

1 HWZRUNj: RUNLQJy*URXS
5HTXHVWjIRUj&RPPHQMwajecã
&DWHJRU\aj,QIRUPDMLROD0

yyy. i1 LFKROV
9iy-DFREVRO
yyyyyyyy&LVFR
yyy/iy=KDOJ
yyyyyy8&/S
yy-X0\nyï äää

\$y7ZRðELWj' LI IHUHQMLDWHGy6HUylFHVy\$UFKLWHFWXUHjIRUyWKHy, QWHUQHw

6WDWXVjRIyWKLvYOHPR

7KLvYPHPRjSURYLGHVyLQIRUPDMLROjIRUyWKHy, QWHUQHwFRPPXQLN\iyj, WjGRHVjQRWjVSHFLI\yDQj, QWHUQHwVMDQGDUGjRI
DQ\yNLQGiyj' LVWLEXMLROjRIyWKLvYPHPRjLVyXQQLPLWHGi

&RS\ULJKWj1RMLFH

yyy&RS\ULJKWj0&oy7KHj, QWHUQHw6RFLWH\y0ï äääöiyj\$00y5LJKWj5HVHUYHGj

\$EVWUDFW

7KLvYGRFXPHQWjZDVjRULJLQD00\yVXEPLWHGyDVyDQyLOWHUQHwGUDIWjLQj1RYHPEHUjRIyï äääeyj\$VjRQHjRIyWKH
GRFXPHQWjSUHGDMLQJyWKHyIRUPDMLROjRIyWKHy, (7)@Vj' LI IHUHQMLDWHGy6HUylFHVy: RUNLQJy*URXSnyPDQ\yRIyWKH
LGHDVjSUHVHQMwGyKHUHnyLQyFRQFHUWjZLWKy' DYHy&0DUN@VjVXEVTXHQWjSUHVHQMwDMLROjWRyWKHy' HFHPEHUjï äääyPHHMLQJ
RIyWKHy, (7)y, QWHJUDWHGy6HUylFHVy: RUNLQJy*URXSnyZHUyNH\yWRYWKHyZRUNyZKLFKy0HGyWRy5) &VjéééyDQGyééæè
DQyWKHyVHFMLROjRQyD00RFDMLROjUHPDLQVjDyMLPH0\ySURSRVD0iy) RUyWKLvYUHDVROnyDQyWRySURYLGHyDyUHIHUHQFHnyLWjLV
EHLQJyVXEPLWHGyLQyLWjRULJLQD00jIRUPj7KHjIRUZDUGLQJySDWKySRUMLRQjRIyWKLvYGRFXPHQWjLVyLOWHQHGyDVyDyUHFUG
RIyZKHUHyZHyZHUHyDwLQy0DWHyï äääyDQyQRWjDVyDQyLQGLFDMLROjRIyIXWUHjGLUHFMROj, QySDUMLFX0DUNyWKLvYGRFXPHQW
XVHVyWKHyWHUPjUVHUYLFHyWRyGHQRWjDyPRUHjSULPLMLYHyFRQFHSWjWKDQyLQyFXUHQWjXVHyLQyWKHy' LI IHUHQMLDWHG
6HUylFHVy: RUNLQJy*URXSj

7KHjSRVWFULSWjYHUVLRQjRIyWKLvYGRFXPHQWjLQF0XGHVj&0DUN0VjV0LGHVjDVyDQyDSSHQGL[iy7KHjSRVWFULSWjYHUVLRQ
RIyWKLvYGRFXPHQWjD0VRjLQF0XGHVjPDQ\yILJXUHvYWKDwDLGjJUHDW0\yLQyLWjUHDGDEL0LWï

