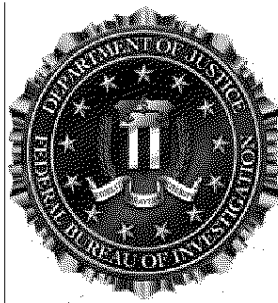


**Next Generation Identification (NGI)**

**Facial Recognition Trade Study Plan**

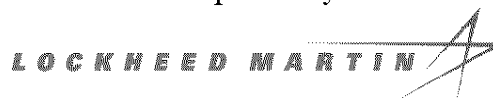
Version 2.0  
Final  
May 25, 2010



NGI-DOC-27009-2.0

Contract No. J-FBI-08-041  
CDRL NGI-62

Prepared by:



9211 Corporate Boulevard  
Rockville, MD 20850

Produced for:  
Federal Bureau of Investigation  
Criminal Justice Information Services Division  
1000 Custer Hollow Road  
Clarksburg, WV 26306

Distribution is limited to authorized United States Government Agencies only. All other requests for this document shall be referred to:  
FBI, Attention: Information Technology Contracts Unit, 1000 Custer Hollow Road, Clarksburg, West Virginia 26306.

# Signature Page

b6  
b7C

**Prepared by:**

**Name:**

**Title:** Technical Performance Lead

**Organization** Lockheed Martin

**Signature:**  **Date:** 5/25/2010

**Submitted by:**

**Name:**

**Title:** NGI Project Manager

**Organization** Lockheed Martin

**Signature:**  **Date:** 5/25/2010

**Coordinated by:**

**Name:** \_\_\_\_\_

**Title:** \_\_\_\_\_

**Organization** \_\_\_\_\_

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

**Approved by:**

**Name:** \_\_\_\_\_

**Title:** \_\_\_\_\_

**Organization** \_\_\_\_\_

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

## Change Page

Revision	Change Description	Changed By	Date	Approved By
1.0	Draft		4/30/2010	See Signature Page
2.0	Final		5/25/2010	See Signature Page

b6  
b7c

## PREFACE

This Facial Recognition Trade Study Plan was prepared by Lockheed Martin (LM) for the Federal Bureau of Investigation (FBI) Criminal Justice Information Services (CJIS) Division Next Generation Identification (NGI) Program.

This Trade Study Plan conforms to Data Item Description (DID) specified in section J of the NGI Solicitation; NGI Contract Data Requirements List, Version 1.2 dated July 16, 2007. Traceability to the DID is documented in Table 1: NGI DID Traceability Matrix.

The Trade Study Plan is required by the NGI Statement of Work dated June 11, 2007. SOW traceability is documented in Table 2: SOW Compliance Matrix.

**Table 1: NGI DID Traceability Matrix**

Para No.	DID Paragraph Text	Document Section
DID NGI-62 10.2	Establishing the problem, including the outcome requirements and constraints	1 Scope 3.1 SRS Requirements 3.2 Architectural Context
DID NGI-62 10.2	Reviewing the study inputs to determine conflicts and completeness	4.3 Performance Evaluation
DID NGI-62 10.2	Selecting the trade-off methodology and selection criteria, to include weighting	4 Study Methodology 4.3 Performance Evaluation Attachment A
DID NGI-62 10.2	Identifying, selecting, and excluding candidate alternatives	4.1 COTS Evaluation 4.1 Vendor Notification
DID NGI-62 10.2	Developing models, measures of merit/metrics, and assessment techniques	4.3 Performance Evaluation Attachment A
DID NGI-62 10.2	Developing analysis plans, methods, and strategies	4.3 Performance Evaluation Attachment A
DID NGI-62 10.2	Designing reporting methods, formats, and media	4.4 Final Recommendation
DID NGI-62 10.2	Establishing the study schedule, resources required, and schedule for those resources	5.2 Government Furnished (Resources) 6 Schedule
DID NGI-62 10.2	Documenting internal and external plan reviews and approvals	4.4 Final Recommendation 6 Schedule

**Table 2: SOW Compliance Matrix**

<b>SOW Para No.</b>	<b>SOW Text</b>	<b>TSP Document Section</b>
3.3.3	The Contractor shall conduct trade studies to analyze each design alternative and identify the associated tradeoffs in the areas of performance, functionality, life cycle and development cost, schedule, risk, and supportability.	All sections of this document
3.3.3	The Contractor shall establish criteria (to include life-cycle cost) for the evaluation and selection of non-developmental items (NDI).	3.1 SRS Requirements 4.3 Performance Evaluation Attachment A
3.3.3	The Contractor shall develop prototypes and simulations and conduct trade studies to support NDI selection.	All sections of this document
3.3.3	The Contractor shall recommend specific NDI for incorporation in the NGI system.	4.4 Final Recommendation

