

Z Specification

Computer System

Total schemas with error checking

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1 Introduction

A computer system that has multiple domains: ReactorCore, ControlRoom, AdminBuilding, OnSite, and OffSite. It also has multiple departments: Tech, Science, Management, and OfficeStaff. The following table defines which Department members can login to which Domain.

	ReactorCore	ControlRoom	AdminBuilding	OnSite	OffSite
Tech		x	x	x	x
Science	x	x		x	x
Management		x	x	x	x
OfficeStaff			x	x	x

2 Types and Globals

[STAFF] set of all uniquely identifiable employees

RESPONSE::= *StaffEntered* | *StaffExited* | *StaffAdded* | *AlreadyAMemberOfStaff* | *StaffRemoved* | *NotAMemberOfStaff* | *StaffNotPresent* | *StaffInArea* | *StaffNotInArea* | *AccessViolation*

DOMAIN::= *ReactorCore* | *ControlRoom* | *AdminBuilding* | *OnSite* | *OffSite*

DEPARTMENT::= *Tech* | *Science* | *Management* | *OfficeStaff*

CanAccess : DEPARTMENT $\leftrightarrow$ DOMAIN

3 The State of the System

<i>Computer</i>	
<i>users, loggedIn</i> : $\mathbb{P}$ STAFF	
<i>belongsTo</i> : STAFF $\leftrightarrow$ DEPARTMENT	
<i>loggedIn</i> : STAFF $\leftrightarrow$ DOMAIN	

4 Initialisation

<i>InitComputer</i>	
<i>Computer'</i>	
<i>loggedIn'</i> = $\emptyset$	
<i>users'</i> = $\emptyset$	
<i>belongsTo'</i> = $\emptyset$	
<i>canAccess'</i> = <i>Tech</i> $\mapsto$ <i>ControlRoom</i> , <i>Tech</i> $\mapsto$ <i>AdminBuilding</i> ,	
<i>Tech</i> $\mapsto$ <i>OnSite</i> , <i>Tech</i> $\mapsto$ <i>OffSite</i> , <i>Science</i> $\mapsto$ <i>ReactorCore</i> ,	
<i>Science</i> $\mapsto$ <i>ControlRoom</i> , <i>Science</i> $\mapsto$ <i>OnSite</i> , <i>Science</i> $\mapsto$ <i>OffSite</i> ,	
<i>Management</i> $\mapsto$ <i>ControlRoom</i> , <i>Management</i> $\mapsto$ <i>AdminBuilding</i> ,	
<i>Management</i> $\mapsto$ <i>OnSite</i> , <i>Management</i> $\mapsto$ <i>OffSite</i> ,	
<i>OfficeStaff</i> $\mapsto$ <i>AdminBuilding</i> , <i>OfficeStaff</i> $\mapsto$ <i>OnSite</i> ,	
<i>OfficeStaff</i> $\mapsto$ <i>OffSite</i>	

5 Change State Operations

Total Operations defined here are:

- i) Add Staff
- ii) Remove Staff
- iii) Change Area
- iv) Leave Area
- v) Is Staff In Area
- vi) Is Staff On Site

5.1 Add Staff

$\frac{\text{AddStaff}_0}{\Delta \text{Computer}}$	$p? : \text{STAFF}$
$p? \notin \text{users}$	$\text{users}' = \text{users} \cup \{p?\}$
$\text{loggedIn}' = \text{loggedIn}$	$\text{belongsTo}' = \text{belongsTo}$
$\frac{\text{AddStaffError}}{\Xi \text{Computer}}$	$p? : \text{STAFF}$
$p? \in \text{users}$	$\text{reply!} : \text{RESPONSE}$
$\text{reply!} = \text{AlreadyAMemberOfStaff}$	

$$\text{AddStaff} == (\text{AddStaff}_0 \wedge [\text{reply!} : \text{RESPONSE} \mid \text{reply!} = \text{StaffAdded}]) \vee \text{AddStaffError}$$

5.2 Remove Staff

$RemoveStaff_0$ $\Delta Computer$ $p? : STAFF$	
$p? \in users$ $users' = users \setminus \{p?\}$ $p? \notin dom\ loggedIn$ $p? \in dom\ belongsTo$ $loggedIn' = loggedIn$ $belongsTo' = belongsTo$	

$RemoveStaffError$ $\Xi Computer$ $p? : STAFF$ $reply! : RESPONSE$	
$p? \notin users \wedge reply! = NotAMemberOfStaff$ $\vee$ $p? \in users \wedge p? \in dom\ belongsTo \wedge response! = StaffInArea$ $\vee$ $p? \in users \wedge p? \in dom\ loggedIn \wedge response! = StaffEntered$	

$$RemoveStaff == (RemoveStaff_0 \wedge [reply! : RESPONSE \mid reply! = StaffRemoved]) \vee RemoveStaffError$$