ï iy, QWJRGXFMLRO

7KLvYGRFXPHQWjSUHVHQMwDyGLI IHUHQMLDWHGyVHUylFHVyDUFKLWHFWXUHjIRUyWKHyLOWHUQHw' DYHy&0DUNyDQy9DQ
-DFREVROjHDFKySUHVHQMwGyZRUNyRQjGLI IHUHQMLDWHGyVHUylFHVyDwWKHyOXQLFKy, (7)yPHHMLQj>ëëë@j(DFK
H[S0DLOHGyKRZyWRyXVHyRQHjELWjRIyWKHy, 3yKHGDGHUyWRyGH0LYHUjDyQHJyNLQgyRIyVHUylFHyWRySDFNHWjLQyWKHyLOWHUQHw
7KHVHyZHUHyWZRjYHU\yGLI IHUHQWjNLQVjRIyVHUylFHyZLWKyTXLWjGLI IHUHQWjSR0LF\yDVXPSMLROVj(QVXLQJ
GLVFXVLRQjKDVjFRQYLOFHGyXVjWKDwERWKjVHUylFHyW\SHVjKDYHyPHULWjDQyWKDwERWKjVHUylFHyW\SHVjFDQyEH
LPS0HPHQMwGyZLWKyDyVHWjRIyYHU\yVLPLODyPHFKDQLVPVï: HySURSRVHyDQyDUFKLWHFWXUDyIUDPHZRUNyWKDwSHUPLW
WKHyXVHyRIyERWKjRIyWKHVHyVHUylFHyW\SHVjDQyH[S0RLWjWKHLyVLPLODULHVyLQyIRUZDUGLQJySDWKyPHFKDQLVPVj7KH
PDMRjJRD0VjRIyWKLvYDUFKLWHFWXUHjDUHyHDFKyVKDUHGyZLWKyRQHjRUyERWKjRIyWKRvHyWZRjSURSRVD0VnyNHHSyWKH
IRUZDUGLQJySDWKyVLP0HnySXVKyFRPS0H[LW\yWRyWKHyHGJHVjRIyWKHyQHwZRUNyWRyWKHyH[WHQWjSRVLE0HnySURYLGHyD
VHUylFHyWKDwDYRLGVyDVXPSMLROjDERXWjWKHyW\SHjRIyWUDIILFyXVLQJyLWjHP0R\yDQyD00RFDMLROjSR0LF\yWKDwZL00yEH
FRPSDML0HyZLWKyERWKj0RQJ0WHUPjDQyVKRUM0WHUPjSURYLVLRQLQJnyPDNHjLWjSRVLE0HyIRUyWKHyGRPLQDQWj, QWHUQHw
WUDIILFyPRGH0yWRyUHPDLQyEHVW0HIRUWj

7KHjPDMRjFRQWLEXMLROjRIyWKLvYGRFXPHQWjDUHyWRySUHVHQMwWZRjGLVMLQFwVHUylFHyW\SHVnyDyVHWjRIyJHQHUD0

ï i 7KHjXQGHU0LQJyVLPLODUL\yLvyQRWjDQyDFLGHQWj00y' DYHy&0DUNyILUWjSUHVHQMwGySDUWjRIyKLVyDUFKLWHFWXUHjLQyWKHyH0U0\yãïVyDQy-DFRE0
VROjZDVyKH0Y0\yLQI0XHQFHGyE\yWKHyVLP0FLWjDQyVFD0DEL0LWjRIy&0DUN@VjPRGH0j

PHFKDQLVPVý IRUj WKHy IRUZDUGLQJý SDWKý WKDwý FDOqý EHý XVHGý WRý LPS0HPHQWý Dý UDQJHý RÍy GLI THUHQMLDWHG VHUUYLFHVýDQGYWRýSURSRVHýDýIOH [LE0HýIUDPHZRUNýIRUýSURYLVLRLQLOJýDýGLI THUHQMLDWHGýVHUUYLFHVýQHwZRUNý, WLVý SUHFLVH0\ý WKLvý NLOGý RÍy DUFKLMHFWXUHý WKDwý LVý QHHGHy IRUj H [SHGLHQWý GHS0R\PHQWý RÍy GLI THUHQMLDWHG VHUUYLFHVý ZHy QHHGý Dý IUDPHZRUNýDQGYVHwý RÍy SULPLMLYHVýWKDwý FDOqý EHýLPS0HPHQWýLQýWKHyVKR0W0HUP DQGY SURYLGHý LQMHURSHUDE0Hý VHUUYLFHVý \HWý FDOqý SURYLGHý Dý áVDQGER [úý IRUj H [SHULPHQMDLROqý DQG HODERUDLROqýWKDwýFDOqýHDGýLQýMLPHýWRýPRUH0HYH0VýRÍyGLI THUHQMLDMLROqýZLWKLOqýHDFKýVHUUYLFHVýDýVýQHHGHGý

