

# COMMERCIAL CLIENT CASE STUDIES: TELECOMMUNICATIONS & TRANSPORTATION

AUGUST, 2014

# Typical Business Objectives

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## \* Sample Clients:

- Fortune 100 companies that spend over \$1.0 Billion on software development annually
- Sophisticated corporate staff that acts as a technology gatekeeper for the corporation
- Software development expertise and processes varied:
  - Most used agile development methods
  - Most were CMMI Level 3 or higher
  - Some had experience in Model Driven Development, requirements verification and autogeneration of code

## \* Typical objectives:

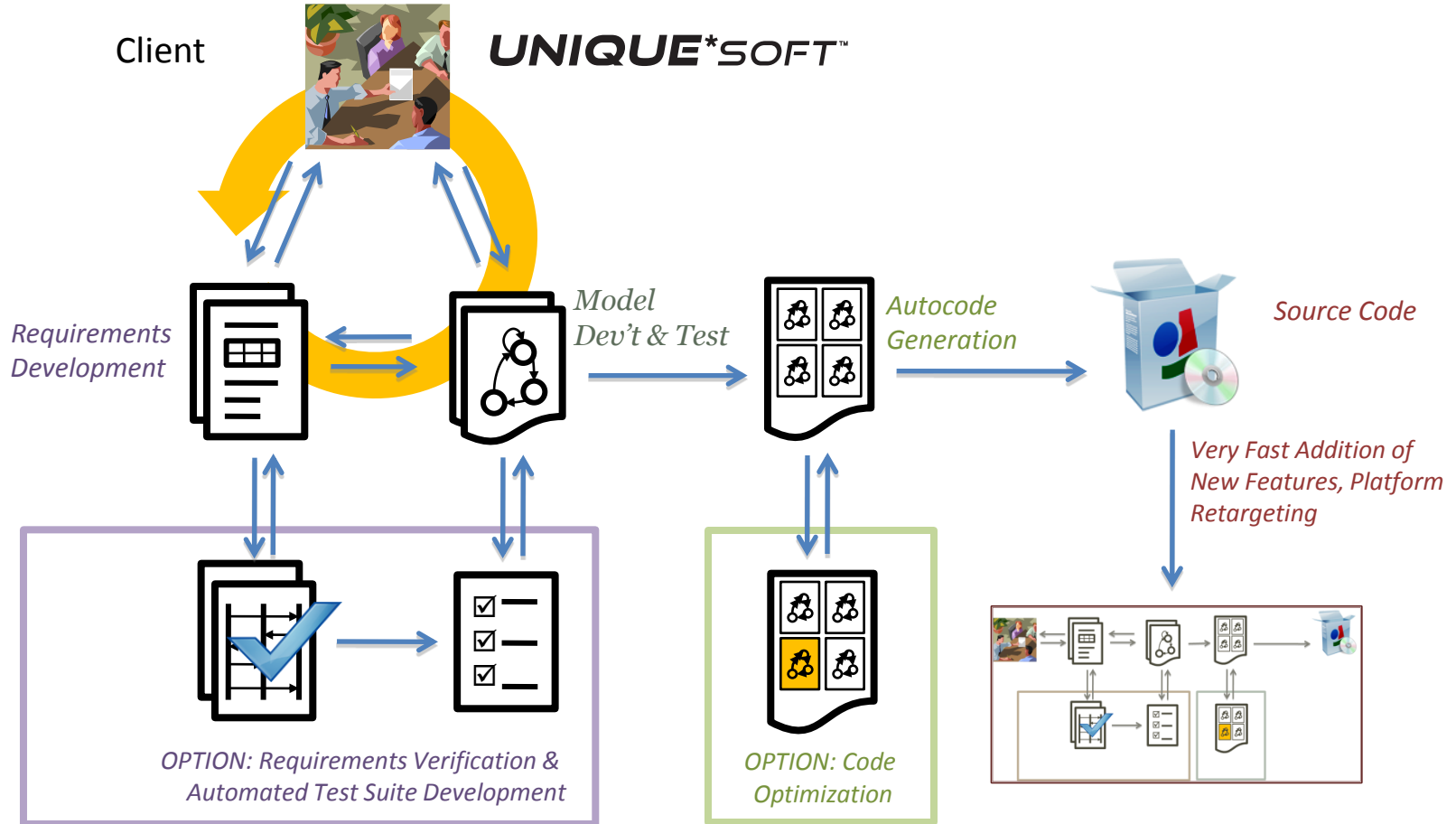
1. High quality development
2. Requirements verification
3. An integrated development process with integrated tool chains.
4. Fast cycle time – for initial development
5. Fast cycle time – for enhancements and new versions
6. Legacy support
7. Ease of Maintenance
8. Cost effectiveness
9. Optimization

