysis.

4. Calculate time and cost-savings.

   Time savings are calculated as the difference between treatments (manual vs. automated) for each model.

   Net dollar savings or costs are calculated in the financial model as the product of time savings and an estimated annual loaded salary of a position associated with the range of data-entry and administrative activity associated with the impacted process steps. The assumptions for these calculations are an annual salary of $33,700 with 15% overhead, prorated for a 260 day work year and 8 hour work day.

5. Calculate infrastructure and implementation costs.

   Costs of the infrastructure and per application implementation costs were calculated based on the architecture and assumptions outlined above (see sections 3.4 and 4.3) including loaded support costs, hardware and software maintenance.

   For the infrastructure, assumptions were based on the acquisition of the somewhat more costly Microsoft/Adobe platform (vs. the opensource-Java/Adobe platform) in recognition of a preference by ESS based on available skill set, and because it was the more conservative estimate.

   For the implementation costs, project plans were built to arrive at credible estimates of duration and resource requirements for both electronic form and smart client implementations. The proposed architecture, including enterprise integration with department data repositories, was a key input for determining the WBS of these plans. Resource requirements were priced using a blended rate of Battelle and ICC rates for equivalent positions. Additionally, durations and costs for simpler and more complex implementations were modeled, with the average cost of implementations serving as key investments for the NPV analysis.

6. Perform Net Present Value (NPV) analysis for multiple cases and terms.

   The NPV analysis was run for each of the two different EDC architectures, for the same time frames, but three transaction volumes each.

   While the infrastructure costs are constant for each of the two different architectures, the application development costs for the two models vary. Electronic forms are recommended for simple and moderately complex implementations, where few assumptions could be made regarding the client device. Smart clients would be built to meet complex requirements which entail custom application development, and situations were the state has full control of the end-user device. These assumptions require separate analyses (corresponding to NPV.eForms, NPV.SmartClient and NPV.SmartClient (2) worksheets in the Business Case Estimate-MTG-FNL.xls).

   The discounted cash flow (DCF) analysis is worked for periods of one, two, three, four, five years and terminal value. While the analysis isn't very meaningful for periods less than two years out, they were including for purposes of illustration. The target periods are three and five years, but

longer periods are not unrealistic given the historically slower pace of government/institutional technology refreshment (vs. that of the private sector).

For each analysis, NPV was calculated for three different transaction volumes. These volumes were determined from scant empirical data, but deemed to be acceptable given the assumptions that transactions would be accumulated annually and would range statewide to generate reasonable volumes.

In the case of the Adobe forms architecture, we did an inspection of existing forms used to support various lead abatement processes. Data regarding the volume and duration of these transactions was requested, but not forthcoming by the time of the analysis, estimates of minimum and maximum volumes were made based on counts from available on-line reporting tools (approx. 1,200 instances) and the knowledge that, in one particular case, Taxation had a form for which two hundred thousand (200,000) instances were processed per annum. Given this paucity of data, we worked the business case for twenty (20,000), forty (40,000), and eighty thousand (80,000) instances to yield an analysis we felt to be illustrative, and not unreasonable.

In the case of the Microsoft Smart Client analysis, we had somewhat better data resulting from our POC engagement with Commerce which reported forty-five thousand (45,000) elevator inspections per year. Variants of fifteen (15,000), thirty (30,000), and forty-five thousand (45,000) instances seemed to be quite achievable volumes.

4.3 Assumptions

The scope and approach to the business case relies upon two sets of assumptions for estimating the investments associated with the pilot infrastructure, the pilot, and subsequent implementations. Inputs driving the discounted cash flow analysis account for a third.

4.3.1 Infrastructure

- High-availability installation, 15 hours down-time per annum (99.6)
- Sufficient scale to handle 100K transaction per day, or 35 million forms per year
- Annual hardware maintenance based on 20% of hardware cost with 1 year warranty
- Annual cost of MRC for additional bandwidth (DS3 @ $3,600 per month)
- A hardware refreshment cost in year three corresponding to slightly discounted initial investment
- Annual Platform Maintenance based on 1 FTE
- Annual user support based on 2 FTE

4.3.2 Applications

- Focus on Electronic Data Collection (EDC) processes for the quantitative analysis
- Define models for eforms and smart client applications as ideal cases
- Quantify work and cycle-time savings
- Base implementation costs and extensions on blended rates and average complexity
- Conservatively estimate the number of implementations per annum
- Divide fixed costs evenly between eForms and Smart Client in consideration of time