\$WýWKHyLVNýRÍyEH0DERULQJýDQýDQD0Rj \ñý ZHyDUHyPRMLYDWHGýWRýSURYLGHyVHUUYLFHVýMLHUVýLQýVRPHZKDW WKHyVDPhýIDVKLROqýDVýWKHyDLUOLQHVýGRýZLWKýILUVWýF0DVVýEXVLQHVýF0DVVýDQGYFRDFKýF0DVVý7KHý0DWHUýD0VR KDvýMLHULOJýEXLOWýLQýGXHyWRýWKHyYDULRXVýUHVWLFMLROqýSXWýRQýWKHySXUFKDVHyý \$ýSDUWýRÍyWKHyDQD0Rj\ýZH ZDQWýWRýVUHVVýLVýWKDwýEHVýHIIRUNýWJDIILFý0LNHyFRDFKýF0DVVýVHDWýRQýDQýDLUS0DQHýLVýVML00ýH [SHFHWGýWR PDNHýXSýWKHyEX0NýRÍyLQMHUQHwýWJDIILFý%XLQHVýDQGYILUVWýF0DVVýF0DUU\ýDýVPD00ýQXPEHUýRÍySDVWQJHUv EXWýDUHyTXLWýLPSRUMDQWýWRýWKHyHFRQRPLFVýRÍyWKHyDLUOLQHVýLQGXVWU\ý7KHýYDULRXVýHFRQRPLFýIRUFHVýDQG UH0DMLHVýFRPELQHyWRýGLFMDWýWKHyUH0DMLYHyD0RFDMLROqýRÍyWKHyVHDWýDQGYWRýWU\ýWRýILO0ýWKHyDLUS0DQHý: HGR0WýH [SHFHWýWKDwýGLI THUHQMLDWHGýVHUUYLFHVýZL00ýFRPSULVHyD00ýWKHyWJDIILFýRQýWKHyLQMHUQHwýEXWýZHýGR H [SHFHWýWKDwýOHZýVHUUYLFHVýZL00ý0HDGýWRýDýKH0D0K\ýHFRQRPLFýDQGYVHUUYLFHyHQYLUROPHQW

7KLvýGRFXPHQWýLVýRUJDQL]HGýLQWRýVHFMLROqýGHVULELQJýVHUUYLFHyDUFKLMHFWXUHýPHFKDQLVPVýWKH EDQGZLGWýD0RFDMLROqýDUFKLMHFWXUHýKRZýWKLvýDUFKLMHFWXUHýPLJKWýLQMHURSHUDWýZLWKý5693ñLQW0VHUy ZRUNýDQGYJLYHVýUHFRPHQGDMLROqýIRUýGHS0R\PHQW

