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Abstract: This is a joint Fujitsu Services/Post Office contract controlled document describing the strategic approach to be applied for all testing and integration activities performed for the HNG-X Programme.

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Note: See Post Office Account HNG-X Reviewers/Approvers Role Matrix (PGM/DCM/ION/0001) for guidance.

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0 Document Control

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0.2 Document History

Version No.	Date	Summary of Changes and Reason for Issue	Associated Change - CP/PEAK/PPRR Reference
0.1	21/08/06	Initial draft.	
0.2	21/08/06	Updated following initial feedback	
0.3	20/10/06	Updated following informal review.	
1.0	20/12/06	Updated following formal review	

0.3 Review Details

Review Comments by :	N/A
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(*) = Reviewers that returned comments

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0.4 Associated Documents

	Reference	Version	Date	Title	Source
[1]	PGM/DCM/TEM/0001 (DO NOT REMOVE)	1.0	13/6/06	Fujitsu Services Post Office Account HNG-X Document Template	Dimensions
[2]	VI/STR/064	1.0	15/08/05	Testing Approach for the Horizon System	PVCS
[3]	VI/STR/062	2.0	16/11/2005	Fujitsu Services Testing Strategy for Horizon System	PVCS
[4]	RM/STR/005	0.3	21/06/2005	Horizon NG – Programme Test Strategy	PVCS
[5]	n/a	n/a	n/a	HNG req 2.1 sect16.xls (compliance matrix for HNG requirements on testing)	email
[7]	n/a	n/a	n/a	Branch Migration V0-2.doc (migration working paper – transaction data)	Email
[9]	n/a	n/a	n/a	Process_Test_Execution_Main.pdf and Process_Test_Planningandprep_Main.pdf (corporate testing processes)	CafeVic
[10]	DE/STR/010	0.3		Strategy for Delivering T-Release Content	Email
[11]	VI/STR/086	0.1		T-Release Testing Strategy (Post S92 Testing Strategy)	Email
[12]		1.0		Establishing and Assuring the HNG-X User Interface	Email
[13]	TST/GEN/STG/0001	1.0	17/03/2006	HNG-X Testing Strategy	Dimensions
[14]	PGM/PAS/PRO/0003			Code, Build and Component Test	
[15]	PGM/PAS/PRO/0004			Test Planning & Preparation	
[16]	PGM/PAS/PRO/0005			Test Execution processes	

Unless a specific version is referred to above, reference should be made to the current approved versions of the documents.

On each revision of this document the above list of associated documents should be considered. If they have changed since last used, then any such changes may be relevant to the strategic approach presented by this document. Where any such changes have been reflected in revising this document, the reference given for the document concerned must also be updated to indicate the correct version number.

N.B. Printed versions of this document are not under change control.

0.5 Abbreviations/Definitions

Abbreviation	Definition
API	Application Program Interface – a published/approved interface through which to access an application for a given purpose
APOC	Architectural Proof of Concept – brief exercise prior to main development activity to prototype/prove architectural principles, probe solution characteristics and trial technology combinations
BIT	Horizon only terminology - Business Integration Test – a sub-stage of SV&I as used for Horizon Application testing
BSTP	Business Specified Test Point – a supplementary specification to Business Threads, to cover an area of particular importance to Post Office, but where it cannot readily be fitted into a Business Thread
BT	Business Thread – a (typically lengthy) test scenario contrived to link together many areas of particular importance to Post Office, such that as the tests for these areas are one, one feeds the next, gradually maturing the data along a chain of system events, and so also proving data flow integrity

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CAST	Computer Aided Software Testing – term used to refer to the use of purpose built management and automation tools for software testing
CIT	Component Integration Test – component level verification and integration stage, against the design, where an individual component is linked with its direct neighbours
CM	Configuration Management – used interchangeably to refer to the system/toolset, the organisation, the processes, and the principles of managing the configurable items making up the solution
CMMI	Capability Maturity Model Integration – a quality management model seeking to promote continuous improvement and increasing maturity of process and supporting information/data
CR	Change Request
CT	Component Test – component level verification stage, against the design, where an individual component is exhaustively tested in isolation
DIT	Direct Integration Test – formal validation of an external system interfaces, performed for Horizon Application
DR	Disaster Recovery
E2E	Horizon only terminology - End-to-End testing stage - performed for Horizon Application by Post Office
ELT	Horizon only terminology - Extended Link Test – verification stage, linking units across platforms, performed for Horizon Application
EOD	End of Day
GUI	Graphical User Interface
HLD	High Level Design
HLTP	High Level Test Plan
Horizon Application	means software which performs or supports a specific business function at a Branch or in the Back Office and which operates on the Horizon Service Infrastructure, including (without limitation): (a) those applications listed in (as applicable) Schedule B4.2 or Part 2 of Annex 2 to Schedule B5; or (b) any applications of a similar nature;
I/F	Interface
I/O	Input/Output (usually disk reading and writing traffic)
IT	Information Technology
LAN	Local Area Network
LLTS	Low Level Test Script
LST	Live System Test – the final stage of testing for Horizon Application just before Go-Live, using a highly Live-like environment managed by the Live operational support team
LT	Horizon only terminology - Link Test – verification sub-stage (part of Unit Test) , against the design, linking individual modules together into Units, performed for Horizon Application
MT	Horizon only terminology - Module Test – verification sub-stage (part of Unit Test), against the design, testing an individual module, performed for Horizon Application
NFR	Non-Functional Requirement
NT4	Microsoft's NT version 4 operating System for the PC
O-O	Object-Oriented, or Object-Orientation
PAT	Product Acceptance Test – brief confirmation that third party deliverable meets minimum acceptable standard, so as to insulate later testing stages from potential disruption
PC	Personal Computer
PED	Physical Environment Description

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POA	The Post Office Account within Fujitsu Services
Project HNG-X	means the design, development and testing of the HNG-X Service Infrastructure and the Business Capabilities and Support Facilities, together with all of the HNG-X Project Activities, but excluding the Associated Change Activities
PRF	Problem Review Forum – joint supplier/customer forum discussing and prioritising problem reports mostly arising from testing
RAB	Release Authorisation Board
RV	Release Validation – release level validation and integration stage, preparing the solution for release and confirming it is acceptable
SAN	Storage Area Network
ST	System Test – validation stage (though performed within the development arena), against the system requirements, integrating all the necessary component to form a discrete system within the overall solution
SUC	System Use Case
SUCM	System Use Case Model
SV&I	Solution Validation and Integration (or for Horizon, System Validation and Integration) – solution level validation and integration stage, assembling all the systems together to form the whole solution and validating it against the requirements
TBC	To be completed – an area of the document to be completed at some future point when the necessary information emerges as the project lifecycle unfolds
TBD	To be determined – a particular point as yet unknown, yet to be determined in detail
TPOC	Testing Proof of Concept – devising, developing and piloting any new or changed testing processes, tools and automation methods, and environment management and build procedures, in advance of having to use them in anger in the mainstream programme delivery
TPS	Transaction Processing System – one of the business applications within Horizon Application
UAT	User Acceptance Test – formal stage of testing performed by end users to confirm acceptability of a delivered system (no longer performed for Horizon Application, but a common concept within the IT industry)
UI	User Interface (see also GUI)
UT	Horizon only terminology - Unit Test – verification stage on Horizon Application which includes MT and LT
WAN	Wide Area Network
XP	Microsoft's Windows XP operating system for PCs

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0.6 Copyright

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1 Introduction

1.1 Purpose of Document

This contract controlled document covers the agreed joint testing approach required for Project HNG-X.

This document is based on the jointly produced HNG-X test strategy **[13]** and makes significant re-use of this material. To achieve detailed understanding of the background to the approach outlined in this document, the reader should refer back to the strategy document.

Consistent with the general aim to reduce total cost of ownership, this is a joint document, meeting the needs of both Fujitsu Services and Post Office, rather than each organisation producing separate documents. This document describes the intention to adopt a single consistent approach to the testing and integration for HNG-X, exploiting synergy wherever possible, to eliminate unnecessary duplication of effort and to reduce the overall elapsed time consumed without compromising product quality.

To this end it is intended to:

- Provide a central artefact defining the strategic approach with which to govern the testing and integration activities necessary for HNG-X, both for Fujitsu Services and for Post Office.
- Provide visibility to the stakeholders concerned, that adequate consideration has been given to various aspects influencing the testing and integration required, and where appropriate to have those stakeholders approve the strategy.
- Communicate the agreed approach to all relevant parties, explaining how the approach addresses the principal drivers of the programme, defining at an outline level the scope and coverage of the testing required, and identifying the stages and types of assurance and testing to be employed.
- Indicate the approach to be adopted for tools, automation, environments, test management, defect management, metrics, traceability, and configuration management.
- Highlight the key risks, assumptions, dependencies, constraints, and responsibilities.

1.2 Scope of Document

This strategy covers all the testing activities required across the whole Project HNG-X, for both Fujitsu Services and Post Office. It spans from initial involvement in the requirement analysis stage, up to and including pre-Live Operational Proving, and also covers the testing of the Microsoft Windows XP Counter application, following shortly after completion of the Project HNG-X counter application migration.

It is concerned with all aspects of that testing and integration, encompassing both static and dynamic forms of code based testing. It covers both verification and validation perspectives, and also the integration of software components, systems, and the whole solution.

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However, this strategy is confined to covering only the testing and integration activities required for the Project HNG-X. It does consider the Horizon Application systems, but only in so far as the Project HNG-X solution involves re-engineering and/or re-deployment of those systems, and in so far as the two architectures coexist in hybrid form during the counter application migration period. (See **[10]** & **[11]** for relationship to Horizon Application T-Releases and the strategy for testing them.)

It is not concerned with the testing and integration required for the succession of Horizon Application releases that are potentially continuing in parallel with and in preparation for the Project HNG-X – these are covered in separate testing strategy documents specific to those Horizon Application releases.

Similarly, it is not concerned with the ongoing testing and integration of the Project HNG-X solution to take place for possible future releases following the completion of the Project HNG-X. Again, that will be covered in separate documents.