# TABLE OF CONTENTS

<b>1</b>	<b>SCOPE .....</b>	<b>1</b>
<b>2</b>	<b>REFERENCES.....</b>	<b>2</b>
<b>3</b>	<b>REQUIREMENTS AND CONSTRAINTS.....</b>	<b>3</b>
	3.1 SRS Requirements .....	3
	3.1.1 Response Time Requirements.....	3
	3.1.2 Workload Requirements .....	3
	3.1.3 Capacity Requirements .....	5
	3.2 Architectural Context.....	6
<b>4</b>	<b>STUDY METHODOLOGY .....</b>	<b>8</b>
	4.1 Vendor Notification.....	8
	4.2 Request Proposal from Vendors .....	8
	4.3 Performance Evaluation.....	11
	4.4 Final Recommendation.....	11
<b>5</b>	<b>RESOURCES .....</b>	<b>12</b>
	5.1 Contractor Furnished .....	12
	5.2 Government Furnished .....	12
<b>6</b>	<b>SCHEDULE .....</b>	<b>13</b>
<b>7</b>	<b>ACRONYMS .....</b>	<b>14</b>
	<b>ATTACHMENT A: SOURCE SELECTION PLAN (SSP).....</b>	<b>18</b>
<b>1</b>	<b>INTRODUCTION.....</b>	<b>18</b>
	1.1 Program Mission.....	18
	1.2 Type Of Contract .....	18
	1.3 Bidder’s List .....	18
	1.4 Best Value.....	20
	1.5 Request for Proposal.....	20
<b>2</b>	<b>TRADE STUDY SCHEDULE .....</b>	<b>21</b>
<b>3</b>	<b>SOURCE SELECTION ORGANIZATION.....</b>	<b>22</b>
	3.1 Source Selection Authority.....	22
	3.2 Source Selection Committee.....	22
	3.3 Evaluation Teams .....	23
	3.3.1 Management Evaluation Team .....	23

3.3.2 Technical Performance Evaluation Team.....24

3.3.3 Cost Evaluation Team.....24

**4 SOURCE SELECTION PROCESS..... 25**

4.1 Source Selection Preparation.....25

4.2 Major Subcontract Administration Receipt and Control of Proposal Data.....25

4.3 Proposal Review.....25

4.4 Technical Solution Review and Management Capabilities Review.....25

4.5 Evaluation and Scoring.....26

4.5.1 Numeric Rating for Evaluations.....26

4.6 Risk Assessment.....26

4.7 Source Selection Recommendation.....27

**5 EVALUATION CRITERIA..... 28**

**APPENDIX A: MANAGEMENT EVALUATION CRITERIA (30%)..... A-1**

A.1 Risk Based Assessment Tool (RBAT)..... A-3

**APPENDIX B: TECHNICAL PERFORMANCE EVALUATION CRITERIA (70%)..... B-1**

**APPENDIX C: COST EVALUATION CRITERIA..... C-1**

**APPENDIX D: CERTIFICATE OF NON-DISCLOSURE..... D-1**

# LIST OF FIGURES

Figure 3.2-1 NGI Architecture..... 7



## LIST OF TABLES

Table 1: NGI DID Traceability Matrix.....	iii
Table 2: SOW Compliance Matrix.....	iv
Table 3.1-1 Accuracy Requirements.....	3
Table 3.1-2 Response Time Requirements.....	3
Table 3.1-3 Photo Workload Requirements.....	3
Table 3.1-4 Average Daily Photo Workload Estimates.....	4
Table 3.1-5 Average Hourly Photo Workload Estimates.....	5
Table 3.1-6 Photo Capacity Estimates.....	5
Table 6-1: Major Face Trade Study Activities.....	13

# 1 SCOPE

This plan defines the analysis study to evaluate potential solutions for meeting the NGI facial recognition requirements. The candidate solutions will be evaluated for their ability to perform Facial Recognition Searches against a facial photo repository. In the context of this study, the term solution is defined to be the combination of one or more algorithms together with the core software needed to meet the specified and derived requirements. The focus of this study is the evaluation of Commercial-off-the-Shelf (COTS) products.