5.3 ChangeArea

<i>ChangeArea</i> ₀	_____
$\Delta Computer$ $p? : STAFF$ $dep? : DEPARTMENT$	
$p? \in users$ $p? \notin dom belongsTo$ $users' = users$ $belongsTo' = belongsTo \cup \{p? \mapsto dep?\}$	

<i>ChangeAreaError</i>	_____
$\Xi Computer$ $p? : STAFF$ $dep? : DEPARTMENT$ $reply! : RESPONSE$	
$(p? \notin users \wedge reply! = AccessViolation)$ $\vee$ $(p? \in users \wedge p? dom belongsTo \wedge reply! = StaffInArea)$	

ChangeArea == (*ChangeArea*₀ $\wedge$ [*reply!* : *RESPONSE* | *reply!* = *StaffEntered*])
 $\vee$ ChangeAreaError

5.4 Leave Area

$LeaveArea_0$	$\Delta Computer$ $p? : STAFF$ $dep? : DEPARTMENT$ $p? \in users$ $p? \in dom\ belongsTo$ $users' = users$ $belongsTo' = belongsTo \setminus \{p? \mapsto dep?\}$ $loggedIn' = loggedIn$
$LeaveAreaError$	$\Xi Computer$ $p? : EMPLOYEE$ $dep? : DEPARTMENT$ $reply! : RESPONSE$ $p? \in users \wedge p? \notin dom\ belongsTo \wedge reply! = StaffNotInArea$ $\vee$ $p? \in users \wedge p? \in dom\ loggedIn \wedge response! = StaffInArea$

$LeaveArea ==$
 $(LeaveArea_0 \wedge [reply! : RESPONSE \mid reply! = StaffExited]) \vee LeaveAreaError$

5.5 Is Staff In Area

$ \begin{array}{l} \text{IsStaffInArea}_0 \\ \Delta \text{Computer} \\ p? : \text{STAFF} \\ d? : \text{DOMAIN} \end{array} $	
$ \begin{array}{l} p? \in \text{users} \\ p? \notin \text{dom loggedIn} \\ \{p? \mapsto d?\} \in \text{belongsTo} \text{ } \S \text{ canAccess} \\ \text{users}' = \text{users} \\ \text{belongsTo}' = \text{belongsTo} \\ \text{loggedIn}' = \text{loggedIn} \cup \{p? \mapsto d?\} \end{array} $	

$ \begin{array}{l} \text{IsStaffInAreaError} \\ \Xi \text{Computer} \\ p? : \text{EMPLOYEE} \\ d? : \text{DOMAIN} \\ \text{reply!} : \text{RESPONSE} \end{array} $	
$ \begin{array}{l} p? \in \text{users} \wedge \{p? \mapsto d?\} \text{ belongsTo } \S \text{ canAccess} \wedge \text{reply!} = \text{AccessViolation} \\ \vee \\ p? \in \text{users} \wedge p? \in \text{dom loggedIn} \text{ reply!} = \text{StaffInArea} \end{array} $	

$$\text{IsStaffInArea} == (\text{IsStaffInArea}_0 \wedge [\text{reply!} : \text{RESPONSE} \mid \text{reply!} = \text{StaffInArea}])$$

$$\vee \text{IsStaffInAreaError}$$

5.6 Is Staff On Site

$ \begin{array}{l} \text{IsStaffOnSite}_0 \\ \Delta \text{Computer} \\ p? : \text{STAFF} \\ d? : \text{DOMAIN} \end{array} $	
$ \begin{array}{l} p? \in \text{users} \\ p? \notin \text{dom } \text{loggedIn} \\ \{p? \mapsto d?\} \in \text{belongsTo} \text{ } \S \text{ canAccess} \\ \text{users}' = \text{users} \\ \text{belongsTo}' = \text{belongsTo} \\ \text{loggedIn}' = \text{loggedIn} \cup \{p? \mapsto d?\} \end{array} $	
$ \begin{array}{l} \text{IsStaffOnSiteError} \\ \Xi \text{Computer} \\ p? : \text{EMPLOYEE} \\ d? : \text{DOMAIN} \\ \text{reply}! : \text{RESPONSE} \end{array} $	
$p? \in \text{users} \wedge p? \in \text{dom } \text{loggedIn} \text{ } \text{reply}! = \text{StaffNotPresent}$	

$$\text{IsStaffOnSite} == (\text{IsStaffOnSite}_0 \wedge [\text{reply}! : \text{RESPONSE} \mid \text{reply}! = \text{StaffEntered}])$$

$$\vee \text{IsStaffOnSiteError}$$