4.3.3 Analysis

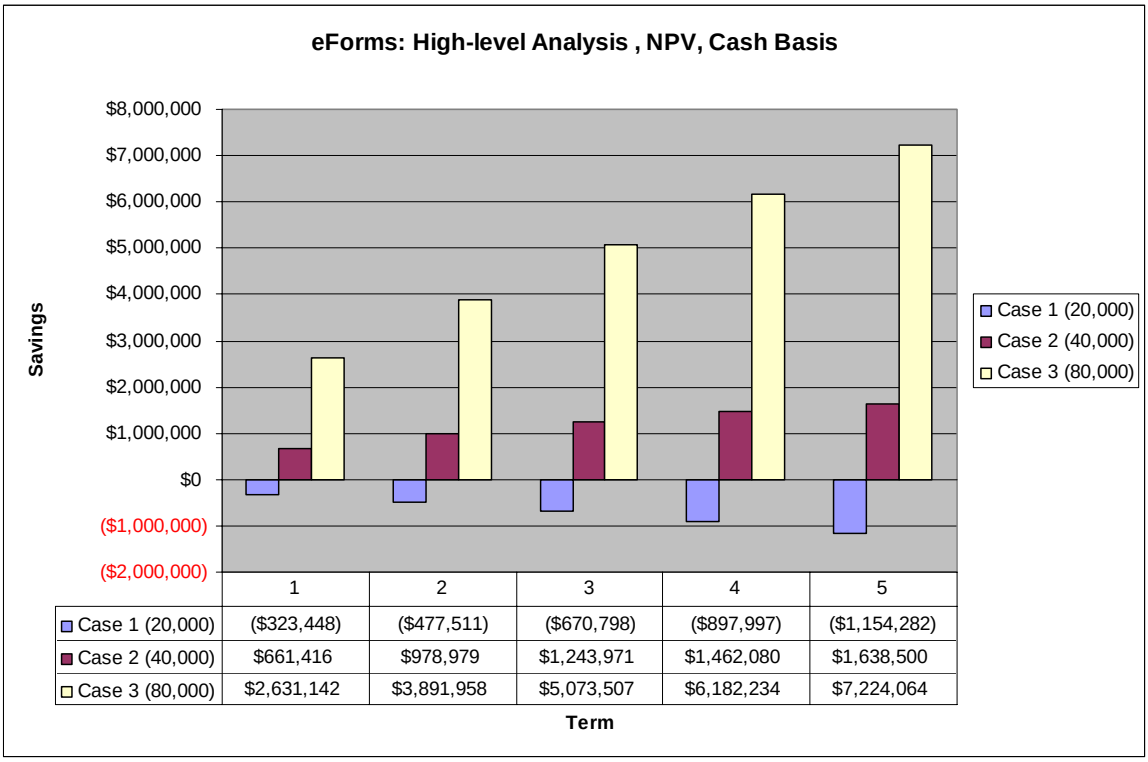
- Two principal types of implementation in support of EDC: Adobe Forms, and Microsoft Smart Clients
- A discount rate of 6% (assuming a favorable rate to the state)
- Periods of 1 – 5 years and terminal value for discounted cash flows

- Incremented transaction volumes estimated from (sparse) empirical data for the following volumes:
    - eForms at twenty (20,000), forty (40,000), and eighty thousand (80,000) transactions
    - Smart Clients at fifteen (15,000), thirty (30,000), and forty-five thousand (45,000) transactions

4.4 Findings

4.4.1 Results

As complex as the associated financial model appears, it is comparatively simple when considered to the scope of the MTG architecture, its assumptions regarding enterprise application integration, and its potential impact. Despite this simplicity, it demonstrates cost recovery and viability of the MTG gateway, on the assumption of industrial level support of EDC scenarios alone.



	1	2	3	4	5
Case 1 (20,000)	($323,448)	($477,511)	($670,798)	($897,997)	($1,154,282)
Case 2 (40,000)	$661,416	$978,979	$1,243,971	$1,462,080	$1,638,500
Case 3 (80,000)	$2,631,142	$3,891,958	$5,073,507	$6,182,234	$7,224,064

Figure 9. Discounted Cash Flow for Adobe Forms

Figure 9 charts the results of the business case for eForms implementation in volumes of twenty (20,000), forty (40,000), and eighty thousand (80,000) transactions over periods of one (1) to five (5) years. Savings are realized over time, but only when a sufficient volume of transactions can be serviced. Savings increase for each period, so long as transaction volume remains high.

The importance of volume is similar in the case of the Microsoft Smart Clients as depicted in Figure 10, were savings are seen to accumulate in each period in the cases of thirty (30,000) and forty-five thousand (45,000) transactions with the slight fall-off in savings in year five related to technology refreshment costs injected into the investment strategy.