This trade study will have a different approach than the previous two NGI trade studies. The previous NGI trade studies were performed in two phases which included vendors responding to a set of capability and requirements based questions to allow for a down select and assist in detailed schedule planning of the actual performance tests. A fixed number of vendors were then invited to participate in the second phase of the study where their proposed solution was installed on NGI hardware within the NGI trade study lab and thoroughly tested and compared. During the performance tests, the vendors were requested to respond to a Request for Proposal (RFP). The test results were analyzed and used along with the RFP response to determine the best overall solution for NGI. While this approach worked well for the selection of the solution for the large scale tenprint and latent fingerprint search solutions, the facial matching workload for NGI is much smaller than the tenprint and latent search workload, so it is expected that the facial biometric contract award will be worth far less. This makes the participation in a head-to-head test a much higher risk to reward ratio for the vendors. This cost and risk would likely prevent all but the largest vendors from participating. This type of testing also requires a significant NGI trade study staff to define, develop, perform and analyze the performance tests. Another consideration was that facial recognition algorithms are not nearly as mature as the leading fingerprint match systems.

The face trade study will include a “paper” evaluation of COTS vendor solutions. Since facial matching solutions are less complex than fingerprint matchers, the facial SDK testing that NIST is performing in the NIST Multiple Biometric Evaluation (MBE) Still test will provide accuracy results that are representative of the COTS vendors’ full solutions that NGI performance testing would provide. That along with CJIS providing the same operational mug shot imagery that a NGI trade study test would use, allows the face trade study to utilize the NIST test results as the empirical head-to-head accuracy comparison of the COTS accuracy. Similar to the previous trade studies, the potential COTS vendors will be provided an RFP and the resulting COTS vendor proposal and NIST empirical test results will be used to determine the best value solution for NGI.

## 2 REFERENCES

1. ANSI/NIST-ITL 1-2007, Data Format for the Interchange of Fingerprint, Facial, & Other Biometric Information – Part 1, dated May, 2007
2. NGI Statement of Work, NGI-DOC-06123-1.3, dated February 2009
3. NGI Contract Data Requirements List, version 1.3, dated February 2009
4. LM NGI Systems Engineering Management Plan, NGI-DOC-05508-4.1, dated June 12, 2009
5. LM NGI Incremental Development Plan, NGI-DOC-02229-6.0, dated June 9, 2009
6. NGI System Requirements Specification (SRS), NGI-DOC-01276-4.0, dated June 9, 2009
7. NIST Multiple-Biometric Evaluation (MBE) Still Face Image Track Concept, Evaluation Plan and API, Version 1.0.0, dated February 1, 2010
8. NGI Interstate Photo System (IPS) Enhancements Concept of Operations, IAFIS-DOC-010480-5.0, 04/14/2010

## 3 REQUIREMENTS AND CONSTRAINTS

### 3.1 SRS REQUIREMENTS

The following NGI System Requirement Specification (SRS) requirements will be the initial basis for comparison of performance metrics.

#### Accuracy Requirements

Table 3.1-1 shows accuracy requirements as they currently are known.

**Table 3.1-1 Accuracy Requirements**

SRS2246	The NGI System shall return the correct candidate a minimum of 85% of the time within the top 50 candidates, when it exists in the searched repository, as a result of a facial recognition search in support of photo investigation services.
SRS2252	The NGI System shall return the correct candidate a minimum of 75% of the time, when it exists in the UPF, as a result of a cascaded facial recognition search of the UPF.

#### 3.1.1 Response Time Requirements

Facial response time requirements are shown in Table 3.1-2. Note that these response time requirements are for the entire NGI system which will be further broken down to provide a biometric solution level response time requirement.

**Table 3.1-2 Response Time Requirements**

SRS2355	The NGI System shall respond to all Facial Recognition Searches that do not require nonstandard intervention in less than or equal to 2 hours of receipt by NGI.
SRS2363	The NGI System shall complete all cascaded Facial Recognition Searches in less than or equal to 24 hours of NGI completing the original request.

#### 3.1.2 Workload Requirements

Applicable Workload requirements are shown in Table 3.1-3.