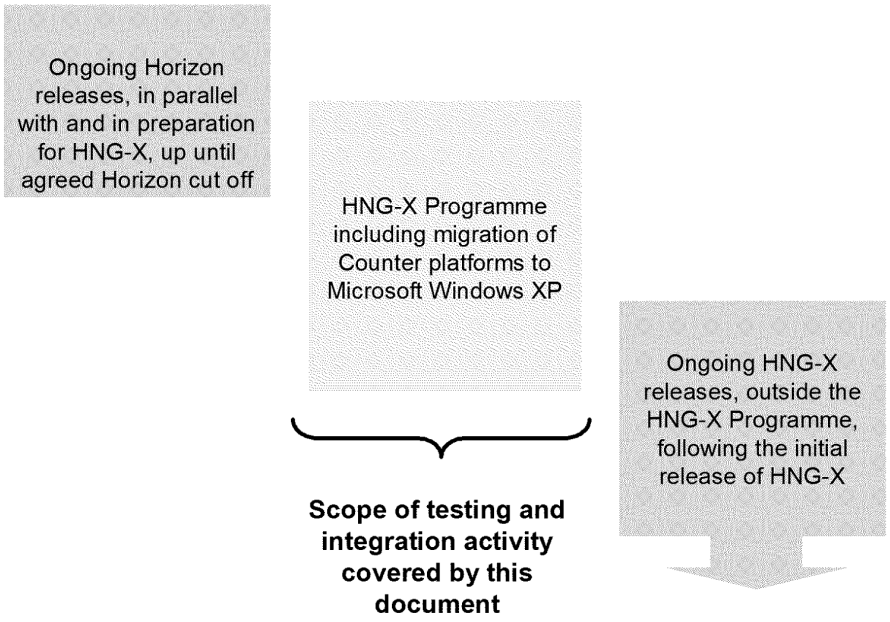

Figure 1: Scope of Testing Covered by this Document

1.3 Context

This approach document is specific to the Project HNG-X and stands independent of the strategies previously agreed for Horizon Application (see [2], [3], [4], [5], [10] & [11]). Nonetheless, these earlier documents remain relevant. In particular, to assist continuity, much of that earlier terminology has been retained, having become familiar through long use on Horizon Application. Similarly, corporate processes and CMMI requirements are also taken into account (see Figure 2 : Document Context Map).

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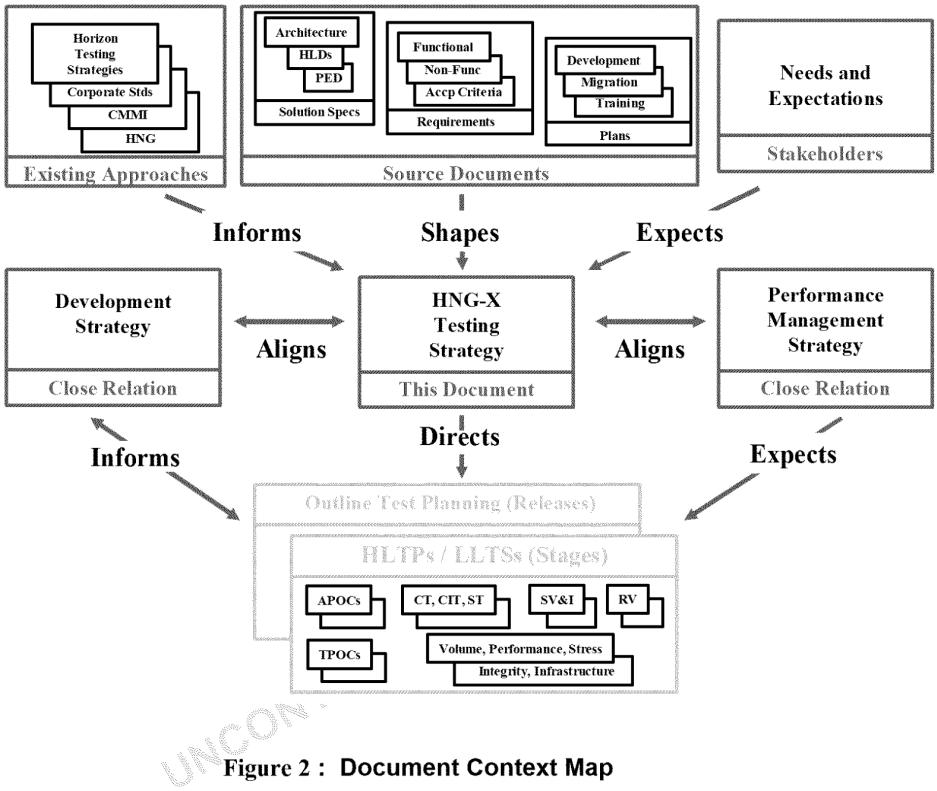

Figure 2 : Document Context Map

1.4 Compliance

A number of compliance areas have been taken into consideration for this document, including existing Fujitsu Services Post Office Account (POA) processes, wider Fujitsu Services Corporate Processes, POA's adoption of CMMI, and the Post Office initiative known as Harmony. Where possible this strategy is aligned or compatible with these process frameworks.

Overall it is the existing POA processes, as used for Horizon Application, which carry most relevance for this document. A strong preference has been expressed by Post Office (the Customer) to continue using the existing terminology where practicable. As this is a joint document, for both POA and Post Office, adopting a common and familiar terminology is very important. Also, as the Horizon Application systems feature heavily within the testing and integration of the Project HNG-X solution then the investment made in these existing procedures has a significant bearing.

1.4.1 New/Revised Processes & Tools

To minimise the impact and maximise the benefit of iterative and targeted testing, using comprehensive regression testing packs, it is a requirement of this approach to adopt automated testing techniques wherever and whenever it provides a clear benefit. The adoption must therefore be pragmatic, embracing automation where it can be readily

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applied, and avoiding it where costs become prohibitive. The detailed test automation strategy will need to be developed, but it is clear that the primary focus should be in the early verification stages (these are small, self contained, and have fewer data dependencies to contend with, but require exhaustive coverage, making them ideal candidates for automation). Automation of the later stages of testing should be approached more critically, adopting automated scripts only where the benefit is clear, and where the cost of future maintenance of scripts will not escalate. (Sample coverage to support minimum regression testing would seem appropriate.)

As part of developing any automated functional and non-functional test suites, consideration should be given to how tests will function when the application under test is connected to 3rd party systems. Fujitsu shall inform Post Office at time of automated test development of any known issues that would prevent these tests from being executed in an end to end test environment. (*requirement reference TST 285*)

The new testing processes and tools necessary to address any new development approaches and their new technologies (including any test automation involved) must be developed and piloted well in advance of their full-scale use in anger.

Similarly, the mechanisms necessary for exploiting the Disaster Recovery installation for testing purposes, and so obviating the need for a separate Test Estate, must be devised, developed, piloted, and used throughout the Project HNG-X development and testing lifecycle programme

2 Approach Required

Based on the programme considerations and implications, an appropriate testing approach for Project HNG-X is in outlined as follows:

- Engage with the requirements analysis at the earliest opportunity to influence the emerging requirements, ensure that they are testable and to assist with the codification of appropriate scenario based Acceptance Criteria. (It is important to note here that requirements traceability will have to be maintained throughout, from requirements sign-off through to acceptance sign-off, and so the means by which this traceability will be achieved must be built into the requirements specification process from the outset. Some method of persistent and unique identification will be essential.)
- Run an Architecture Proof of Concept (APOC) exercise to provide early feedback on the suitability of the proposed architecture, and to prove the scalability mechanisms and get early indications of the likely system performance. (Commence Performance Modelling to support this activity.)
- Continue Performance Modelling throughout Project HNG-X.
- Run a Testing Proof of Concept (TPOC) exercise to develop and prove the necessary testing processes and tools to cope with any new development approaches and the new technologies used for Project HNG-X, and to pilot the mechanisms for making use of the DR site as the Test Estate. (As the TPOC will be run alongside the APOC, then it is likely that certain objectives for the TPOC may in fact be achieved by the APOC. Care will be taken in planning the two to exploit synergy and avoid duplicated effort.)
- Adopt Risk Based Testing, to ensure that the principal drivers of reduced total cost of ownership and Business Equivalence are achieved in an acceptable and cost effective fashion.
- Apply Objective Driven Testing techniques to simplify the implementation of Risk Based Testing, and to facilitate removing duplicated effort, exploiting synergy, reducing overall elapsed time, and maintaining product quality.

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- Analyse source material, derive Test Objectives (common set covering needs of all parties)
- Engage with Business and Operations to conduct highly granular risk assessments (workshops), and so prioritise the Test Objectives
- Start the outline test planning by seeking to exploit synergy, combining multiple objectives to be covered by a minimum number of tests
- Normalise the outline tests by considering their likely environmental needs/constraints
- Produce High Level Test Plans accordingly (Logical level)
- Generate Low Level Test Scripts (ideally in automated form) and associated Test Data.

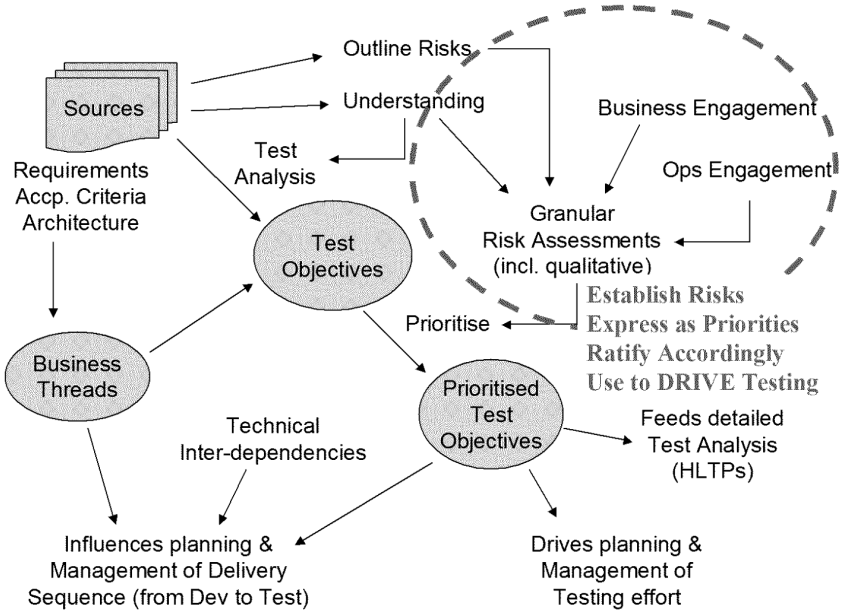

Figure 3: Objective Driven Testing - Outline

- Apply a process of Progressive Integration, incrementally assembling and proving ever larger portions of the solution, following a clear sequence of lifecycle stages (i.e. adopting appropriate controls regarding the promotion of deliverables from stage to stage to ensure their inherent inter-dependencies will be satisfied).
- For existing Horizon Application areas being carried forward into the Project HNG-X solution, follow the existing testing lifecycle, but create and retain comprehensive Regression Test packs for the Unit Test (UT) and Extended Link Test (ELT) stages.
- For new developments such as new code or significant changes to existing code, take a generic perspective to provide exhaustive verification (against the design spec) at the component level.
- Increase the emphasis on code reviews to trap code defects at the earliest possible opportunity. They also serve to apply an additional perspective (testing) on the design specification.
- Adopt new terminology to emphasise the need for increased rigour in this area – Component Test (CT) and Component Integration Test (CIT).

