

Transport for London

Revenue Collection Services

Schedule 9.1 – Technical Authority

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1 Introduction

1.1 Scope and purpose

- 1.1.1 TTL owns and maintains a complex portfolio of systems, including the System and the IRC System (the "**TTL System Portfolio**"). TTL has established a technical authority function to provide oversight of proposed developments to the TTL System Portfolio and systems comprised within this portfolio to ensure that these developments are controlled and compatible with potential future developments (the "**Technical Authority**" or "**TA**").
- 1.1.2 This Schedule 9.1 (Technical Authority) sets out the additional activities and deliverables that TTL requires the Contractor to provide in order for TTL to be Assured that Technical Changes implemented and/or integrated by the Contractor pursuant to the Contract will not adversely impact the performance of the Services or introduce technology constraints that could hinder development of the TTL System Portfolio during or after the Term.

2 Principles and Guidance

2.1 Purpose of the TTL Technical Authority

- 2.1.1 The Contractor acknowledges and agrees that the primary role of the Technical Authority is to ensure that:
- (a) changes implemented to the TTL System Portfolio do not adversely impact services that TTL provides to its business stakeholders and TTL customers (including Customers);
 - (b) system changes are implemented according to a set of principles and rules established to Assure TTL that those changes do not constitute obstacles to TTL's strategy for long term TTL System Portfolio developments. These principles and rules are set out in Schedule 9.2 (System Design & Operating Principles); and
 - (c) the assurance framework set out in paragraph 3 of this Schedule is followed by providers of any systems within the TTL System Portfolio (including by the Contractor).
- 2.1.2 The TTL System Portfolio consists of a large suite of systems ranging from the System and the IRC System, to back office transactions processors and contact centre applications. To facilitate the management of the systems within the TTL System Portfolio, TTL has introduced a hierarchy providing four (4) levels of system abstraction as follows:
- (a) domain level;
 - (b) module group level;
 - (c) module level; and
 - (d) component level.
- 2.1.3 The Contractor acknowledges and agrees that the Technical Authority is the custodian of the IRC System Architecture as well as the Interfaces between domains, module groups, modules and components across different systems within the TTL System Portfolio.
- 2.1.4 The Contractor shall ensure that all Technical Changes affecting systems, and which Interface in multiple Domains across the TTL System Portfolio, are carried out, with TTL's awareness and express prior Assurance, by the Contractor pursuant to this Schedule, Schedule 10.2 (Programme and Project Lifecycle) and Schedule 10.5 (Assurance).

2.2 Technical Change Categories

- 2.2.1 The Contractor shall Assure TTL in relation to all Technical Changes but TTL acknowledges that it is not efficient for all Technical Changes to be submitted to the Technical Authority. In order to distinguish between such Technical Changes, all Technical Changes shall be divided into one of two (2) categories as set out in paragraphs 2.2.2 and 2.2.3 below.
- 2.2.2 A "**Category 1 Technical Change**" means any Technical Change that:

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- (a) changes the architecture of the System;
- (b) changes an Interface;
- (c) introduces new technology into the System; or
- (d) is being implemented by the Contractor and is not a Category 2 Technical Change.

2.2.3 A “**Category 2 Technical Change**” means any Technical Change that:

- (a) forms part of a Fares Revision;
- (b) is only a change to the configuration of an individual Configuration Item;
- (c) is a Related Change; or
- (d) is within a pre-determined category agreed in writing in advance by TTL as being a Category 2 Technical Change and within any constraints set out by TTL under such agreement.

2.2.4 All Category 1 Technical Changes shall be submitted to the Technical Authority in accordance with this Schedule. The Contractor shall also submit Category 2 Technical Changes to the Technical Authority if the Parties agree this is appropriate in the circumstances.

2.2.5 The obligations set out in this Schedule in relation to each category of Technical Change (as set out in paragraphs 2.2.2 and 2.2.3) apply to all such Technical Changes by the Contractor pursuant to the Contract regardless of the implementation process in relation to such Technical Changes. For the avoidance of doubt, this includes Technical Changes initiated by TTL or by the Contractor through a Variation, or Changes initiated by the Contractor for Corrective Maintenance, Preventative Maintenance or Performance Assurance purposes pursuant to this Contract.