**Table 3.1-3 Photo Workload Requirements**

SRS3315	The NGI System shall be capable of processing the estimated average hourly workload for Facial Recognition Search Requests contained in the row identified as applicable to Facial Recognition Searches in the Average Hourly Photo Workload Estimates table.
SRS3316	The NGI System shall be capable of processing the estimated average hourly workload for adding to the UPF via Facial Recognition Search Requests contained in the row identified as applicable to UPF Add in the Average Hourly Photo Workload Estimates table.

SRS3343	The NGI System shall be capable of processing the peak hourly workload for Facial Recognition Search Requests that is 150% of the average hourly workload contained in the row identified as applicable to Facial Recognition Searches in the Average Hourly Photo Workload Estimates table.
SRS3344	The NGI System shall be capable of processing the peak hourly workload for adding to the UPF via Facial Recognition Search Requests that is 150% of the average hourly workload contained in the row identified as applicable to UPF Add in the Average Hourly Photo Workload Estimates table.
SRS3405	The NGI System shall be capable of processing the estimated yearly workload for Facial Recognition Search Requests contained in the row identified as applicable to Facial Recognition Searches in the Yearly Photo Workload Estimates table.
SRS3406	The NGI System shall be capable of processing the estimated yearly workload for adding to the UPF via Facial Recognition Search Requests contained in the row identified as applicable to UPF Add in the Yearly Photo Workload Estimates table.
SRS3415	The NGI System shall be capable of processing the estimated average daily workload for Facial Recognition Search Requests contained in the row identified as applicable to Facial Recognition Searches in the Average Daily Photo Workload Estimates table.
SRS3416	The NGI System shall be capable of processing the estimated average daily workload for adding to the UPF via Facial Recognition Search Requests contained in the row identified as applicable to UPF Add in the Average Daily Photo Workload Estimates table.

Daily and Hourly Photo workload estimates are shown in Table 3.1-4 and Table 3.1-5 respectively per NGI Workloads version 4.1 (preliminary). Workloads and capacities are based on an advance copy of updated requirements received from CJIS. It is assumed that the NGI requirements baseline will be updated to reflect these changes.

**Table 3.1-4 Average Daily Photo Workload Estimates**

Average Daily	FY2012	FY2013	FY2014	FY2015
<b>Identification Services</b>				
Fingerprint w/Photo	3,417	6,202	14,083	18,784
<b>Information Services</b>				
Photo Retrievals	0	28,059	30,865	33,952
RISC Photo Retrievals	0	0	2,750	3,025
Photo Feature Retrievals	0	1,000	1,400	1,960
SMT Photo Retrievals	0	600	840	1,176
Photo Audit Trail Retrievals	0	30	36	41
<b>Investigative Services</b>				
Facial Recognition Searches	0	100	140	196
UPF Add (via Facial Recognition Search request)	0	6	9	12
SMT Text-Based Searches	0	10	14	20
Photo Text-Based Searches	0	10	14	20

Average Daily	FY2012	FY2013	FY2014	FY2015
<b>Data Management Services</b>				
Direct Photo Enrollments	0	0	54,795	54,795
Photo Deletions	103	320	423	564

**Table 3.1-5 Average Hourly Photo Workload Estimates**

Average Hourly	FY2012	FY2013	FY2014	FY2015
<b>Identification Services</b>				
Fingerprint w/Photo	143	260	588	784
<b>Information Services</b>				
Photo Retrievals	0	1,170	1,287	1,415
RISC Photo Retrievals	0	0	115	127
Photo Feature Retrievals	0	42	59	82
SMT Photo Retrievals	0	25	35	49
Photo Audit Trail Retrievals	0	2	2	2
<b>Investigative Services</b>				
Facial Recognition Searches	0	5	6	9
UPF Add (via Facial Recognition Search request)	0	1	1	1
SMT Text-Based Searches	0	1	1	1
Photo Text-Based Searches	0	1	1	1
<b>Data Management Services</b>				
Direct Photo Enrollments	0	0	2,284	2,284
Photo Deletions	5	14	18	24

### 3.1.3 Capacity Requirements

Cumulative Photo Capacity estimates are shown in Table 3.1-6 per NGI Workloads version 4.1.