# Case Study Overview

Domain	Title	Purpose	Size	% of code Autogenerated	Cycle Time
Telecom	4G ASN Gateway	1. Automate testing 2. Optimization	147 KLOCs	>95%	17 weeks
Telecom	3G data network test system	1. Development 2. Maintenance	34 KLOCs	>95%	7.5 weeks
Telecom	Cellular DB Proxy	1. Development 2. Optimization	146 KLOCs	>99%	6 weeks
Defense*	Mobile Gateway	1. Development 2. Verification	35 KLOCs	>93%	4 weeks
Defense*	LAPDm protocol	1. Development 2. Legacy	56 KLOCs	>97%	8 weeks
Defense*	SW Bridge/ Router	1. Development 2. Speed/cost	37 KLOCs	>95%	6 weeks
Transportation	Signaling Interface Display Controller	1. Development 2. Verification	17 KLOCs	>96%	8 weeks

\* For Defense-related case studies, please see the Defense Pilot Summary pdf available on the UniqueSoft website

# UniqueSoft Co-Development Process



# Project Process

	4G Gateway	3G Network Test	Cellular DB Proxy	Mobile Gateway	LAPDm Protocol	SW Bridge/Router	Signal Display Control
Requirements Elicitation	✓	✓	✓	✓	✓	✓	✓
Requirements Verification	✓			✓			
Architecture	✓	✓	✓	✓	✓	✓	✓
Model Dev't & Test	✓	✓	✓	✓	✓	✓	✓
Code Generation	✓	✓	✓	✓	✓	✓	✓
Source Code Optimization	✓		✓				
Post Release Feature Addition		✓					

# Telecom/ 4G Gateway

## Objective:

1. Benchmark UniqueSoft vs other MDD vendors
2. Specifically include verification capability
3. Benchmark non-functional metrics like system performance and code size

## Project Selected:

1. Element in a 4G cellular system – WiMax ASN Gateway
2. Implemented Mobility functionality of the ASN GW

## Conclusion:

1. UniqueSoft provided a substantial improvement over the internal development teams using state of the art MDD tools.

Metric	Result	Comments
Project Duration	16 weeks	Significant time spent on re-working client's test cases increased duration by about 50%
Lines of Code	147 KLOC	>95% autogenerated
Quality	0.06 defects/kloc	Also detected 8 instances of incomplete requirements during requirements verification
Performance metrics	<ul style="list-style-type: none"> <li>• 40% reduction in CPU utilization</li> <li>• 60% reduction in footprint</li> </ul>	Substantial performance improvement – vs. auto-generated code created using commercial MDD tools

# Telecom/ 3G data network test

## Objective of the project:

1. Demonstrate UniqueSoft's domain expertise
2. Demonstrate the ease with which new features could be added post-release using model-driven development

## Project Selected:

1. Loopback test for cellular network (1xEV-DO RAN). Sends and receives signals through a cellular system to verify operation of a network element like a BTS.
  - Phase 1 – implement features per specification
  - Phase 2 – implement enhanced features similar in scope to a new release of product (~20% change)

## Conclusion:

1. UniqueSoft changed 20% of the source code in a single week of modeling and testing, demonstrating the effectiveness of maintaining and modifying applications as a model rather than as source code.

Metric	Result	Comments
Duration	<ul style="list-style-type: none"> <li>• Phase 1: 6.5 weeks</li> <li>• Phase 2: 1 week</li> </ul>	Requirements changes delivered in Phase 2 affected 20% of code and 65% of test cases
Lines of code	34 KLOC	>95% Autogenerated
Quality	0.00 defects/kloc	<p>Phase 1 – fully compliant with specification</p> <p>Phase 2- fully compliant with revised specification</p>
Performance metrics	Not measured in project	Throughput was not a high priority for this application and was not tested.