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- Assemble and validate (against the requirements) each system as and when it becomes viable, and integrate with its supporting infrastructure – System Test (ST)
- Adopt integrated, mixed-discipline project teams for CIT, & ST, for example ST team supporting CIT work.
- Make extensive use of stubs and harnesses, etc., for CT & CIT, and to a lesser extent for ST.
- Verify all system interfaces against their design
- Formally plan and prepare all tests (Plans, Scripts, Data) and preserve results, to provide a comprehensive set of Regression Test packs, ideally automated.
- Promote flexible planning and pragmatic implementation to focus on high priority areas first.
    - Plan test cycles (thread based tests) flexibly, with high priority objectives to the fore.
    - Run test cycles pragmatically, being prepared to terminate the cycle early to progress fixes on high priority material first, and rerun in quick succession as appropriate.
    - Must have quick and easy mechanism for resetting environments (hours not days).
- Utilise Entry & Exit Criteria (and Suspension & Resumption Criteria) to provide realistic Quality Gates for controlling testing progress (from stage to stage) on the basis of objectives achieved rather than cycles run or arbitrary planning dates/deadlines reached.
- Pass proven systems to Independent Test area as and when each has become sufficiently stable (Entry Criteria) for onward integration and validation – System Validation & Integration (SV&I).
- Formally validate each external interface (DIT) as a collaborative activity
- Iteratively validate the emerging solution and integrate with the supporting infrastructure, until the entire solution has been assembled and fully validated, running End to End data flows within the bounds of the Project HNG-X solution. (Thread based testing, multiple test cycles, progressively introduce migrated data.) Threads should pre-empt later reuse in RV for wider End to End running.
- Separate from SV&I conduct full Performance, Volume, and Stress testing
- Separate from SV&I conduct full Integrity testing.
- Extend End to End data flows out into external systems, and interleave with full blown rehearsals of migration plans – Release Validation (RV)
- Treat the final cycle of RV as the formal UAT
- Adopt a collaborative working approach. From System Test stage onwards establish a joint test team with the following characteristics:
    - Establish a core team composed roughly 50% Fujitsu Services Testing and 50% Post Office Testing personnel.
    - Use core team as the primary resource for engaging with the Requirements and Systems Analysis team(s), and for conducting the early test planning (see Objective Driven Testing bullet above).
    - Go on to use the core team throughout the project to provide the necessary strategic and technical direction and assurance.
    - Introduce additional Post Office Testing personnel and Operational personnel into SV&I, integrated into the Fujitsu Services managed test teams, to both contribute business/operational knowledge, to provide extra resource, and to gain knowledge of the new systems.
    - Introduce further Post Office Testing personnel, including end users, into RV.

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- Provide and support access for any Post Office nominated person to independently review any required test plans, procedures, environments or results during the testing project phases subject to commercial constraints such as licensing and Non Disclosure Agreements (*requirement reference TST 291)*

- Pass through Release Authorisation Board (RAB) into Pilot (hand system over to Operations, Pilot run by Post Office.

The following schematic (see Figure 4) summarises the outline approach, illustrating the lifecycle stages involved and their main areas of coverage.

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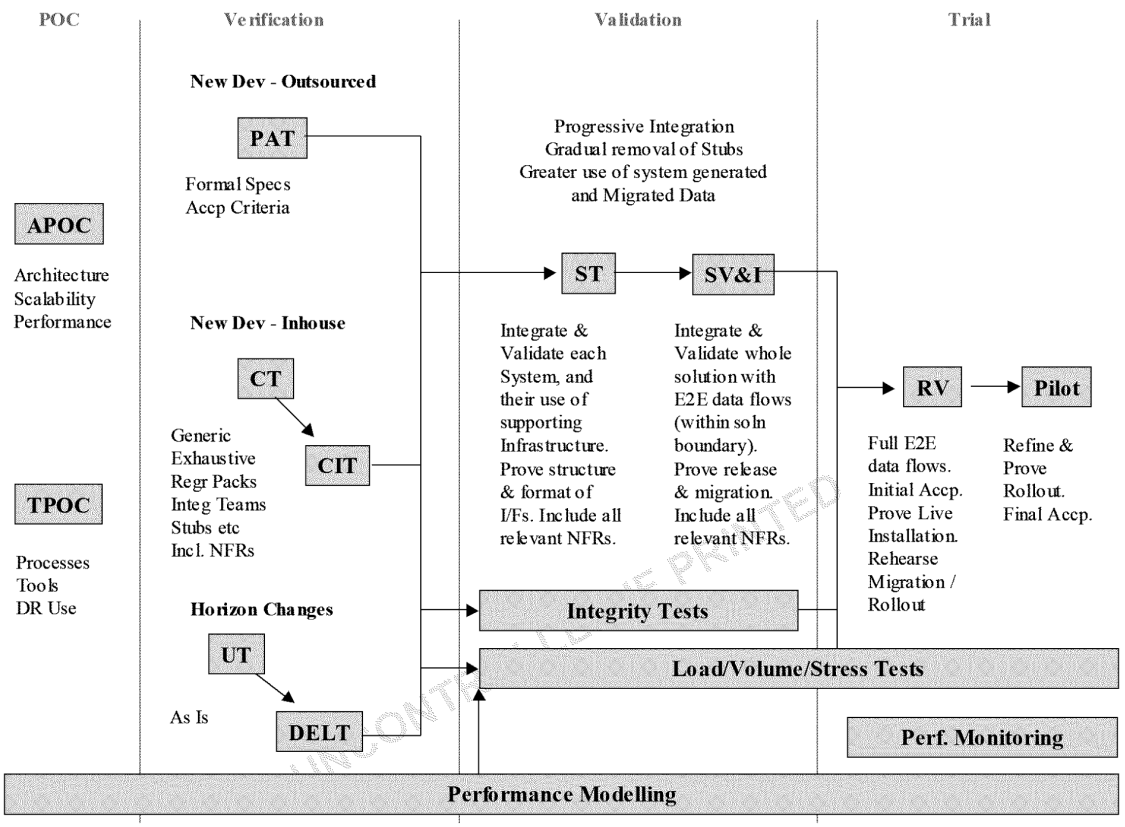

Figure 4: Outline Approach

3 Goals & Objectives

3.1 Test Mission (Top level testing goals)

The following defines the mission for the overall testing and integration effort for the whole Project HNG-X.

- Provide exhaustive yet realistic verification and validation of the entire solution prior to Live release
- Govern the testing effort on the basis of risk, using the resulting prioritisation of the detailed testing objectives to drive the process.
- Trap defects as early as possible in the lifecycle, placing a heavy emphasis on Reviews, CT, and CIT, with comprehensive (and preferably automated) Regression Test packs.
- Demonstrate that the principal drivers of the programme have been met, by running tests satisfying all those Acceptance Criteria specified as to be met by testing.
- Provide management information (feedback on testing progress and outcome) to the business.

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- Establish a comprehensive Performance Management regime, and in particular conduct extensive Performance Modelling from an early stage and on an ongoing basis.
- Develop efficient and effective testing processes, aligned with the development methods adopted, the desire to adopt a more collaborative style of working, and the move toward using the DR site as a test estate. Prove these, and their supporting tools and automation, through a series TPOCs well in advance of their widespread use for mainstream testing.
- Exploit stubs, harnesses, emulators, and the like, to provide a sound basis for component level testing in isolation, and to enable limited integration as early as possible in the lifecycle.

3.2 Test Motivators (Key sources determining tests)

The following defines the primary artefacts and drivers influencing the overall testing and integration effort for the whole Project HNG-X. This should be used as a checklist of necessary inputs for the high-level test analysis, early planning, and later more detailed test analysis, planning and scripting activities.

- System Use Cases (SUCs) and related Models (SUCMs)
- Supplementary (non-functional) Requirements (NFRs)
- Supplementary Usability Requirement
- Acceptance Criteria
- Business Processes, Procedures, Instructions
- Training Strategy
- Release Strategy
- Implementation/Migration Plans
- Topic Architecture Documents
- Physical Environment Description (PED)
- Deployment Configuration Guide (DCG)
- Infrastructure High Level Design (IHLD)
- Application High Level Designs
- Analysis User Experience Model
- Logical User Interface Model
- Analysis Entity Class Model
- Logical Data model
- Use Case Realisation Sequence Diagrams
- Activity Diagrams
- State Diagrams
- Class Diagrams

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- SRS (composite artefact gathering elements to form a comprehensive System Requirement Specification)
- Requirement Catalogue
- Business Rules Catalogue
- Product Catalogue
- Business Specified Test Points (BSTPs)
- Business Threads (BTs)
- Change Requests (CRs)
- Risk Register
- Programme Plan
- Delivery Plans
- Environmental Constraints
- Stakeholder Requests
- Test Reports (3rd Party Systems)
- Regression Test Packs (existing or 3rd Party systems)
- Known Error Logs
- Interface Specifications (AIS and TIS)

3.3 High Level Objectives (The Principles)

The following list of high level objectives represents the fundamental principles to be observed throughout Project HNG-X testing and integration:

- Test early – incremental testing (test what you can at any given stage/time)
- Developers are responsible for writing tests for the code they create
- Test enough (risk/cost based, value for money)
- Independent Testing Unit to integrate and validate whole solution
- Progressive integration – component level, then system level, then solution level, then release level
- Ability to provide full requirement traceability through tests being linked to acceptance criteria via Business Threads
- Optimise the use of automation to reduce cost and improve quality – focus primarily on component level verification for maximum payback
- Insulate test investment from change impact – exhaustive testing, with comprehensive regression test packs, for component level verification
- Targeted testing (avoid blanket regression)
- Test environments appropriate for tests concerned – highly synthetic for component level verification, through to being as close to Live 'shape' as practical for validation

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and integration of the whole solution, and being of significant scale for performance, volume, and stress testing – all live components to be trialled on target live platforms before released to Live.

- Aim to prepare, maintain and update a test environment for the commencement of a new iteration or instance of a testing cycle within a target of 24 hours except in the circumstances listed below. An agreement will be made by exception in the event of the 24 hour target being unachievable or if there is a requirement for a more rapid reset time. a) new hardware is required, b) Fujitsu Services requires a new virtual environment to be created and primed with a baseline, c) Fujitsu Services has applied a major new release to a rig and rig commissioning is necessary prior to the solution being released for testing (requirement reference TST 284)
- Consistent use of test management tools across all testing streams – exploit synergy – reuse test materials wherever practicable
- Testing teams working collaboratively with both Post Office Testing and Fujitsu Services Operations – combine test objectives, avoid duplication of effort, and exploit synergy – share and reuse test materials wherever practicable
- Test management tools to be fully integrated with other software development lifecycle tools (e.g. defect management, requirements management and change management systems).
- Testing fully integrated with software development lifecycle – early engagement, from Requirements Analysis onward – component level verification and system level validation conducted within integrated mixed-discipline project teams
- Early engagement with Post Office and Fujitsu Services Operations – risk assessments, prioritisation of test objectives
- Objective driven testing – DRIVE all testing activity on the basis of the prioritised test objectives, so observing the underlying risk assessments
- Progress through achievement – promote from stage to stage on the basis of the test objectives achieved, and so the 'readiness' of the system(s) under test to advance to the next stage of progressive integration. (i.e. risk-based, not time driven)
- Flexible test planning – bringing higher priority material to the fore, and organising testing cycles such that they can be run very flexibly, with rapid resetting of test environments to enable testing cycles to be restarted quickly and economically
- Continuous reassessment/reinforcement of strategic direction – joint core team working throughout to set and check direction and gain assurance
- Non-functional aspects included in every stage of testing

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4 Strategic Approach

This section expands on the outline approach described in section 2.