2.2.6 The Contractor shall throughout the Term comply with the System Design and Operating Principles and provide Assurance to the Technical Authority regarding such compliance in the form and at such times as reasonably required by TTL.

2.3 Relevant frameworks and corporate standards

2.3.1 The Contractor shall develop (with the exception of the TTL Modules), install, operate, maintain and integrate a subset of TTL System Portfolio, known as the System.

2.3.2 The IRC System domains and their Interfaces with Interfacing Systems are represented in the IRC System Architecture Artefacts which shows the IRC System in the context of the wider TTL System Portfolio.

2.3.3 The obligations set out in this Schedule apply to the IRC System, operated and maintained either by the Contractor itself pursuant to this Contract or by Related Contractors (as applicable).

3 Technical Authority Assurance Processes

3.1 Introduction

- 3.1.1 The TA will perform technical assurance of Category 1 Technical Changes and architecture by:
- (a) maintenance of TTL System Portfolio architecture artefacts;
 - (b) Assuring the Contractor's maintenance of IRC System Architecture Artefacts; and
 - (c) ensuring the Contractor implements Category 1 Technical Changes according to associated Assurance Plans.
- 3.1.2 The "**IRC System Architecture Artefacts**" consist of the following documents:
- (a) Domain Component Map (DCM) which provides a structural and hierarchical view of the domains, module groups, modules and components forming the IRC System;
 - (b) System Architecture Diagram (SAD) which outlines the physical architecture of the IRC System;
 - (c) System Data Flow diagram (SDF) which represents IRC System modules and their Interfaces;
 - (d) Change Reconciliation Matrix (CRM) which provides traceability between Changes to the IRC System and Domains, Module Groups, Modules, Components and Interfaces; and
 - (e) Interface Register and Interface Specification Catalogue as set out in Schedule 7.3 (System Interfaces).
- 3.1.3 The Contractor shall at all times during the Term comply with:
- (a) its obligations in respect of the processes set out in paragraph 3.1.1;
 - (b) the System Design and Operating Principles, unless granted a Non-Compliance Waiver; and
 - (c) the System Architecture Standards in accordance with Schedule 9.3 (Standards).

3.2 Establish IRC System Architecture Artefacts

- 3.2.1 TTL shall provide to the Contractor on the Service Commencement Date the most recent updated version of the System Design and Operating Principles.
- 3.2.2 The Contactor shall provide the IRC System Architecture Artefacts on the Service Commencement Date.

3.3 Maintenance of IRC System Architecture Artefacts

- 3.3.1 The Contractor shall maintain the IRC System Architecture Artefacts according to the process set out in paragraph 5.1.
- 3.3.2 The Contractor shall provide an updated version of the IRC System Architecture Artefacts to TTL:
- (a) fifteen (15) Business Days before each TAF meeting; and/or
 - (b) within two (2) Business Days of a request from TTL.
- 3.3.3 Where the Contractor fails to submit the IRC System Architecture Artefacts for Assurance within twenty eight (28) days of the due date, the Contractor shall prepare and submit a Corrective Action Plan within ten (10) Business Days in accordance with Schedule 12.4 (Contract Management).

3.4 Assurance of Technical Changes

- 3.4.1 The Contractor shall comply with the requirements of this paragraph 3.4 when implementing Technical Changes.
- 3.4.2 The Contractor shall comply with the System Design and Operating Principles in relation to Technical Changes (other than Related Changes) unless a Non-Compliance Waiver is granted by TTL in accordance with this paragraph 3.4. The Contractor shall Assure all proposed Category 1 Technical Changes in accordance with paragraph 6, and all proposed Technical Changes in accordance with this paragraph, including those that are subject to the Project and Programme processes set out in Schedule 10.2 (Programme and Project Lifecycle).
- 3.4.3 Prior to a Category 1 Technical Change being implemented, the Contractor shall provide to TTL a:
- (a) System Impact Assessment; and
 - (b) Assurance Plan.

Where Category 1 Technical Changes are proposed by a Related Contractor, TTL shall, where appropriate, use reasonable endeavours to procure that the Related Contractor delivers the above documents to the Contractor, which shall be treated as a Dependency.