ëiy\$UFKLMHFWXUH

ëñ ý%DFNJURXQG

7KHýFXUHQWýLQMHUQHwýGH0LYHUVýRQHýW\SHýRÍyVHUUYLFHyEHV0HIIRUNýWRýD00ýWJDIILFý\$ýQXPEHUýRISURSRVD0VýKDYHyEH0QýPDGHýFRQFHUQLQJýWKHyDGGMLROqýRÍyHQK0DFHGýVHUUYLFHVýWRýWKHy, QMHUQHwý: HyIRFXV RQýWZRYSDUMLF0DUýPHWKRGVýRÍyDGGLOJýDýGLI THUHQMLDWHGý0HYH0ýRÍyVHUUYLFHyWRý, 3ñýHDFKýGHVJQDWHGýE\ýROH ELWý>ñ ñëñë@ý7KHVýVHUUYLFHVýUHSUHVHQWýDýUDGLF0ýGHS0UWXUHýIURPýWKHy, QMHUQHwýWJDGLMLROD0ýVHUUYLFHyEXW WKH\ýDUHyD0VRýDýUDGLF0ýGHS0UWXUHýIURPýWJDGLMLROD0ýTXD0LWýRÍyVHUUYLFHyDUFKLMHFWXUHýZKLFKýUH0\ýRO FLUFXL0EDVHGýPRGH0Vý%RMLýWKHVHySURSRVD0VýVHNýWRýGHILQHýDýVLQJ0HyFRPPRQýPHFKDQLVPýWKDwýLV XVHGýE\ýLQMHULRýQHwZRUNýURXWUvñýSXVKLOJýPRVWýRÍyWKHyFRPS0H [LW\ýDQGYVMDWýRÍyGLI THUHQMLDWHG VHUUYLFHVýWRýWKHyQHwZRUNýHGJHVý%RMLýXVHyEDQGZLGWýDVýWKHyUHVXUFHyWKDwýLVýEHLQJýUHTXHVWHyDQG D0RFDWHGý&0DUNýDQGY: URF0DZVNLýGHILQHýDQýú\$VWXUHýVHUUYLFHyWKDwýIR0RZVýúH [SHFHWýFDSDFLW\ú XVDJHySURILOHVýWKDwýDUHyVMDLVMFD00\ýSURYLVLRQHý>ë@ý7KHýDVVXUDQFHýWKDwýWKHyXVHUýRÍyVXFkýDýVHUUYLFH UHFHLVHyLVýWKDwýVXFkýWJDIILFýLVýXQ0LNH0\ýWRýEHýGURSSHGýDVý0RQJýDVýLWýVMD\ýZLWKLOýWKHyH [SHFHWG FDSDFLW\ýSURILOHý7KHýH [DFWýPHDQLQJýRÍyúXQ0LNH0\ýGHS0QGVýRQýKRZýZH00ýSURYLVLRQHýWKHyVHUUYLFHyLVý \$Qý\$VWXUHýVHUUYLFHyWJDIILFýI0RZýPD\ýH [FHHGýLWý3URIL0HñEXWýWKHyH [FHVýWJDIILFýLVýQRWýJLYHQýWKHyVDPH DVVXUDQFHý0HYH0ý-DFREVRQýGHILQHýDýú3UHPLXPýVHUUYLFHyWKDwýLVýSURYLVLRQHýDFFRUGLOJýWRýSHDN FDSDFLW\ý3URIL0HVýWKDwýDUHyVWMLF0\ýQRWýRYHUVXEVFULEHGýDQGYWKDwýLVýJLYHQýLWýRZQýKLJK0SULRULW\ýTXHXH LQýURXWUvñý>ë@ý\$ý3UHPLXPýVHUUYLFHyWJDIILFýI0RZýLVýVKDSHGýDQGYKDUG00LPLWHGýWRýLWýSURYLVLRQHýSHDN UDWýDQGYVKDSHGýVRýWKDwýEXUVWýDUHyQRWýLQMHUQHwýLQWRýWKHyQHwZRUNý3UHPLXPýVHUUYLFHySUHVQWýD úYLUWXD0ýZLUHýZKHUHyDýI0RZ\ýEXUVWýPD\ýTXHXHyDwýWKHyVKDSHyDwýWKHyHGJHyRÍyWKHyQHwZRUNýEXW WKHUHD1WHUýRQ0\ýLQýSURSRULROqýWRýWKHyLQGHJUHHýRÍyHDFKýURXWUvñý' HVSLWHyWKHLUýPDQ\ýVLP0DULMLHVñWKHVH WZRýDSSURDFKHVýUH0X0WýLQýXQGDPHQMD00\ýGLI THUHQWýVHUUYLFHy7KHýIRUPHyXVHVýEXIHUýPDQDJHPHQWýWR SURYLGHýDýúEHV0HýHIIRUNýVHUUYLFHyZKLOHyWKHy0DWHUýFUHDWHyDýVHUUYLFHyZLWKý0LW0HyMLWUýDQGYTXHXHLQJ GH0D\ýDQGYQRýQHGHýIRUýTXHXHyPDQDJHPHQWýRQýWKHy3UHPLXPýSDFNHW\ýTXHXHy