4.1 Objective Driven Testing

Central to this strategic approach is to drive all aspects of the work (planning, setting the priorities, engineering the necessary tests, preparing the test materials, allocating the necessary resources, executing the tests and checking the results) based primarily on achieving the necessary objectives in an efficient and effective fashion.

This means that all the tests have to be justified by the requirements of the release. One of the primary objectives of the test analysis phase is to identify the required set of tests. The importance of each test is also assessed so the most critical ones are given priority.

4.1.1 Risk Based Foundation

When considering what testing coverage must be achieved, and when each element of that coverage must be addressed in the lifecycle, the relative Cost must be assessed against the prevailing Risk. This Cost-v-Risk assessment is pivotal in planning and managing the assurance and testing effort.

Business input is vital. Post Office involvement in the initial risk assessment process, coupled with joint forums (such as PRFs) to continue providing business input on an ongoing basis, will ensure that a balanced perspective is obtained.

4.1.2 Objective Driven Method

Objective Driven Testing is a method of performing risk assessment to govern testing effort, routinely and repeatedly, without having to directly assess the costs and risks on each occasion. This is achieved by recording a highly granular set of priorities based on an initial assessment of the costs and risks, and then using these relative priorities to govern testing effort, exploiting their implicit reflection of the underlying costs and risks.

The key is to construct a comprehensive matrix of relationships, in terms of detailed test objectives (or 'test points'), and using the inbuilt traceability of the test analysis and test preparation processes to relate these test objectives to the relevant requirement, analysis, and design artefacts.

An initial risk identification and risk assessment activity is performed, and the resulting information is related to the test objectives via the traceability relationships, to grade their relative priorities. As the test objectives form an integral part of the test analysis and test preparation process, then again the inbuilt traceability associates them with the test plans, reviews, test scripts, and test steps accordingly. So each potential unit of assurance and testing can be implicitly cost-v-risk assessed by simply using the priority values assigned.

There are a number of additional benefits accruing from this method:

- Test Managers and Testers can relate to these priorities intuitively as they are directly associated with the test materials they prepare and follow.
- They are more amenable to qualitative or subjective risk assessments as the relative priorities can just as easily be set subjectively

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- The inbuilt traceability vastly simplifies assessing the impact of change, as any impact analysis process will already be following those same traceability relationships.
- Since reporting of test process is driven largely by the tests being run, and these can be directly related to the test objectives they satisfy, then it is a simple matter to report (albeit implicitly, in terms of priorities met) on residual risk exposure as a factor of test coverage.
- When risks change, then simply reassigning the priorities will automatically flow through to what tests should / should not be required.

4.1.3 The Principles

The main principles involved are:

- Analyse the available source documentation that defines the system(s) under test and determine WHAT needs to be tested (and WHY), cataloguing this in the form of Test Objectives, traceable back to the relevant requirements. (It is more effective to conduct the analysis from a number of discrete perspectives – Functional, Performance, Security, Integrity, etc. Whilst this may assist the process, for example improving target audiences for quality reviews, it is important that these perspectives are not permitted to influence the forward development of the tests.) Objectives must be:
  - ✓ Meaningful – stated clearly and unambiguously
  - ✓ Measurable – obvious what must be accomplished to satisfy
  - ✓ Manageable – realistic, achievable, and not too complex
- Conduct fine grain risk assessments, engaging Fujitsu Services Operations and Post Office as appropriate, and so prioritise the Test Objectives accordingly, effectively indicating WHICH Test Objectives should take precedence over others. (The relative priorities assigned then become an implicit reflection of their associated risks.)
- Group these prioritised objectives in an optimum fashion, exploiting synergy, to accomplish multiple objectives at once, forming embryonic test plans (effectively indicating WHEN each objective will be addressed).
- Normalise these embryonic tests based on their environmental needs, and further combine them where appropriate to increase efficiency (effectively indicating WHERE the test will be performed).
- Engineer these as explicit tests to achieve the objectives, documenting HOW, (and finalising WHEN and WHERE) they will be performed, first planning the tests in detail at the logical level (HLTP) and defining the necessary supporting data, and then scripting them at the detailed physical level to provide clear instructions for their execution (LLTS or equivalent automated scripts).
- Throughout, maintain the traceability back through the objectives to the source documentation so that the rationale for each test remains clear. Ideally this is accomplished by using a CAST (Computer Aided Software Testing) tool with an integrated repository to document the Test Objectives, HLTP and LLTSs, with appropriate interlinking relationships.

It should be noted that these principles apply iteratively, as further source documentation becomes available. Typically, business requirement-based sources are available earlier and are appropriate for early planning of solution level and release level testing, such as that performed within the SV&I and RV stages. As the system requirements emerge these can be further

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refined, and work can commence on planning the system level testing, such as that performed within the ST stage, whilst design-based sources become available a little later, and can be used to plan the component level testing and to refine the system level testing.

4.1.4 Outline Process

The following schematic provides an overview of the way in which Objective Driven Testing is implemented within the Project HNG-X test approach to integration and testing. It illustrates the outline processes (Analyse, Prioritise, Optimise, Normalise, Engineer), giving an outline breakdown of each, highlighting the main activities and data flows. It also shows the relationship at each stage with the stated principles, which may be characterised by the simple questions:

- WHAT to test? – the Test Objectives
- WHY test them? – the rationale, usually relating back to Requirements
- WHICH take priority? – some objectives will be more urgent/important
- WHEN to test them? – grouping them in an optimal fashion
- WHERE to test them? – assigning an appropriate environment type
- HOW to test them? – engineering the tests accordingly

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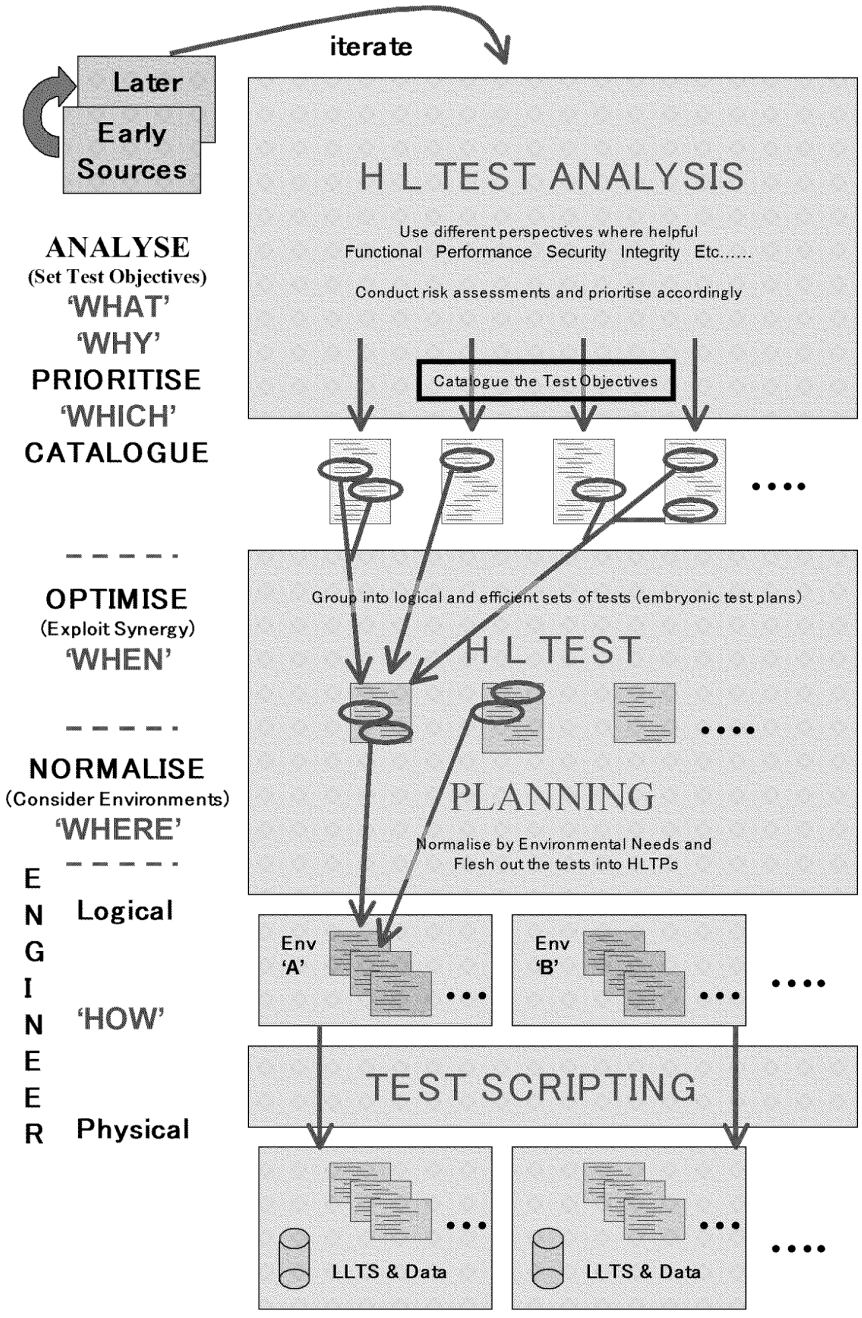

Figure 5 - Objective Driven Testing – Process Flow

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4.2 Formal Planning & Preparation

Formally documenting test plans and scripts is an obvious consequence of adopting Objective Driven Testing (see 4.1 above), but is also essential for a number of other reasons, as follows:

- To provide traceability from the planned tests (and so the executed tests) back to the Requirements, as required by CMMI, and as necessary in order to conduct coverage analysis, and assess residual risk
- To make the tests reusable (re-runable) and so protect the considerable investment involved in engineering a correct set of tests for a large and complex solution such as Project HNG-X
- To enable impact analysis (and so targeted testing) based on changes to certain identified components, using the traceability provided by the formal plans and scripts
- To provide an ongoing, and easily understood and amendable testing infrastructure for future use
- To allow the creation (collectively) of comprehensive Regression Test packs

As implied in 4.1 above, the steps involved are:

- The prioritised test objectives (derived from the principal sources) are grouped into logical and efficient sets, optimising them to exploit synergy, and so producing embryonic test plans.
- Their particular environmental requirements/constraints are then considered, normalising them accordingly (effectively allocating them to the most appropriate and cost effective testing stage) ….
- …. and fleshed out further to form High Level Test Plans (HLTPs)
- These are at a logical level and so should remain independent of their implementation (e.g. any tools/automation used) and so form a valuable and enduring test asset
- Low Level Test Scripts (LLTSs) are generated from the HLTPs, effectively physicalising the tests and providing detailed instructions for their execution. (LLTSs may take the form of automated test scripts, where applicable.)