- 3.4.4 The Contractor shall ensure that the System Impact Assessment and Assurance Plan required under paragraph 3.4.3 are submitted to TTL within a reasonable period and, in any event in accordance with the Submissions Procedure, prior to the implementation of such Category 1 Technical Change and release into the production environment, save where such Category 1 Technical Change is as a result of an Emergency Change.
- 3.4.5 The System Impact Assessment shall provide TTL with an unambiguous understanding of the nature and scale of the proposed Category 1 Technical Change. The System Impact Assessment shall include, as a minimum, the following information:
- (a) the list of reference codes uniquely identifying Components and Interfaces subject to the relevant Category 1 Technical Change. The Contractor shall

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ensure that codification is consistent with the Module Breakdown Structure defined in Schedule 14 (IPR Management and Licences) and the Interface reference code specified in the Interface Register;

- (b) a description of the relevant Category 1 Technical Change for each Component or Interface subject to the Change; and
- (c) a description of any functionality to be removed as part of the Category 1 Technical Change.

3.4.6 The Assurance Plan shall detail how the Contractor will Assure TTL appropriate to the Assurance Level and requirements determined by TTL pursuant to paragraph 3.4.8. The Assurance Plan shall include sufficient detail of the methodology for the implementation of the relevant proposed Category 1 Technical Change and Contractor Personnel involved to enable the TA to verify the Assurance process and deliverables in connection with such proposed Category 1 Technical Change. The Contractor shall within ten (10) Business Days update and re-submit the Assurance Plan at TTL's reasonable request to take into account any comments or issues raised by TTL.

3.4.7 The Contractor shall, for each proposed Technical Change (other than a Related Change), comply with the requirements of the ISMS in relation to risk assessment and associated obligations as set out in Schedule 9.4 (Security Management), and for each Related Change the Contractor shall advise on the compliance of that Related Change with the requirements of the ISMS in relation to risk assessment and associated obligations as set out in Schedule 9.4 (Security Management). The Contractor shall explicitly state in the Assurance Plan whether the proposed Category 1 Technical Change has an impact on the Security Controls Matrix as set out in paragraph 2.1.2(k)(iv) of Schedule 9.4 (Security Management).

3.4.8 The Contractor shall propose an Assurance Level and submit the same to TTL. If, based on the information provided by the Contractor in the SIA and TTL's own assessment if applicable, TTL in its reasonable opinion disagrees with the Assurance Level proposed by the Contractor, it may determine a different Assurance Level for each relevant proposed Category 1 Technical Change and TTL shall inform the Contractor of such Assurance Level.

3.4.9 Where the Contractor believes it is unable or inappropriate to comply with the System Design and Operating Principles in relation to a Technical Change (other than a Related Change), the Contractor may request a waiver of compliance from TTL by submitting non-compliant IRC System Architecture Artefacts to TTL accompanied by a written and sufficiently detailed explanation of the reasons for non-compliance. TTL shall consider the Contractor's request and shall notify the Contractor of its decision within five (5) Business Days of receipt of such request as to whether a waiver of compliance has been granted (a "**Non-Compliance Waiver**") or not. Such decision shall be at TTL's sole discretion.

3.4.10 If TTL does not grant a Non-Compliance Waiver, the Contractor shall:

- (a) where the Technical Change has already been implemented, make the Technical Change compliant with the System Design and Operating Principles;
- or

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- (b) where the Technical Change has not yet been implemented, amend the proposed system design (or system operations) and documents to be compliant with the System Design and Operating Principles,

and in each case shall resubmit all relevant documents to TTL as specified in paragraphs 3.4.3 to 3.4.7 inclusive in advance of a subsequent TAF meeting.

3.5 Assurance Plan Compliance

3.5.1 The Contractor shall, on completing the implementation of each relevant Category 1 Technical Change:

- (a) update the IRC System Architecture Artefacts relating to the relevant Category 1 Technical Change; and
- (b) incorporate the IRC System Architecture Artefacts in the TTL Depository as set out in paragraph 2.8 of Schedule 14 (IPR Management and Licences).