**Table 3.1-6 Photo Capacity Estimates**

YEARLY	FY2012	FY2013	FY2014	FY2015
Criminal Photo Record (Frontal Face)	12,177,404	13,319,470	28,782,332	46,021,052
Civil Photo Record (Frontal Face)	0	1,131,657	2,475,502	4,299,969
Unsolved Photo Record	0	2,190	5,296	9,548
RISC Photo Records	0	149,299	179,159	214,991

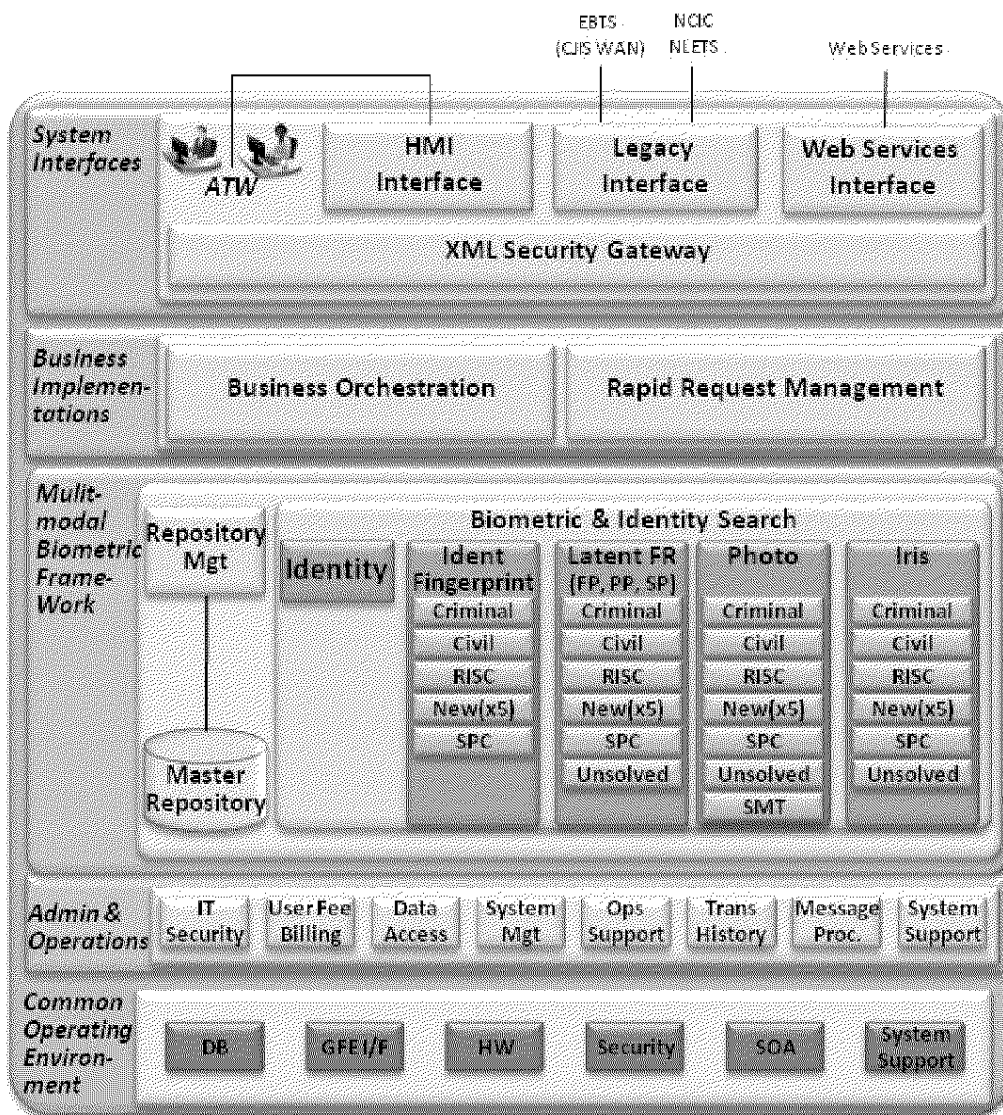
YEARLY	FY2012	FY2013	FY2014	FY2015
New Repositories Photo Records (up to 5)	0	0	61,888	214,998
New Repositories			1	2

## 3.2 ARCHITECTURAL CONTEXT

The architectural description provided in this section applies to the objective NGI system as shown in Figure 3.2-1. Within the NGI Service Oriented Architecture (SOA), the Photo subsystems are expected to provide services for adding photos to a photo Master Repository, adding facial photos to a facial recognition search repository(s), performing Text Based Photo Search Requests and performing Facial Recognition Search Requests. Service transactions will be fulfilled via a messaging system based on the Java Message Services (JMS) protocol. Biometric subsystems will pull work from queues when they have capacity to process them. Multiple instances of the search subsystems may be instantiated, if needed, to meet the workload requirements. NGI will maintain a master repository of photo images and photo biometric templates (feature vectors). The Facial Recognition subsystem components will be given read only access to these repositories to load a local cache of repository templates at startup. After startup, template maintenance transactions made in the master repository will be sent to each affected biometric subsystem.