4.3 Progressive Integration

In common with all large and/or complex IT solutions, it would be unrealistic to expect to successfully integrate the very great number of individual components making up Project HNG-X, to form a coherent overall solution, all in a single step. A progressive approach is called for.

This entails a series of integration steps, each building on the added stability provided by the previous one. At each step it is important to have a solid, stable foundation to start from. This is provided by verification/validation activity conducted at that level of maturity. The integration step then takes the 'proven' elements and exercises them in combination to integrate them to the next level, ready for further verification/validation.

These verification/validation activities, and the progressive integration steps, are arranged in a series of testing stages. There are four universally recognised levels of integration – Component Level, System Level, Solution Level (where the solution involves multiple systems), and Release Level.

The starting point is the individual Component (the smallest meaningful deliverable, of whatever type, forming a part of the target runtime state). These must first be verified before they can be successfully integrated together to form small sub-assemblies, which in turn must be verified. These sub-assemblies can then be integrated to the next level (System Level) and validated to confirm they are conforming to the relevant system requirements. Again this then forms the appropriate stable foundation to integrate to the next level (Solution Level), bringing all the co-operating systems together and validating them as an overall solution.

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Finally (at the Release Level) the solution can be integrated with its deployment mechanisms and the target Live runtime environment, to prepare it for Go-Live. (The deployment mechanisms should not be considered as incidental. They are an important aspect of the solution design, and whether implemented in an automated fashion, or by a manual process, form a vital element for successful deployment.)

The stages of testing required for Project HNG-X, shown in relation to these 4 levels of integration and verification/validation can be seen in more detail at 4.4 below.

4.4 Stages & Types of Testing & Integration

4.4.1 Addressing the Issues

As Project HNG-X involves a substantial re-engineering of the Horizon Application solution, it offers the ideal opportunity to redress this expensive imbalance in the testing lifecycle, applying rigorous verification methods to exploit the benefits of any changes to the development methods[1]. It also offers the opportunity to attack the areas of duplication and to exploit the areas of synergy, merging many of the existing testing stages together and working more collaboratively.

4.4.1.1 Component Level

The existing rather lightweight UT activities are replaced by a new much more rigorous regime. Code reviews will be retained, but given a higher profile than has been common for Horizon Application, seeking to trap code defects at the earliest opportunity. Adopting the usual industry terminology for component developments, Module Test (MT) and Link Test (LT) are replaced by Component Test (CT) and Component Integration Test (CIT). The new terminology is deliberate, to emphasise the fact that this must be a very different activity to that currently performed. The important characteristics to emphasise are:

- Conducted within development (with some support from system test team)
- Exhaustive coverage, made possible by strictly limiting the scope
- Object-Based (Encapsulation)
- Generic basis of testing (synthetic data sensitising full breadth of stimuli)
- Verify against Design
- Include Relevant non-functional requirements (NFRs)
- Comprehensive Regression Packs (insulate wider solution from localised changes)
- Extensive use of Stubs, Harnesses, etc. to enable testing in isolation

[1] Note this applies to the new Project HNG-X components; it does not apply to those Horizon Application components that are taken into Project HNG-X unchanged or with some minor change.

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Component Testing (CT):

Individual component "Z" tested in isolation
Stubs used at each interface

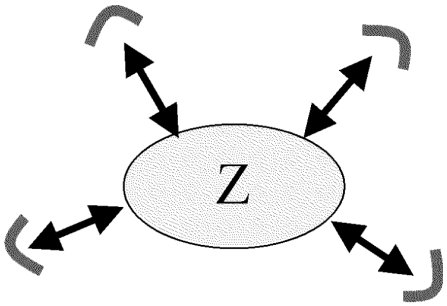

Figure 6: Component Test Context

Component Integration Test (CIT):

Component "z" integrated and re-verified together with immediate neighbours, but no further.

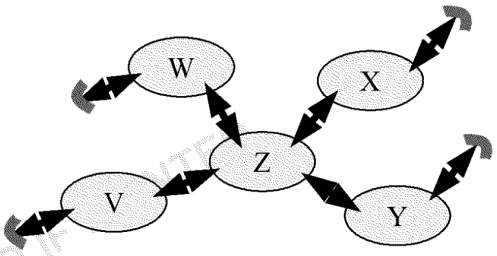

Figure 7: Component Integration Test Context

4.4.1.2 System level

The important characteristics to emphasise in this phase are:

- Conducted within development (integrated project teams)
- Detailed coverage, made possible by strictly limiting the scope
- Thread based tests (scenarios) integrate components into discrete systems
- Largely synthetic data to improve sensitisation of tests
- Validates against system requirements
- Integrates applications with supporting infrastructure elements
- Verifies the system interfaces against the interface specifications
- Includes relevant non-functional requirements (NFRs)
- Sample Regression Packs (insulate wider solution from localised changes)
- Some continuing use of Stubs, Harnesses, etc. to enable testing in isolation and to avoid schedule impact through interdependence
- Test and not development environments used[2]
- Entities delivered, installed and managed by the target solution architecture.

4.4.1.3 Solution Level

Retain the existing SV&I nomenclature – Solution Validation and Integration. Focus attention on gradual integration of whole solution. It includes all aspects of acceptance testing (to satisfy the acceptance criteria specified as to be met by solution testing (ST) and not allocated to RV – see 4.4.1.4). The important characteristics to emphasise are:

- Conducted within independent testing unit

[2] In practice this means Systems testing is run on the test environments in the live data centres whereas development testing is run on environments local to the development teams, e.g. BRA01, CRW01 etc.

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- Broad and shallow coverage - shallow here does not imply weak or superficial, but that at this level of validation the test coverage is not intended to be exhaustive, i.e. trying to cover every logic path in every combination. (Such detailed testing is performed at the earlier levels) Here important functional paths through the solution are used to confirm it is properly integrated and that it delivers to the overall requirements.
- Thread based tests (scenarios) integrate systems into whole solution
- Largely system generated data to confirm data flow integrity
- Validates against business / operational requirements
- Integrates applications with supporting infrastructure elements
- Validates Systems Management elements

Formally validates the external interfaces against the interface specifications

- Increasing level of collaborative working
- Includes relevant non-functional requirements (NFRs)
- Incorporates Integrity Tests (resilience/recovery)
- Incorporates Performance Tests (load, volume, stress)
- Threads incorporate all BTs and BSTPs to pre-empt acceptance
- Tests planned and prepared for subsequent reuse in RV (i.e. cover both POA and Post Office objectives and so encompass all the goals that E2E previously had) though at this stage not operating beyond the Project HNG-X solution boundary (i.e. external systems used only for validating interfaces and not for data flow integrity)
- Sample Regression Packs (insulate wider solution from localised changes)
- Use of Stubs, Harnesses, etc. removed except in support of interface testing and performance testing
- Test and not development environments used
- Entities delivered, installed and managed by the target solution architecture.

Note - For Project HNG-X, with the extensive changes to the underlying infrastructure systems, it will not be practicable to operate Integrity Tests or Performance Tests to a sufficient extent from within SV&I (the integrity tests will be too intrusive and disruptive, and the performance tests will need to be operated at very large scale). These will therefore operate as discrete testing stages for Project HNG-X.

4.4.1.4 Release Level

The RV nomenclature is retained – Release Validation. However, the scope is expanded to also encompass all the earlier Post Office Testing stages – Accreditation, E2E, Field-Trial, Pre-Pilot testing. This is achieved by combining the POA and Post Office test objectives (see the description of Objective Driven Testing at 4.1 above) into a single stream of scenario based tests, run interleaved with Migration tests/rehearsals, and so including all aspects of Acceptance testing (to satisfy the Acceptance Criteria specified as to be met by testing). The important characteristics to emphasise are:

- Conducted within independent testing unit
- Broad and shallow coverage of business functionality (see note on equivalent item under 4.4.1.3 above), with full rehearsal of migration and deployment processes
- Thread based tests (scenarios) interleaved with Migration tests/rehearsals
- Reuses test materials prepared for SV&I
- Incorporates all BTs and BSTPs and so achieves Acceptance testing goals
- Entirely system generated data to confirm data flow integrity
- Validates against business / operational requirements (which for the migration element also involves confirming non-regression from the previous baseline)

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- Integrates Solution with deployment mechanisms, including migration
- Further validates Systems Management elements
- Reuses interface validation materials toward achieving Accreditation. (It is important to recognise that if a particular area of Accreditation demands multiple re-runs, or the synchronisation it requires with the third party cannot be organised flexibly (perhaps having to be 'booked' a long time in advance) then this will clash with scheduling the rest of the testing for the RV area, and so in such cases that piece of Accreditation would need to be separated out from the rest to avoid adverse impact.)
- Very high level of collaborative working
- Sample Regression Packs
- All Stubs, Harnesses, etc. removed
- Test and not development environments used
- Entities delivered, installed and managed by the target solution architecture.

4.4.2 Project HNG-X Testing Stages

So, to summarise, the following stages of testing are required for the Project HNG-X, mapping them onto the recognised levels of integration:

- Proof of Concept
  - Architectural Proof of Concept (APOC)
  - Testing Proof of Concept (TPOC)
- Component Level
  - Code Review (CR)
  - Component Test (CT)
  - Component Integration Test (CIT)
- System Level
  - System Test (ST)
- Solution Level
  - Solution Validation & Integration (SV&I)
- Release Level
  - Release Validation (RV)

The following schematic illustrates how these testing stages will in practice overlap in time (for example, not all components are required to enable one system to enter ST, and not all systems are required to enable integration of systems to commence in SV&I).