3.5.2 The TA may review and/or audit the implementation of any Technical Change in accordance with Clause 65 (Records, Audit and Inspection) and/or Schedule 10.5 (Assurance).

4 Technical Authority Forum

- 4.1.1 The Technical Authority's key governance structure is the Technical Authority Forum ("TAF").
- 4.1.2 The Technical Authority Forum shall be used to govern the System Architecture and Interface management for the IRC System. The TAF shall provide the necessary oversight to ensure that the Contractor and TTL follow the processes and obligations set out in this Schedule and Schedules 7.1 (System Integration Overview), 7.2 (System Integrator) and 7.3 (System Interfaces). The TAF shall also provide the necessary oversight to ensure that the integrity of the IRC System Architecture Artefacts is maintained at all times throughout the Term.
- 4.1.3 TTL shall create and maintain terms of reference for the TAF and provide such terms of reference to the Contractor on the Service Commencement Date. Each Party shall ensure that the suitably qualified attendees of each Party as set out in paragraph 4.1.5 below attend meetings of the TAF.
- 4.1.4 The Contractor shall update and submit the documents specified in paragraph 3.1.2 in advance of each TAF meeting as specified in paragraph 3.3.2.
- 4.1.5 TTL shall prepare the meeting agenda for each TAF meeting and the TA shall chair each such meeting. At the end of each TAF meeting there shall be an agreed set of actions and, where necessary, formal minutes which TTL shall produce and circulate within three (3) Business Days of each meeting.

ATTENDEES	
TTL	Contractor
Head of customer technology any other representative of TTL relevant to the matters to be discussed at the meeting	Integration Manager Solution architects any other representative of the Contractor relevant to the matters to be discussed at the meeting

FREQUENCY AND LOCATION	
Once per quarter or upon the reasonable request of either Party in London at a location determined by TTL.	

INPUTS AND OUTPUTS	
Required Inputs	<p>To be provided by TTL:</p> <ul style="list-style-type: none"> (a) TAF meeting agenda; (b) current DCM; and (c) forward schedule of DCM Changes. <p>To be provided by the Contractor:</p> <ul style="list-style-type: none"> (a) System Architecture documents; (b) Module / Contract Variation matrix; and (c) Interface / Contract Variation matrix.
Required Outputs	<ul style="list-style-type: none"> (a) TAF meeting set of actions; and (b) TAF meeting minutes (if applicable).

5 Maintenance of IRC System Architecture Artefacts

5.1 Changes to System Architecture Artefacts

- 5.1.1 The Contractor shall comply with the approach and obligations relating to IRC System Architecture Artefacts specified in this paragraph 5.
- 5.1.2 Paragraph 5.2 sets out general requirements in relation to updating the SAD and SDF. Specific requirements in relation to the SAD and SDF are set out in paragraphs 5.3 and 5.4 respectively. Specific requirements in relation to creating and maintaining the Technology Road Map are set out in paragraph 5.5.
- 5.1.3 The Contractor shall, on making each Category 1 Technical Change:
- (a) update each of the IRC System Architecture Artefacts (with the exception of the Technology Road Map) to reflect a consistent point in time and reflect all Technical Changes whose design has been Assured by TTL, ensuring traceability between Technical Changes and IRC System Architecture Artefacts; and
 - (b) create a forward-looking version of each of the IRC System Architecture Artefacts (with the exception of the Technology Road Map) to take account of any known or potential Category 1 Technical Changes occurring in the next twelve (12) months. These forward-looking versions of the IRC System Architecture Artefacts shall clearly distinguish between current and future states by identifying elements that have not been implemented, for example by depicting these elements in different colours.
- 5.1.4 The Contractor shall submit the draft amended IRC System Architecture Artefacts in paragraph 5.1.3 to TTL for Assurance by the TAF according to paragraph 3.3.2. Draft documents shall clearly show changes (e.g. to connectivity, additional or changed Components) since the last TTL Assured version, for example using strikeout font and/or different colours.
- 5.1.5 TTL shall review the draft amended IRC System Architecture Artefacts within ten (10) Business Days of receipt from the Contractor and may provide feedback to the Contractor. The Contractor shall, within ten (10) Business Days of receipt of any feedback from TTL, revise the IRC System Architecture Artefacts to fully address any such feedback and supply TTL with the updated final clean copy of the IRC System Architecture Artefacts with change tracking removed.
- 5.1.6 The Contractor shall ensure that changes to the IRC System Architecture Artefacts are also reflected, where necessary, by changes to other related documents including the Module Breakdown Structure, and shall ensure that these documents are consistent.