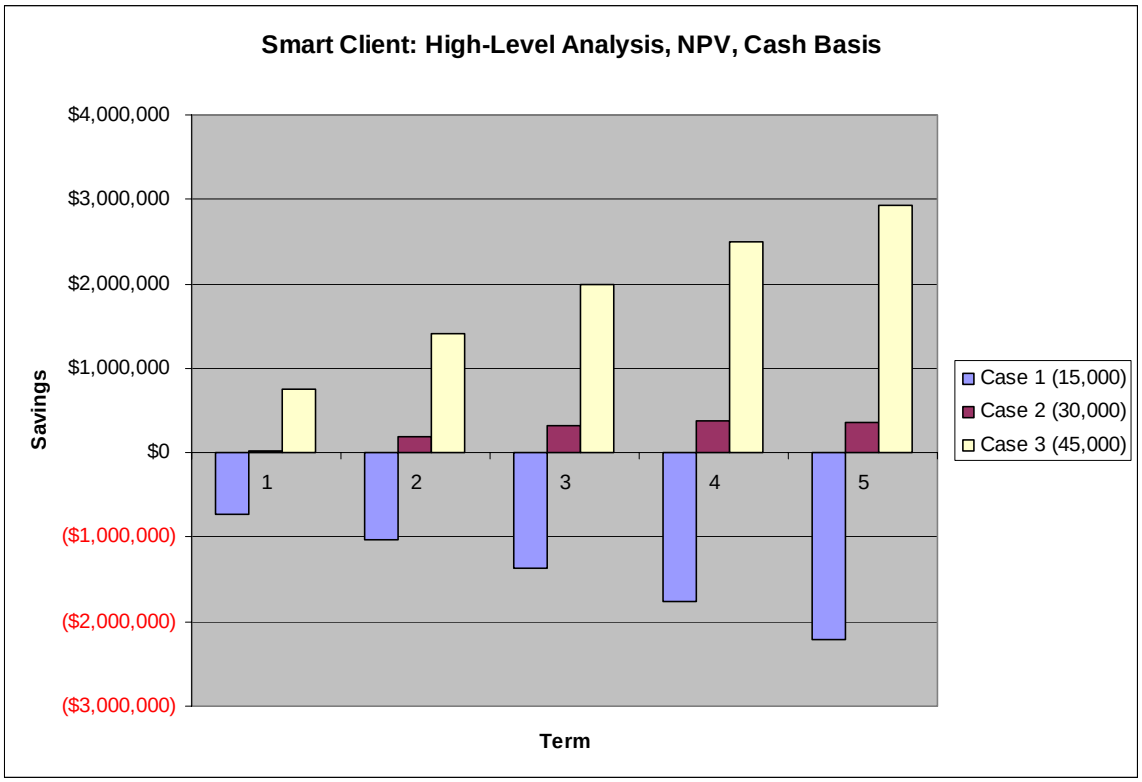


Figure 10. Discounted Cash Flow for Smart Client Implementation

These two illustrations further indicate that payback and cost savings can be achieved via a proper mix of implementations, the platform assumes support of both delivery mechanisms -- Adobe Forms and Smart Clients. Only the applications costs are varied.

4.4.2 Qualifications

Numerous cases could be analyzed via the financial model. It is presented as part of the package for assessing possible future scenarios with concrete rather than hypothetical variants. The model has been provided in its original spreadsheet form for experimentation by the customer. A range of inputs and assumptions could be varied noting the following points:

- Current cases are based on the most readily quantifiable, most obvious opportunities for return on investment.
- Further research is required to profile electronic data collection opportunities and determine the right mix of applications for a cost effective pilot and should include:
    - A forms/application census
    - A profile of transaction volumes
    - Models of empirically grounded workflows

4.5 Associated Deliverables

Please see the associated financial model and supporting project plans:

- MTG Business Case Estimate.xls
- eForms, 1st one.mpp
- eForms, additional.mpp
- Smart Client, 1st one.mpp
- Smart Client, additional.mpp

5.0 Recommendations

Battelle and ICC have recommended the following deliverables in support of an MTG pilot implementation:

1. A pilot infrastructure (see Section 3.4, Concept Architecture, *Findings*) to support key requirements of MTG including:

    a. Portal access with personalization and roll-based access control (RBAC) and identity management.

    b. Electronic Data Collection implementations supporting:

        i. Service requests for Citizens, Business Partners, and Employees with rudimentary workflow and agency data integration via Adobe forms.

        ii. Inspections and Audits with rudimentary workflow and data integration via:

            1. Adobe forms (as appropriate)

            2. Smart Clients (as appropriate)

2. Pilot implementations of Inspection and Audit for two or more departments, ranked and selected according to State priorities, or additional candidates as suggested:

    a. Asbestos Inspection
    b. Boiler Inspection
    c. Blood-alcohol Testing
    d. Dam Safety Inspection
    e. Elevator Inspection (production-worthy)
    f. Fire Code Enforcement
    g. Gas and Oil-Well Safety Inspection
    h. Grant Compliance Enforcement
    i. Grant Compliance Enforcement (Via SPESS)
    j. Grant Eligibility
    k. Ground-Water and Well Safety Inspection
    l. Household Energy Inspection
    m. Labor and Safety Inspection
    n. Lead Inspection
    o. Liquor License Enforcement
    p. MARCS Trouble/Service Management
    q. Mine Safety Inspection
    r. Mobile Driver Examinations
    s. Nuclear Inspection
    t. Pollution Incident Reporting & Assessment
    u. Radon Inspection
    v. STD Monitoring
    w. Title Inspections
    x. Vehicle Safety Inspections
    y. X-Ray Inspection Program

3. A showcase deployment of web content for wireless devices

6.0 Conclusions

The Mobile Transaction Gateway Project has provided the following information to date:

- An inventory of mobile scenarios as reported by participating stakeholders
- A classification of these scenarios into a generic set of mobile application process types
- A set of related business requirements (behavioral and non-behavioral)
- A logical architecture defined to support these types of application
- Two component architectures based on competing implementations (Microsoft and Java/Open-source)
- A definition for a corresponding/supporting hardware deployment
- Pricing models for the hardware and software infrastructure
- Pricing for electronic data collection EDC process type implementation in two forms, eForms and Smart Client
- A business case and financial model for the MTG architecture and EDC implementations in two variants and six scenarios (by transaction volume)

It should be noted that, for all of the information generated by the MTG phase one analysis, the following issues/questions remain unresolved or were deemed beyond scope of the present effort:

- A solution to the bandwidth/reliability issues of MARCS
- An arbitration of DPS/DNR solutions sets (The DPS Solution[5] vs. VisionTEK vs. PADCOM)
- Service and Quality of Service (QoS) definitions with third-party wireless service providers (WSP)
- Related network layer requirements and specifications

In addition to the recommendations for infrastructure and EDC applications for an MTG pilot, the following areas are highlighted for further investigation:

1. A State of Ohio Certificate Authority (CA) and Public Key Infrastructure (PKI) – Research into EDC foregrounds the need for the support of digital signatures and non-repudiation. If the elimination of paper and complete roundtrip automation is truly an objective to be supported via EDC (and other areas, such as contract management), the State will need a public key infrastructure (and associated policies). Rather than purchasing these services outright from a third-party CA, the State should investigate the possibility of being its own CA. PKI has been cited as an impending project by twenty-one state agencies during the FY2004 – FY2005 planning process, so considerable common cause and cost savings could potentially be made in this area.

2. Enterprise Application Integration – The MTG assessment identified the need for shared services of security, document management, workflow, and data transport in support of the various MTG mobile process types. To be realized at the level of true enterprise application integration, each of these services needs to be investigated with respect to hosting, network, and usage requirements to address not only the needs of MTG traffic, but inter-agency work and data flows, more generally, with the objective of building a primary scalable infrastructure.

5 The specifics of this have not been shared, but sources contend that it is ready to go out for bid.

3. Policies for Wireless Access – In our discussions with Dan Orr regarding wireless access points for site-specific Wi-Fi deployments, he noted that the State currently had no well-defined policies in place to govern such deployments. The definition of these policies could be considered to be part of the larger MTG initiative, or external to it, but such policies should be defined before wireless infrastructure is deployed to support site-based application access or electronic data collection.

4. Census of all forms-based applications with usage profiles and prioritization – As mentioned in the qualifications to the business case, the right mix of applications for a quicker reclamation of investments is better informed by good empirical data sampled from the full range of benefiting agencies.

In closing, Battelle and ICC have considered it a privilege to support the Office of Information Technology and Enterprise Shared Services in MTG Phase One, and we would look forward to providing further clarifications or future service to MTG or related initiatives.

APPENDIX

Appendix A: Acronyms

CAP	Common Alerting Protocol
DAS	Department of Administrative Services
DHS	Department of Homeland Security
DNR	Department of Natural Resources
DOC	Departments of Commerce
DOD	Department of Development
DPS	Department of Public Safety
EMA	Emergency Management Agency
GPS	global positioning system
IC	The Industrial Compliance
ICC	Information Control Corporation
JAD	Joint Application Definition/Development
JFS	Job and Family Services
MTG	Mobile Transaction Gateway
ODH	Ohio Department of Health
PDA	Personal Digital Assistant
RBAC	Role-based Access Control
WPS	Wireless Access Provider