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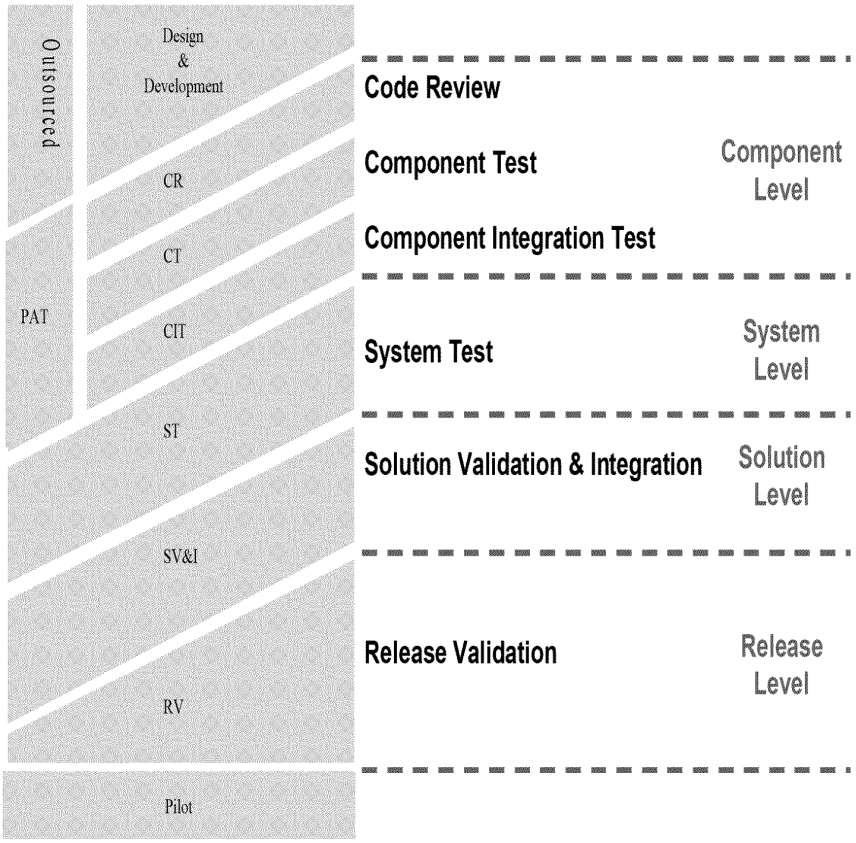

Figure 8: Testing Stages – Overlap

Product Acceptance Test (PAT) is retained for third party deliverables, to confirm that such deliverables meet the necessary minimum levels of stability of functional conformance so as not to adversely impact the wider testing activities taking place. PAT may not be a physical test - it may be by a review of artefacts such as low level design documentation or review of code where a physical test is not practical.

In addition, as already explained, for Project HNG-X it will be necessary to conduct both Integrity Testing (Recovery & Resilience) and Performance Testing (Load, Volume, and Stress) separately from SV&I, as discrete testing stages. Also, each testing stage requires formal planning and preparation, and as already mentioned there will also be Proof of Concept exercises run at the outset. Performance Modelling will commence alongside the APOC, and continue throughout. Complementary Performance Monitoring will be trialled in RV and then run on an ongoing basis thereafter (to support Monitor acceptance method requirements). The following schematic illustrates:

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Figure 9: Project HNG-X Testing Lifecycle Overview

4.5 Regression Testing & Retesting

The regression testing and re-testing policy for Project HNG-X is as follows:

The policy for Regression Testing for Project HNG-X is that for all change(s) being made to the solution, large or small, simple or complex, a sufficient series of Regression Tests will be run to confirm that (on the balance of probability, and commensurate with the risks involved) those change(s) have not caused the solution as a whole to regress, neither functionally nor non-functionally.

This will be achieved by:

- Strong design separation – this testing approach is predicated on Design & Development adhering to essential component-based development and O-O principles, such that the newly developed areas of Project HNG-X will be inherently more resistant to invasive change impact. This will be reinforced by Design Walkthrough and code reviews, and verified by Component Test (CT), and Component Integration Test (CIT). Change impact will therefore be much more localised than is currently the case with the Horizon Application Solution.

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- CT and CIT test coverage will be exhaustive, and generic in nature, to ensure the design capabilities of each component (and its interfaces) are fully met.
- CT and CIT materials will be retained to form comprehensive packs of Regression Tests at the component level.
- Extended Configuration Management (CM) and Impact Analysis facilities providing change impact details to allow specific changed components, and their neighbouring components, to be targeted for testing
- Related areas of the solution will similarly be identified as requiring specific regression testing at the component level
- The change documents and related sources will be subject to test analysis in the normal fashion, adopting Objective Driven Testing (ODT) principles to determine the basis of risk and so the relative priorities for testing each affected component and neighbouring components, and other areas likely to be affected as indicated by Impact Analysis.
- More general regression testing to confirm the continuing operation of the system(s) concerned and the overall solution will take the form of sample regression tests, selected on the basis of their priority rating(s)
- In general, the smaller, simpler, and more localised the changes are, then the less regression testing will be required, and conversely the larger, more complex, and more invasive the changes are, then the more regression testing will be required.

4.6 Horizon Application Based Areas

As explained previously, Horizon Application will persist (and so will need to continue to be maintained in Production) until Project HNG-X rollout is completed[3]. The existing processes in use on Horizon Application have been developed and refined over many years to cover the circumstances of the Horizon Application solution, and these will continue to be used for as a basis for all Horizon Application work that may be required in parallel with the Project HNG-X.

Horizon Application also persists within the target Project HNG-X solution (the Host systems, many of the Agents, and certain areas of infrastructure and Systems Management). It is likely that the work involved in these areas, albeit within the Project HNG-X, will draw upon common (shared) Horizon Application based resources. It is not really practical therefore to adopt different processes for these Project HNG-X areas than will be in use for Horizon Application. So, to avoid the clash, Project HNG-X will adopt the existing Horizon Application processes for all such areas, for all verification, validation, and integration activities up to and including the System Level. The two process streams will then be fused at the point where the systems concerned enter SV&I, where the Project HNG-X processes will prevail. (This will not cause a clash in process as this testing stage (and all subsequent ones) will be performed outside development, in the independent testing unit.)

Just one exception is imposed by this approach – the Horizon processes will be slightly extended to include creation of regression testing packs for Unit (UT) Test and Extended Link Test (ELT)[4]. This is necessary to complete the layer of insulation to protect the wider solution from localised changes.

[3] Note the continued operation of Horizon during HNG-X Migration is dependent on the Migration Strategy (see [13]).

[4] It is likely these regression test packs will be assemblies of existing material.

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4.6.1 Iterative Lifecycles and Integrated Mixed-Discipline Project Teams

Project HNG-X will utilise iterative development techniques as and where they may be of benefit. Depending on the circumstances the particular brand of iterative development may vary.

The following schematic illustrates the underlying iterative testing process for all development lifecycles:

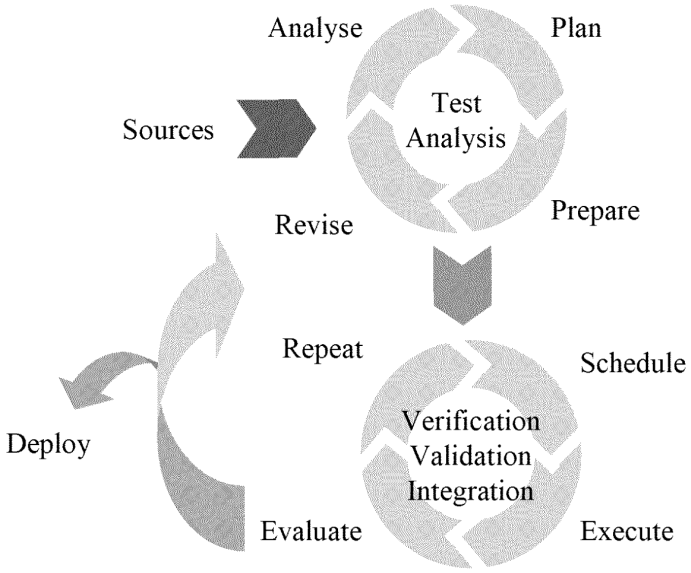

Figure 10: Testing Lifecycle – Always Iterative

Where this approach does affect testing is in the implementation and management. Iterative development processes always benefit from being organised as small close-working project teams, working together across the whole of the relevant portion of the development lifecycle (including testing). For Fully iterative developments this would apply to the entire lifecycle. For Part-Iterative developments, such as is for Project HNG-X, the relevant portion of the lifecycle is that portion which behaves iteratively. So, from a testing and integration perspective, it means those areas of Testing that are performed within the Development zone of responsibility (i.e. Component and Component Integration) and not the areas handled by the independent testing unit (i.e. the System, Solution and Release Levels).

So, for Project HNG-X, this approach requires CR, CT and CIT to be conducted within Development, by a mixed-discipline project which encompasses appropriate testing expertise. It is also likely that early periods of ST will also benefit from mixed-discipline working, i.e. developers and testers (or more correctly development orientated testers).

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4.7 Parallel Testing

TDN. This section is likely to require revision when the Migration Strategy has been baselined.

The Project HNG-X solution presents a number of unusual characteristics, which when taken in combination offer the opportunity to adopt an extremely cost effective testing technique known as Parallel Testing, and Project HNG-X intends to exploit this opportunity.

The key characteristics of the solution relevant here are:

- The Project HNG-X is predominantly a re-engineering exercise, and for the vast majority of the functionality it is seeking to achieve 'Business Equivalence' (i.e. very little new or changed business functionality involved).
- The external interfaces remain entirely unchanged.
- The majority of the external interfaces are file based and batch driven, and the Host systems responsible for generating these interface files also remain unchanged[5].
- Although the transaction volumes processed by the systems are very large, and the system data transformations and relationships are complex, this results in a relatively low volume of interface data.
- All the interface data is determined as a direct result of the content of the central transaction store (the Riposte Messages in the Correspondence Servers for Horizon Application, and the tables/rows of the Branch Database for Project HNG-X.
- There will be a clearly defined migration mechanism to transform the Riposte Messages into equivalent transaction information on the Branch Database
- Conducting equivalent business on both Horizon Application and Project HNG-X will result in equivalent interface records being produced on both.

So, simply by running a parallel test on the new Project HNG-X solution (parallel to the live operation of Horizon Application in terms of the data present, the transactions conducted, and the interface files generated), then the enormous complexity of the internal processing involved in the two solutions can be reduced to the net resultant interface files produced. The bottom line is that it dramatically reduces the test planning and test checking required to confirm overall non-regression of the solution.

In this case then, it would involve:

- Selecting a well delineated period of live operation of the Horizon Application solution. Using the EOD position on a given business day is a convenient method – effectively a business day's worth of transactions. If one of the four correspondence servers is selected, approximately 25% of a daily workload, providing a highly representative spread of transaction types. Alternatively specific branches could be targeted, though naturally the smaller the sample dataset the smaller the range of different business circumstances would included in the test.
- Take a backup of the selected correspondence server(s).
- Allow all that night's batch processing to proceed, producing the interface files corresponding to those transactions, and take a backup of them also.