5.2 System Architecture Diagram and System Data Flow Diagrams: common requirements

- 5.2.1 The Contractor shall provide the SAD and SDF to TTL in electronic format that can be viewed and edited using standard software tools (e.g. Microsoft Visio). The Contractor shall not use specialist computer aided design (CAD) drawing packages to deliver the SAD and SDF to TTL.
- 5.2.2 The versions of the SAD and SDF shall, as at the Service Commencement Date:

- (a) provide a view of the IRC System scope in a single diagram;
- (b) show only one (1) instance of each location (e.g. Station, bus, Core Data Landing Module) or Component (e.g. Gate, Ticket Machine) even though the IRC System may comprise many of each such location or Component;
- (c) partition different Domains, Module Groups and Modules into different areas of the diagram, insofar as this is possible for a complex system;
- (d) show in shaded grey the Interfacing Systems that are not part of the IRC System, but which interface to components that are part of the IRC System. These Interfacing Systems include systems operated by Third Parties (e.g. Merchant Acquirers, TOCs, ITSO, other TTL Contractors) and systems operated by TTL;
- (e) show only those components that are operational in the IRC System as at the Service Commencement Date. Components that are obsolete and have been removed from the IRC System as at the Service Commencement Date shall not be shown and components that are attached to the IRC System for test purposes shall not be shown;
- (f) include a Module number from the Module Breakdown Structure as a unique identifier for each Component. In relation to the SDF, where the Data Flow is common between a number of Modules these shall be grouped to simplify the diagram; and
- (g) include comment labels where necessary to aid understanding.

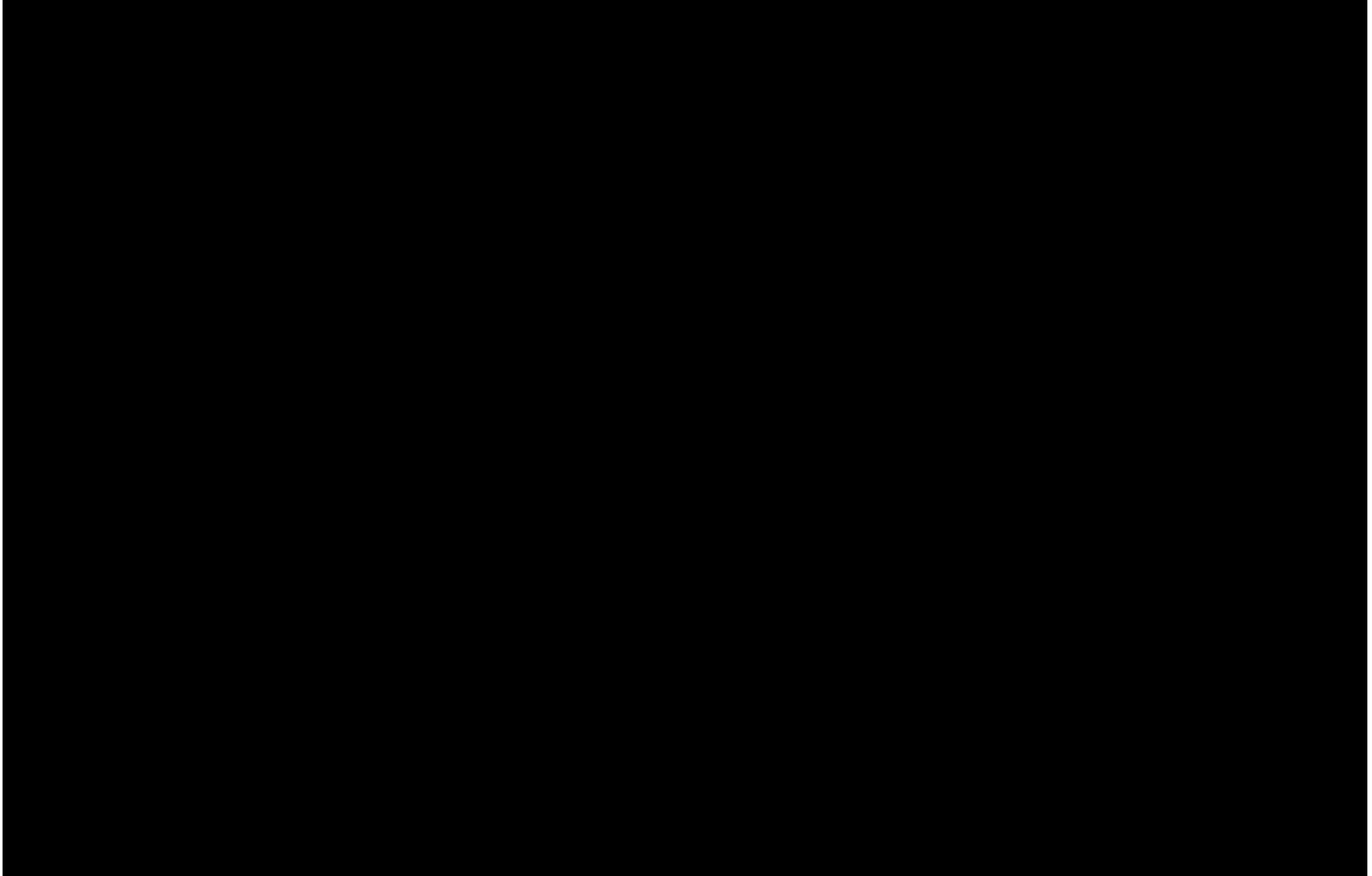
5.2.3 The Contractor shall apply the requirements set out in paragraph 5.2.2 above in preparing and maintaining the SAD and SDF throughout the Term.