\$Qý\$VWXUHýVHUUYLFHyZDVýLQWURGXFHGýLQý>ë@E\ý&0DUNýDQGY: URF0DZVNLñWKRXJKýZHýKDYHyPDGH VRPHýD0MHUDMLROqýLQýLWýVSHFLILFDMLROqýIRUýRXUýDUFKLMHFWXUHý)XUWKHyUHILQHPHQWýDQGYDQýú([SHFHWG &DSDFLW\ýIUDPHZRUNýDUHyJLYHQýLQý&0DUNýDQGY)DQJý>ñ í@ý7KLvýIUDPHZRUNýLVýIRFXVHGýRQýúSURYLGLOJ GLI THUHQWý0HYH0ýRÍyEHV0HIIRUNýVHUUYLFHyDwýMLPHVýRÍyQHwZRUNýFRQJHVMLROqýEXWýD0VRýPHQMLROqýWKDwýLVýLV SRVLE0HyWRýKDYHyDýVHSDUDWHyURXWUvñTXHXHyWRýLPS0HPHQWýDýúXDUDQWHGý0HYH0ýRÍyDVVXUDQFHý: H EH0LHYHyWKLvýIUDPHZRUNýDQGYRXUý7ZRðELWýDUFKLMHFWXUHýDUHyFRPSDML0HyEXWýWKLvýQHGHVýIXUWKHU

H[S0RUDMLRQýý \$Vý 3UHPLXPýVHUUYLFHy KDvý QRWý EHHQý GRFXPHQMHGý HOVHZKHUHñý ZHy GHVFULEHy LWý QH [Wý DQG IR00RZýMkLVýZLWKýDýGHVFULSMLRQýR IýMkHyWZ RðELWýDUFKLMHFVXUHñý

ëiëý3UHPLXPýVHUUYLFH

, Qý>ëñýDý 3UHPLXPýVHUUYLFHy ZDVý SUHVHQMHGýWKDñýLVý IXQGDPHQMD00\ýGLI THUHQWý IURPýWKHy , QMHUQHWPV FXUUHQWýEHVñýHI IRUWýVHUUYLFHy 7KLvýVHUUYLFHyLVýQRWýPHDQWñýRýUHS0DFHyEHVñýHI IRUWýEXWýSULPDULO\ýWRýPHHñýDQ HPHUJLQJýGHPDQGý IRUýDýFRPPHUFLODýVHUUYLFHyWKDñýFDQýVKDUHyWKHyQHwZRUNýZLWKýEHVñýHI IRUWýWUDIILFý 7KLvýLVýGHVLUDE0HyHFRQRPLFD00\ñýVLOFHýMkHyVDPHyQHwZRUNýFDQýEHýXVHGýIRUýERWýNLOGVýR IýWUDIILFý, WýLV H[SHFWHGýWKDñý 3UHPLXPý WUDIILFý ZRX0GýEHý D00RFDWHGýDýVPD00ýSHUFHQMDJHy RýWKHyWRND0ýQHwZRUN FDSDFLW\ñýEXWýWKDñýLVýZRX0GýEHýSULFHGýPXFkýKLJKHUñý2QHýXVHyRýVXFkýDýVHUUYLFHyPLJKWýEHýWRýFUHDWH ùYLUWXD0ý0HDVHGý0LQHVñýVDYLOJýWKHyFRVñýRýEXL0GLOJýDQGýPDLOWDLQJýDýVHSDUDWHýQHwZRUNñý3UHPLXP VHUUYLFHyQRWýXQ0LNHyDýVMDQGDUGýWH0HSKRQHý0LQñýLVýDýFDSDFLWýZKLfKýMkHyFXVWRPHUyH [SHFwñýWRýEHýMkHUH ZKHQýMkHyUHfHLYHUýLVý0LWñýD0MkRXJKýLVýPD\ñýGHSHQGLQJýRQýMkHyKRXVHKR0ñýEHýLG0HyDýJRRGýGH0DýRI MkhñýLPHñýý3URYLVLRQLQJý3UHPLXPýWUDIILFýLVýLVýZD\ýUHGXfHVýMkHyFDSDFLWñýR IýMkHyEHVñýHI IRUWýLQMHUQHWH E\ýMkHyDPRXQWýRý 3UHPLXPý D00RFDWHGñýLQýMkHyZRUWñýFDVñýMkXVýLVýZRX0GýKDYHyWRýEHýSULFHG DFFRUGLQJ0\ñý2QýMkHyRmKHUýK0QñýZKHQHYHUýWKDñýFDSDFLWýLVýQRWýEHLQJýXVHGýLVýLVýDYDLODE0HyWRýEHVñ HI IRUWý WUDIILFý ,QýFRQWUDVñýWRýQRUPD0ýEHVñýHI IRUWý WUDIILFýZKLfKýLVýEXUVW\ýDQGýUHTXLUHVýTXHXH PDQDJHPHQWýWRýGH0DýIDL00\ýZLWKýFRQJHVWLYHyHSLVRGHVñýMkLVý3UHPLXPýVHUUYLFHyE\ýGHVLJQýFUHDWHVýYHU\ UHX0DUDýWUDIILFýSDWñýHUQVýDQGýVPD00ýRUýQRQH [LVWHQWýTXHXHVñ