[5] However it is not intended to downplay the importance of the real-time interfaces to payment card systems etc.

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- Transfer the backups into a test environment (special authorisation would be required to make use of this Live data for testing purposes).
- Migrate the selected transaction data onto the Branch Database of an Project HNG-X test environment, and run that night's batch processes.
- Secure the resulting interface files, and compare them with those produced by the Horizon Application Solution. Certain physical differences would be expected (such as time stamp differences and the random chunking of the TPS files) but in business terms they should be identical.

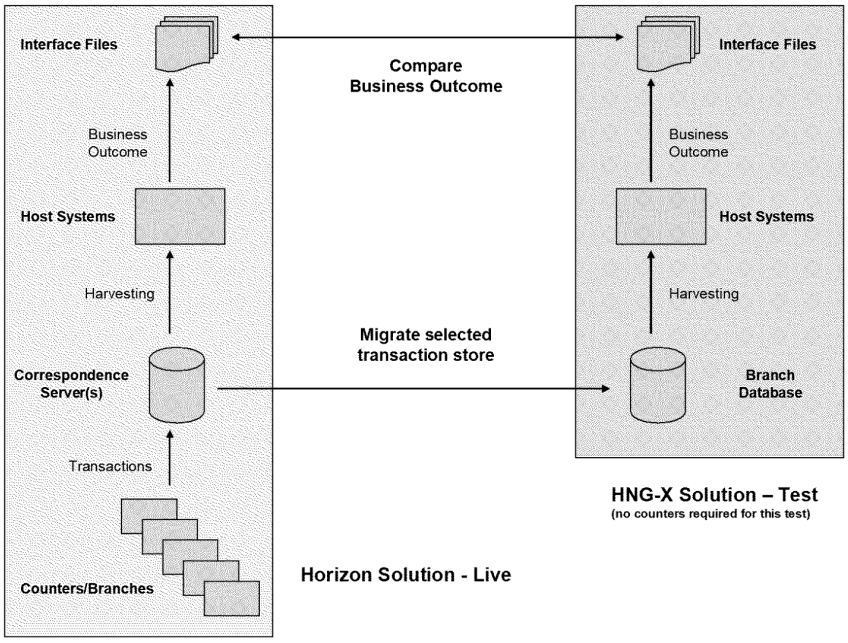

Figure 11: Parallel Testing for Project HNG-X

4.8 Collaborative Working

Fundamental to this strategic approach is the adoption of fully collaborative working between POA and Post Office for broad range activities spanning every aspect of testing and integration for the Project HNG-X. This extends well beyond simple witnessing of POA tests by Post Office, and even joint teams executing certain tests together. Essential to it is a lifecycle long relationship to jointly:

- set the strategic direction (this document);
- engage with the requirements analysis activities to ensure testability and to commence the high level test analysis;
- work with the requirements analysis area to help produce meaningful and practical acceptance criteria in the form of test scenarios (BTs and BSTPs);

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- establish a combined set of test objectives covering all the needs of both parties, engaging with both the business and operations to prioritise them on the basis of business and operational risk;
- iteratively expand the catalogue of test objectives as the project lifecycle progresses and additional information emerges, such as by engaging with the system designers to ensure testability of all components, including setting the testability framework, and engaging with requirements and design personnel in assessing changes;
- periodically reassess the basis of risk, consulting with the appropriate business and operational representatives to adjust the related priorities as necessary;
- continue to monitor and adjust the strategic direction and gain assurance throughout the programme;
- plan and prepare test materials for shared use and re-use;
- eliminate duplicated effort, exploit synergy and merge separate testing activities together wherever practicable to streamline the overall testing lifecycle;
- execute some areas within the SV&I stage, including formal validation of the external interfaces;
- execute almost all areas of the RV stage, embracing all previous objectives of the existing Post Office Testing activities, including Accreditation, Acceptance Test, and Pre-Pilot Test;
- report testing progress, including the contribution toward Acceptance

The intended implementation for Project HNG-X is to establish a Core Team, comprising roughly 50% POA personnel and 50 % Post Office personnel. This CORE team is initially involved in setting the strategic direction for Project HNG-X testing and integration (i.e. producing this document), and then working with the Requirements Analysis areas (for both business and operational requirements), following the principles of Object Driven Testing as described in outline at section 2 above, and in more detail at section 4.1 above.

This team would comprise exclusively highly experienced senior testing personnel, and would form a line of continuity throughout the whole lifecycle of the programme, setting, monitoring, and refining the strategic approach, assisting and advising the testing teams, and continuously gaining assurance.

Additional Post Office resources would later be injected into the testing teams, for the test planning and preparation activities, and again for RV test execution (including a contingent of End Users to assist in validating Procedures, Instructions, and Training materials, and to help man the Model Office environment.

The roles and responsibilities involved are indicated at section 5 below.

4.9 Defect Management

This area will be actively developed as part of the Testing Proof of Concept (TPOC) exercise. However, at a strategic level the key points are:

- All defects identified by formal testing will be recorded
- Where defects are found in component level testing, conducted by developers, they need not initially be raised as defects in the central defect management system, as it is most likely the same developer who will have to diagnose/fix the bug, and using the defect management tool would impose an unnecessary overhead. However, they will be noted in a defect log for inclusion in later metrics (they may for example help

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identify issues in a particular area of the design, or leakage occurring through inadequate code reviews).

- Where defects are found in later stages of testing, they will be recorded in the central defect management system, in all cases.
- Defects will be related to the test stage/plan/script/step/environment concerned, which through traceability will in turn relate to the test objective(s) and requirement(s)/design(s) concerned. After diagnosis this will also be related to system/component.
- Defects will be assigned priorities/urgencies/importance on the basis of the priority of the related test objective(s), the technical criticality of the system/component, the potential business impact, the potential testing impact (cost/schedule/coverage/dependency), any acceptance or release authorisation consequences, and also perhaps the defect density in that area (if it has become an issue).
- Outstanding defects will be formally reviewed on a regular basis (frequency driven by need – monthly, weekly, daily) by a Problem Review Forum (PRF) to assess/re-assess priority and likely impact. The PRF will have business, operations, testing, design and development representation, working collaboratively.
- Defect rates will be actively tracked as an integral part of test management

TBC when the tooling strategy has been determined (comes out of the TPOC exercise)

4.10 Environments, Tools & Automation

Fujitsu Services shall provide maintenance and support levels for the Project HNG-X test environments during testing as described in the HNG-X Test Strategy [13].

The ongoing requirement is to provide a continuously operational support environment in the DR centre for testing immediate fixes to the live service. In addition there is a requirement to provide a capability to be able to instantiate one or more test environments, as agreed, additional to and concurrent with the support environment, for the development and validation of new business services to the solution. The parameters for exercising the capability to instantiate test environments will be as defined in a post Project HNG-X testing approach CCD (*requirement reference TST 294)*.

Project HNG-X environments is an area will be actively developed as part of the Testing Proof of Concept exercise. However, at a strategic level the key points are:

- Environments
  - Project HNG-X will have three main sets of test equipment available.
    - Existing test estate currently used for Horizon Application, increasingly becoming available as the Horizon Application testing usage diminishes over time (this is not planned to be retained beyond Project HNG-X)
    - New Project HNG-X data centre equipment to be installed well in advance at the “Active” site (this will of course cease to be available for testing use at the time it is required to start preparing for Data Centre Migration)
    - New Project HNG-X data centre equipment to be installed well in advance at the “Standby” site (this will remain for testing use throughout, except when DR is invoked or rehearsed)
  - Mechanisms will be developed to flexibly deploy the equipment at the data centres, enabling:

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- Multiple parallel environments capable of supporting multiple parallel testing streams[6]
- Rapid and reliable reconfiguration and redeployment to form varying numbers of different shaped environments as the testing lifecycle unfolds
- Easy taking of 'checkpoint' positions before, during, and after testing cycles (configuration, code set baseline, data)
- Rapid and reliable resetting of environments to nominated 'checkpoint' position
- Separate data storage provision for Live and Test
- Capability to switch (under appropriate controls) between Live and Test datasets/networks/keys (to support pre-production testing and parallel testing methods)
- Failsafe isolation of Standby site equipment and network which is in use for testing (external interfaces, Active site synchronisation, etc.)
- Practicable remote management facilities – configure, install, regress, time & date manipulation, systems management, batch scheduling, etc.

  - Range of different environment types configurable
    - Full DR
    - Large-scale, Live shaped (e.g. for Performance, Stress, Resilience)
    - Medium-scale, Live shaped (e.g. Acceptance, Migration)
    - Medium-scale Live shaped (e.g. Live System Test)
    - Small-scale, Representative shape (e.g. SV&I)
    - Small-scale, Synthetic (e.g. ST, Interfaces)
  - Component level testing will be performed on development equipment

- Tools
  - There is no drive on Project HNG-X to replace tooling across the programme in support of new development methods, as was the case in earlier proposals – in general it should be assumed that the existing tools will continue to be used unless the nature of the task concerned is new or dramatically changes, or there is some other compelling reason to adopt a different toolset.
    - PVCS[7] for CM, but meta model extended to provide necessary structure in support of any new development methods, and to provide impact analysis
    - TestDirector[8] for test planning and test management
    - PEAK for defect management
    - LoadRunner for performance testing
    - Win Runner and QuickTest Professional[9] for functional test automation
    - New tools for Component level testing (JTest, JUnit, etc.)

[6] Note the ability to achieve this objective will be bounded by the Migration Strategy, i.e. the ability to cost effectively run parallel instances of Horizon components during migration testing. A number of Horizon platforms cannot be 'virtualized' due to the presence of Atalla Cryptographic cards.

[7] It is planned to upgrade to a later version, Dimensions V9.0 – product name changed as the result of change of ownership.

[8] Full name is: Test Director for Quality Center.

[9] WinRunner will be used on NT based Counters, Quick Test Professional for XP Counters. These are essentially the same product rename and packaged.

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The usage/requirement for each tool will decided as part of the TPOC exercise, ensuring that they join up, an the associated processes are properly aligned.
    - Fujitsu Services will provide training for Post Office testing staff to enable use of any new testing tools that are provided by Fujitsu Services *(requirement TST 286)*
    - There will be a need to adopt consistent working practices in the areas employing collaborative working. Typically this will mean standardising on the tools used by Fujitsu Services testing. (For example, it would be sensible to use a single defect management tool for all testing.)
- Automation
    - The testing automation policy for Project HNG-X can be summarised as: automated testing techniques will be adopted wherever and whenever it provides a clear benefit. The adoption must therefore be pragmatic, embracing automation where it can be readily applied, and avoiding it where costs become prohibitive. The detailed test automation strategy will need to be developed, but it is clear that the primary focus should be in the early verification stages (these are small, self contained, and have fewer data dependencies to contend with, but require exhaustive coverage, making them ideal candidates for automation). Automation of the later stages of testing should be approach more critically, adopting automated scripts only where the benefit is clear, and where the cost of future maintenance of scripts will not escalate. (Sample coverage to support minimum regression testing would seem appropriate.)