5.3 System Architecture Diagram: specific requirements

5.3.1 The Contractor shall create and maintain a System Architecture Diagram for the IRC System that illustrates all the components of the IRC System and their physical Interfaces.

5.3.2 The SAD shall provide a representation of the physical infrastructure and how it is distributed across the IRC System.

5.3.3 The SAD for the IRC System as at the Date of Contract is shown below as an example of what is expected to be shown by the Contractor on the SAD.



5.3.4 The version of the SAD as at the Date of Contract:

- (a) uses recognisable icons to represent each component (e.g. Gates, Ticket Machines, Station Computers);
- (b) groups components that are located at a common location together with a box outline (e.g. London Underground station, TOC station, bus Garage, Core Data Landing Module);
- (c) shows only domains, module groups and modules with functionality, domains, module groups and modules representing operational processes are not shown; and
- (d) shows physical connections between components in representative form (e.g. using routers, network hubs and WAN comms clouds). The SDF (as specified in paragraph 5.4) should be used to understand the logical Interfaces between components.

5.3.5 The Contractor shall apply the requirements set out in paragraph 5.3.4 above in preparing and maintaining the SAD throughout the Term.

5.4 System Data Flow Diagram: specific requirements

5.4.1 The Contractor shall create and maintain a System Data Flow diagram for the IRC System that illustrates all the components of the IRC System and their logical Interfaces.

5.4.2 The SDF shall provide a representation of the Interfaces between the different components of the IRC System and the information that flows along those Interfaces.

5.4.3 The SDF for the IRC System as at the Date of Contract is shown below as an example of what is expected to be shown on the SDF.



5.4.4 The version of the SDF as at the Date of Contract:

- (a) shows modules with functionality and also modules representing operational processes where these are relevant to Interfaces and Data Flow;
- (b) shows logical connections between components and does not show components such as networking equipment and communication links that do not have an effect on the Data Flow;
- (c) provides annotation to each Interface that describes the Data that flows in each direction along the Interface between components (e.g. Up: Card validation transactions, Device status; Down: Base Data, Software updates, hotlists); and
- (d) uses different colours to distinguish between Data Flows associated with different transaction types (e.g. Prestige, ITSO, Contactless Payment Card) and status monitoring.