For this Trade Study, candidates will be evaluated for their ability to fit within this objective architecture and the performance of their Facial Recognition services. Other Photo based service requests such as Text Based Photo Searches will not be performed by the facial recognition system therefore are not included in this Trade Study.

All components of the NGI architecture, including the Photo Subsystem, are expected to be modular in design to provide maximum flexibility in accommodating evolving requirements. In the future, the system will accommodate additional needs derived from business analysis to search other segments of the repository. To support these requirements, the selected biometric solutions must be flexible enough to be appropriately configured, and loaded with designated subsets of the master repository population. The biometric subsystem size will meet an initial workload and repository size and will periodically expand to meet growing needs. Additional capacity allocated on demand from reserve, spare, or other resources helps meet near term peaks in workloads. Modularity and redundancy are also instrumental in providing the high availability of services required by NGI's users. These factors are reflected in the derived requirements presented in the next section and will be important criteria used to evaluate candidate solutions.



**Figure 3.2-1 NGI Architecture**

For this Trade Study, software-only solutions will be considered; hardware-based solutions will not be considered due to the new security requirements identified after the completion of the IdFP/RISC trade study. And while the study does not wish to exclude any participant, because the resulting capability is being considered as a biometric search component within NGI, a simple matching algorithm is insufficient. A scalable facial recognition system that includes multi-job management and reporting, configuration settings for thresholding and selectivity, and performance monitoring is best. Thus participants must provide evidence of existing products that have high potential for meeting NGI requirements.



## 4 STUDY METHODOLOGY

Unlike the first two NGI trade studies that were performed in two phases, a down select followed by in-house performance testing; the study will be performed in a single phase where all vendors participating in the NIST MBE-Still test will be invited to participate. Paper studies of the COTS vendors that are likely to be able to provide a facial recognition solution that will meet the NGI requirements will be performed. The time intensive and costly performance tests of each vendor solution will not be performed in the NGI trade study lab for this study. Instead, the NIST MBE-Still testing will provide the necessary performance metrics.

Lockheed Martin will contact those commercial biometric vendors that have expressed interest in participating in the NIST MBE-Still testing. The vendors will be notified that the NIST MBE-Still test results will be used as part of the NGI facial recognition source selection so if they wish to be considered they should submit their SDK to the NIST test. The schedule found in Section 6 leads to a Request for Proposal sent to each participating vendor. Delivery of the Request for Proposal (RFP) will immediately follow government approval of this Trade Study Plan. A vendor's participation and the results will not be disclosed to the public.

### 4.1 VENDOR NOTIFICATION

Lockheed Martin will involve only those commercial participants that participate in the NIST MBE-Still evaluation of their facial recognition capability.

The primary requirements to participate in the study are: 1) the participant's performance must have a reasonable expectation of competing against the NGI requirements; 2) the participant must agree that its solution will not contain proprietary hardware and that, if selected as preferred bidder, participant will provide its software source code to Lockheed Martin for security analysis. The vendors will be vetted against these requirements based on past performance, public knowledge, and vendors' responses to the vendor notification letters.

Lockheed Martin Supply Chain Management personnel will contact vendors in the initial list to confirm contact details. A formal letter of Invitation to Participate (ITP) and a description of the trade study will help the vendor finalize their decision to participate. The vendors should start the Non-Disclosure Agreements (NDA) process as soon as they accept the formal ITP. No participant will be told of any other potential participant.

### 4.2 REQUEST PROPOSAL FROM VENDORS

Each participating vendor will receive an identical RFP that will provide enough detail on the Lockheed Martin NGI architecture and requirements so that they can respond with a proposed NGI solution, along with an associated price proposal. Besides detail on NGI, the RFP will also provide details on the biometric trade study, where the vendors will be expected to propose a configuration based on their proposed NGI solution. The evaluation is structured such that vendors are encouraged to suggest cost effective solutions that exceed the minimum derived performance requirements.

Requested in the RFP response will be an analysis by the vendor to show how their implementation operationally scales to NGI sizing and performance requirements. The vendor's sizing model will also be requested. Also, a firm fixed price proposal will be required with the