TBC when the environment and automation strategy has been determined (comes out of the TPOC exercise)

4.11 Metrics

TDN. This material must be reviewed by Pete Dreweatt.

This is an area which must be closely aligned with the associated tools and automation (see 4.10). In order to avoid undue overheads, it is important to generate any metrics that are required as an integral part of the underlying process and wherever possible do so automatically and transparently. Their precise definition is therefore inextricably entwined with that of the tools and automation being used. However, at a strategic level, the metrics that must be collected are:

- Time and Effort against Plan
    - Manpower resource expenditure by activity/task/skill – informs current budget position and future manpower estimating
    - Activity/Task progress tracking against project plan – informs current schedule position and future timescale estimating
    - The standard POA planning and time recording processes will be followed
- Testing Progress / Product Quality
    - Test Objectives derived, by nature/priority
    - Test Plans/Scripts/Steps produced, by stage/priority
    - Test Plans/Scripts/Steps executed – Success/Fail, by stage/priority
    - Test Coverage Achieved – by Test Objectives covered
    - Defects - Raised, Closed, False, Outstanding – by priority and by component/area, over time, traceable to Test Plan/Script/Step and to Test Objective

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    - Handovers Processed – by component/area, over time
- Process Improvement
    - Root Cause Analysis and Defect Density – by component/area
    - Re-Handovers – by component/area
    - Defect Leakage – by component/area and by test stage
    - PONC (Price of non-conformance)

TBC when the environment and automation strategy has been determined (comes out of the TPOC exercise)

4.12 Process Improvement

Process improvement will be an integral part of the Project HNG-X way of working for all testing and integration activities. As such there will be a post stage review for each stage, and a post release review for each release, specifically to examine the performance and achievement of the testing and integration activities in that stage/release, highlighting any potential process deficiencies and recommending corrective action/process improvement accordingly.

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5 People, Skills & Responsibilities

The following table indicates the primary roles and responsibilities applicable to each of the major activities. Jointly means that the Post Office and Fujitsu Services test managers jointly take responsibility for delivery of the activity.

Key: **P = Post Office, F = Fujitsu Services, J = Jointly** **(+3P = together with the 3rd party concerned)** **Activity**	**Owns**	**Directs/Guides**	**Manages Work**	**Agree/Sign Off**	**Main Resource**	**Supports**
Programme Test Strategy	J	J	F	J	J	J
Involvement in Business Requirements/Accp. Criteria	P	J	P	J	J	J
Involvement in Non-functional Requirements/Accp. Criteria	J	J	F	J	J	J
Involvement in Operations Requirements/Accp. Criteria	F	J	F	J	J	J
Derive Test Objectives	J	J	F	J	J	J
Risk Assessments – establish Priorities	J	J	F	J	J	J
Outline Test Planning	J	J	F	J	J	J
CT	F	F	F	F	F	-
CIT	F	F	F	F	F	-
ST	F	J	F	F	F	P
SV&I – Main	F	J	F	F	F	P
SV&I – External Interfaces	F	J	P	J+3P	F+3P	P
SV&I – Acceptance aspects	F	J	F	J	F	P
Performance Testing	F	J	F	P	F	P
Integrity Testing	F	J	F	J	F	P
Security Testing	F	J	F	J	F	P
DR Proving / Rehearsal	F	J	F	P	F	P
RV – Migration aspects	J	J	J	P	J	F
RV – E2E aspects	P	J	P	J	P	F
RV – Deployment aspects	F	J	F	P	F	P

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RV – Accreditation aspects	P	J	P	P+3P	J+3P	F
RV – Acceptance aspects	P	J	P	P	P	F
RAB	P	J	P	P	P	F
Pilot	P	J	P	P	P	F

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6 Assumptions, Dependencies, Risks & Constraints

6.1 Assumptions

- The primary driver for the Project HNG-X is to reduce the total cost of ownership. Whilst it is desirable in so doing to also improve the responsiveness to future change (reduced Time to Market, and reduced cost of delivery) these are not drivers for the Project HNG-X and can only be pursued on a cost neutral basis. Accordingly, this approach is not optimised for future change, but does exploit opportunities to benefit this area where they occur in satisfying the programme drivers. (e.g. stipulating the need for generic and exhaustive component level testing, and the need to retain comprehensive regression test packs, will require significant investment, which whilst it will be recouped within Project HNG-X is unlikely to realise significant savings overall, but will benefit future changes)
- Both POA and Post Office desire a single, consistent, joined-up testing approach for Project HNG-X.
- Both POA and Post Office desire, and are prepared to support and resource, fully collaborative working for the testing of Project HNG-X, wherever this may result in reduced duplication of effort between the parties, and/or exploit synergy to improve efficiency and/or effectiveness.
- There will be a lengthy Pilot period (about 6 months) where the throughput volumes for the new Project HNG-X will remain low (perhaps 100-300 branches) – this mitigates performance risks at first Go-Live.
- Following Pilot, there will be a gradual migration of branches to the new Project HNG-X systems (over a period of to be defined, see **[13]**), and so there will be a corresponding gradual ramp-up of workload volumes, which further mitigates performance risks whilst the migration proceeds.
- The Host systems (those which provide interfaces to third party systems external to Fujitsu Services) will remain functionally unchanged for Project HNG-X. The external system interfaces employed in Horizon Application will remain unchanged for Project HNG-X
- Development work outsourced to a third party (whether local or offshore) will undertake component level testing with at least equivalent rigour to that outlined in this approach for in-house developments, and will provide the same essential testing deliverables, including comprehensive Regression Test packs.
- There will not be a requirement to perform End-to-End Performance Tests involving external systems.
- Preparatory changes (such as relocating the data centres, installing the branch routers, and installing the additional hardware in the new data centres) will be conducted under the mantle of Horizon Application changes and so are covered by the existing Horizon Application test approach.
- The Project HNG-X solution will adopt an Active/Standby configuration for Disaster Recovery (DR), and the equipment at the Standby site (intended for DR) will ordinarily be available for testing purposes, except when DR is invoked.
- Project HNG-X will benefit from a gradually increasing ability to exploit targeted testing techniques, with the corresponding ability to perform accurate impact analysis, as the new developments progress.
- A Testing Proof of Concept (TPOC) exercise will be conducted prior to the main development, to develop, pilot and tune any necessary testing processes, tools, and automation methods.

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6.2 Dependencies

- Post Office Business Requirements, Non-functional Requirements and Fujitsu Services Operational Requirements will be produced at the outset of the programme, to formally identify both the functional and non-functional requirements for Business Equivalence and the reduction in Total Cost of Ownership.
- There will be an opportunity for Post Office and POA testers, working together, to engage with the corresponding requirements teams and to ensure that the emerging requirements are fully testable.
- Any Acceptance Criteria specified as to be satisfied by means of testing, will be couched in terms of the test scenarios necessary to demonstrate that they are met, and Post Office and POA testers working together will assist in articulating these test scenarios as formal Business Threads (BTs) and supporting Business Specified Test Points (BSTPs) to be carried forward directly into later test planning activities.
- Post Office will provide the necessary business engagement, and POA will provide the necessary operational engagement, in a series of workshops with Post Office and POA testers working together to conduct a highly granular risk assessment of the derived Test Objectives, and facilitate the prioritisation of those Test Objectives on the basis of such risk assessments.
- The equipment at the Standby site will be organised such that it can be quickly, cheaply, and easily be reconfigured to provide multiple, flexible test environments, which will support the taking of rapid 'checkpoints' and the rapid resetting of the environments to such checkpoints.
- It will be acceptable for Live Data to be used in Project HNG-X testing (under appropriate strict controls) in order to exploit Parallel Testing methods and so avoid significant time-consuming and expensive regression testing that would otherwise be necessary. TDN. This has to be reviewed subject to the Migration Strategy
- An Architectural Proof of Concept (APOC) exercise will be conducted prior to the main development, including
    - Commencing performance modelling
    - Proving viability of outline architecture and related technologies
    - Proving intended scalability mechanisms
    - Gaining an indication of likely performance characteristics
- Integrated project teams, with mixed-discipline personnel, will be employed for the development of the new Project HNG-X areas, such that experienced testing personnel will be involved throughout
- The Unit Test (UT) and Extended Link Test (ELT) areas of Horizon Application will extend their existing processes to retain and organise their test materials as Regression Test packs, for those systems which will form a part of the Project HNG-X solution (e.g. the Host and Agent systems).
- The Project HNG-X development area will adopt component-based development and O-O principles to ensure that a strong design separation is achieved (applies equally to outsourced developments also).
- The Project HNG-X development area will adopt exhaustive, generic, component level verification methods, in accordance with this strategic approach - Component Test (CT) and Component Integration Test (CIT) – and retain comprehensive Regression Test packs at this level.
- The Project HNG-X development area will conduct system level validation methods in accordance with this strategic approach – System Test (ST) – for all systems forming a part of the Project HNG-X solution (i.e. in-house development, outsourced developments, and Horizon Application systems redeployed or updated to form a part of Project HNG-X).

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- The existing Configuration Management (CM) system / toolset / processes will be extended appropriately to accommodate the CM requirements of component-based, any new development methods and testing, including supporting the necessary relationships to support effective impact analysis, and providing the necessary information to facilitate automatic configuring of hardware platforms and automatic building/installing/configuring of software stacks.
- The POA and Post Office testing personnel provided for the collaborative working required by this strategic approach, and in particular those forming the Core testing team, will be:
  - Appropriately skilled, highly experienced testing personnel
  - Empowered to make all necessary testing and test management decisions the role will require of them
  - Be assigned such that continuity throughout the programme will be maintained
  - Be supported by their respective managers in a manner that does not compromise their collaborative working role

6.3 Risks

- If the necessary design separation is not achieved or the necessary rigour in component level testing is not applied to exhaustively and generically verify each component, then the subsequent testing stages as described in this strategic approach will be unable to provide the in-depth detailed testing coverage to compensate for this deficiency and so the approach will need to be entirely revised.
- If the personnel involved in the collaborative working areas are not appropriately empowered, then the decision making processes will become protracted, significant levels of rework will result, and so costs and schedules will be adversely impacted.
- If CM is not extended as intended, then accurate targeted testing will not be possible, resulting either in inappropriate testing coverage (reduced product quality) or very extensive regression testing (increased costs and timescales).
- If the Acceptance Criteria are not produced at the outset, and couched in terms of the necessary test scenarios, it may not be possible to accommodate them collaboratively when planning and engineering the test materials as intended, and so may necessitate the re-separation of Post Office testing stages, with all the duplication of effort and increased timescales that will involve.