5.4.5 The Contractor shall apply the requirements set out in paragraph 5.4.4 above in preparing and maintaining the SDF throughout the Term.

5.4.6 The Contractor may choose to create and maintain data flow diagrams using a hierarchical approach which may be part of the SDF, but the SDF shall as a minimum include a single diagram providing a view of the whole IRC System to the level of Modules as defined in the Module Breakdown Structure.

5.5 Technology Road Map: specific requirements

5.5.1 The Contractor shall create and maintain a Technology Road Map detailing possible evolution of the IRC System and how emerging technologies may apply in relation to future development of the IRC System.

5.5.2 The Contractor shall update and supply to TTL the Technology Road Map annually on the anniversary of the Service Commencement Date. Following submission to TTL of the Technology Road Map, the Contractor shall make a presentation of the key elements of the Technology Road Map to TTL. TTL and the Contractor shall discuss the Technology Road Map following such presentation and the Contractor shall update and re-issue the Technology Road Map to reflect any comments provided by TTL.

6 Assurance Levels

6.1 Introduction

- 6.1.1 TTL shall require different levels of Assurance according to the potential impact of proposed Technical Changes ("**Assurance Level(s)**").
- 6.1.2 The Contractor shall propose an Assurance Level for each proposed Category 1 Technical Change. If in TTL's reasonable opinion it disagrees with such Assurance Level, TTL may determine a different Assurance Level in relation to such Category 1 Technical Change and the Contractor shall comply with the same.
- 6.1.3 The Assurance Level shall determine the nature of Assurance to be applied to the Category 1 Technical Change.
- 6.1.4 TTL may at its discretion specify the Assurance Level in a Variation.

6.2 Level 0: Category 2 Technical Change

- 6.2.1 There is no Category 1 Technical Change required.
- 6.2.2 Although it is anticipated that no technical Assurance will be conducted for such a Change, TTL reserves the right, at its discretion, to seek specific Assurance from the Contractor to confirm that no Category 1 Technical Change has taken place (including design reviews, regression tests and audits).
- 6.2.3 Examples of Changes that may be classified as Assurance Level 0 include Device installations and power shutdown type Changes.

6.3 Level 1: Single Component Change

- 6.3.1 The Category 1 Technical Change is limited to one (1) Component and does not impact adjacent Interfaces.
- 6.3.2 TTL Assurance shall be limited to the Component itself and a TTL technical subject matter expert will perform required Assurance activities as determined by TTL in its reasonable opinion in the circumstances.
- 6.3.3 A TTL solution architect may review Component Interfaces to validate the Assurance Level proposed by the Contractor.
- 6.3.4 TTL may, at its discretion, decide to reduce the Assurance Level to Level 0.

6.4 Level 2: Intra-Domain Multiple Components Change

- 6.4.1 The Category 1 Technical Change impacts several Components but is limited to one (1) Domain.
- 6.4.2 The Category 1 Technical Change does not impact any of the Domain Interfaces.
- 6.4.3 A TTL technical subject matter expert and a TTL solution architect will perform required Assurance activities for affected Components in the Domain as determined by TTL in its reasonable opinion in the circumstances.

6.4.4 A TTL solution architect shall review intra-Domain Interfaces to validate the Assurance Level proposed by the Contractor. The TA may also verify that Domain Interfaces are unchanged.

6.5 Level 3: Inter-Domain Multiple Components Change

6.5.1 The Category 1 Technical Change impacts several components distributed across more than one domain and/or impacts multiple domain Interfaces.

6.5.2 A TTL technical subject matter expert will perform Assurance across domains to satisfy themselves that the proposed changes will not impact other domains. The TTL solution architect will validate the impact on intra-domain Interfaces. The TTL domain architect will verify the inter-domain Interfaces.

6.5.3 A TTL technical subject matter expert, a TTL solution architect and a TTL domain architect shall perform required Assurance activities for affected Components in the Domain as determined by TTL in its reasonable opinion in the circumstances.

6.5.4 A TTL solution architect may review component Interfaces and domain Interfaces to validate the Assurance Level proposed by the Contractor.

Appendix 1: Domain Component Map