# Telecom/Cellular DB Proxy

## Objective:

1. Demonstrate UniqueSoft domain expertise in telecom and networking
2. Measure speed of development
3. Software performance and efficiency was critical in this high volume system element

## Project Selected:

1. Proxy in a cellular network monitoring network latency
2. Implemented application logic
3. Very sensitive to performance

## Conclusion:

1. Demonstrated the effectiveness of UniqueSoft's MDD and code generation methods to optimize performance at the model level instead of changing source code.

Metric	Result	Comments
Duration	6 weeks	Optimization phase took an additional 3 weeks – three one week cycles
Lines of Code	146 KLOCs	>99% autogenerated
Quality	0.06 defects/kloc	All defects detected in final test were minor and easily repaired
Performance metrics	<ul style="list-style-type: none"><li>• 50% improvement in throughput</li><li>• 85% reduction in latency;</li><li>• 700% connection capacity improvement</li></ul>	<ul style="list-style-type: none"><li>• Significant performance improvement over existing system metrics.</li><li>• Included dramatic increase in robustness.</li></ul>



# Transportation/ Signaling Display

## Objective of the project:

1. Demonstrate UniqueSoft methodology – with special emphasis on verification

## Project Selected:

1. Signaling Interface Display Controller on train
2. Implemented application logic – included safety features

## Conclusion

1. UniqueSoft demonstrated the transferability of communications expertise across new domains.
2. Auto-generated test cases that covered 100% of the requirements.
3. UniqueSoft detected numerous defects and incomplete specifications in the requirements document that were confirmed by the customer.

Metric	Results	Comments
Duration	8 weeks	Included time spent learning a new domain
Lines of code	17 KLOCs	>96% autogenerated
Quality	0.00 defects	<ul style="list-style-type: none"> <li>• Detected 35 cases of incomplete or unclear requirements that were confirmed by client</li> <li>• Detected 2 violations of correctness conditions</li> <li>• Auto-generated a minimal set of test suites that covered 100% of the requirements.</li> </ul>
Performance metrics	No comparison was made to the existing implementation	Observed response time was fast enough not to merit further measurement

# Case Study Results Summary

Criteria	Projects	Conclusion
High quality development	7	Inherent in process and tools
Integrated development process & tool chain.	7	Inherent in process and tools
Requirements verification	3	Requirements verification is recommended for large complex applications. Only a few of these projects were complex enough to use this tool.
Fast cycle time – for initial development	7	Inherent in process and tools
Fast cycle time – for new features/enhancements	1	One project explicitly tested changes
Legacy support	1	One project explicitly tested this
Ease of Maintenance	1	One project explicitly tested this
Cost effectiveness	2	Savings were between 20% and 50% versus other methods
Optimization	2	Excellent results for both projects where performance optimization was needed

# Additional Project Experience

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- WiMAX CAPc – 147,000 LOC – CAPc controls the mobility aspects of a WiMAX system
- WiMAX Marshaling – 800,000 LOC – protocol data encoding/decoding and error checking
- MME for LTE – 4,500,000 LOC – Mobility Manager Element is a major network management component for a 4G communications system
- Push to Talk (PTT) over Cellular – 369,000 LOC – Implement PTT functionality on a 2G cellular base station
- Base Station Controller (BSC) – 510,000 LOC – 2G cellular network element controls a number of base stations and communications to the cellular switch
- Dispatch Voice Gateway – 325,000 LOC – Voice Gateway to 2G cellular network
- Node B for UMTS – 560,000 LOC – Base Station for a 3G cellular system
- 2G Cellular Marshaling – 1,600,000 LOC – protocol data encoding, decoding and error checking
- LTE Quality of Service (QoS) manager – 200,000 LOC - policy definition, deployment and monitoring
- Service Advertisement Framework (SAF) - 87,000 LOC – application enables network servers and clients to advertise, discover, and select services.
- Phone Book – 77,000 LOC – embedded phone app
- Disruption-Tolerant Mobile Gateway – 46,000 LOC – includes formal requirements verification
- Network Gateway Simulator – test environment for network elements; protocol data encoding, decoding and error checking
- Distributed Database management – 48,000 LOC - real time performance optimization