3UHPLXPý VHUUYLFHy 0HYHOVý DUHy VSHFLILHGý DVý Dý GHVLUHGý SHDNý ELW0DWHñý IRUý Dý VSHFLILFý I0RZý 0RU DJJUHJDMLRQýR Iý I0RZV0ñý 7KHýXVHy FROWDFWýZLWKýMkHyQHwZRUNýLVýQRWýWRýH [FHHGýMkHySHDNýUDWHñý7KH QHwZRUNýFROWDFWýLVýMkDñýMkHyFROWDFWHGýEDQGZLGMkýZL00ýEHýDYDLODE0HyZKHQýWUDIILFýLVýVH0Wñý) LUVñKRS URXWHUVý0RUýRmKHUýHGJHyGHYLFHV0ýILOMHUýMkHySDFNHWýHQWHULQJýMkHyQHwZRUNñýVñWýMkHy 3UHPLXPýELWýRI MkrVHyWKDñýPDWfKýDý3UHPLXPýVHUUYLFHyVSHFLILFDMLRQñýDQGýSHUIRUPýWUDIILFýVKDSLQJýRQýMkHy I0RZýWKDWH VPRRmKvýD00ýWUDIILFýEXUVWýEHIRUHýMkH\ýHQWHUýMkHyQHwZRUNñý7KLvýDSSURDFKýUHTXLUHVýQRýFKDQJHVýLQ KRvñý\$ýFRPS0LDQWýURXWHUýD0RQJýMkHySDMkýQHGGVñýZRY0HYHOVýR IýSULRULWñýTXHXHLQJñýVH0GLOJýD00ýSDFNHW ZLWKýMkHy 3UHPLXPýELWýVñWý%HVñ0HI IRUWýWUDIILFýLVýXQPDUNHGýDQGýTXHXHGýDQGýVHQWýDñýMkHy0RZHU SULRULWñý 7KLvýUHvX0WñýLQýWZRY ùYLUWXD0ýQHwZRUNV0ñýRQHýZKLfKýLVýLGHQMLFD0ýWRýWRGD\@ý, QMHUQHWýZLWK EXITHUVýGHVLJQHGýWRýDEVREýWUDIILFýEXUVWñýDQGýRQHýZKHUHýWUDIILFýLVý0LPLWHGýDQGýVKDSHGýWRýD FROWDFWHGýSHDN0UDWHñýEXWýSDFNHWýPRYHyMkURXJKýDýQHwZRUNýR IýTXHXHVýZKHUHýMkH\ýH [SHULQHfH D0PRVñýQRýTXHXHLQJýGH0D\ñý

, QýMkLVýDUFKLMHFVXUHñýIRUZDUGLQJýSDWkýGHFLVLRQVýDUHyPDGHýVHSDUDWH0\ýDQGýPRUHýVLP0\ýMkDQýMkH VñWMLQJýXSýRýMkHyVHUUYLFHyDJUHHPHQWýDQGýWUDIILFýSURIL0HVñý: LMKýMkHyH [FHSMLRQýR IýSR0FLQJýDQG VKDSLQJýDñýDGPQLQLWUDMLYHyRúý0WUXVñýERXQGDUHVñýMkHyR00\ýDFMLRQVýWKDñýQHGGýWRýEHýK0G0HGýLQýMkH IRUZDUGLQJýSDWkýDUHyWRýF0DVVL\ýDýSDFNHWýLQWRýRQHýR IýWZRYTXHXHVýRQýDýVLOJ0HyELWýDQGýWRýVHUUYLFHyMkH WZRYTXHXHVýXVLQJýVLP0HySULRULWñý6KDSLQJýPXVñýLQF0XGHýERWñýUDWHýDQGýEXUVWýSDUDPHUñýVñWýMkHy0DWHU LVýH [SHFwñýWRýEHýVPD00ñýLQýMkHyRQHýRúýWZRY SDFNHWýUDQJHy 3R0FLQJýDñýERXQGDULHVýHQIRUFHVýUDWH FRPS0LDQFHñýDQGýPD\ýEHýLPS0HPHQWHGýE\ýDýVLP0HyWRNHQýEXFNHñý7KHýDGPVLVLRQýDQGýVñW0XS SURFHGXUHVýDUHyH [SHFwñýWRýHYR0YñýLQýMLPHñýWRýEHýG\QDPLFD00\ýFRQILJXUDE0HyDQGýIDL00\ýFRPS0H [ZKL0HyMkHyPHFKDQLVPVñýLQýMkHyIRUZDUGLQJýSDWkýUHfPDLQVLP0Hy

\$ý 3UHPLXPý VHUUYLFHy EXL0Wý RQý MkLVý DUFKLMHFVXUHý FDQý EHý GHS0R\HGý LQý Dý XVHIX0ý ZD\ý RQFHý Mkh IRUZDUGLQJýSDWkýPHFKDQLVPVýDUHyLQýS0DFHyE\ýPDNLQJýVMDWLFýD00RFDMLRQVñý7UDIILFýI0RZVýFDQýEH GHVLJQDWHGýIRUýVSHFLD0ýWHDWPHQWýMkURXJKýQHwZRUNýPDQDJHPHQWýFRQILJXUDMLRQñý7UDIILFýI0RZVýVKRX0G EHýGHVLJQDWHGýE\ýMkHyVRXUFHñýMkHyGHVWLODMLRQñýRúýDQ\ýFRPELQDMLRQýR IýILH0GýLVýMkHySDFNHWýKHDGHUñ)LUVñKRSý0RUý0HD10ýURXWHUVýZL00ýILOMHUýI0RZVýRQýD00ýRúýSDUñýR IýMkHyKHDGHUýMkX0HyFRQVLVMLQJýR IýMkH VRXUFHy, 3ýDGGUHVVñýGHVWLODMLRQý, 3ýDGGUHVVñýSURWRFR0ýLGHQMLILH0ñýVRXUFHySRUñýQXP EHUñýDQGýGHVWLODMLRQ SRUñýQXP EHUñý%DVHGýRQýMkLVýF0DVVLILFDMLRQñýDýILUVñKRSýURXWHUýSHUIRUPýWUDIILFýVKDSLQJýDQGýVñWñýMkH GHVLJQDWHGý 3UHPLXPýELWýR IýMkHySUHFHGQHfHyILH0Gñý(QG0KRvñýDUHyMkXVýQRWýUHTXLUHGýWRýEH ùGLI THUHQMLDWHGýVHUUYLFHyDZDUHñýMkRXJKýLIýDQGýZKHQýHQG0V\ñWHPVýEHFRPHýXQLYHUVD00\ý0DZDUHñ Mkh\ýPLJKWýGRýMkHLUýRZQýVKDSLQJýDQGýILUVñKRSýURXWHUVýPHUñý0\ýSR0LFHñ

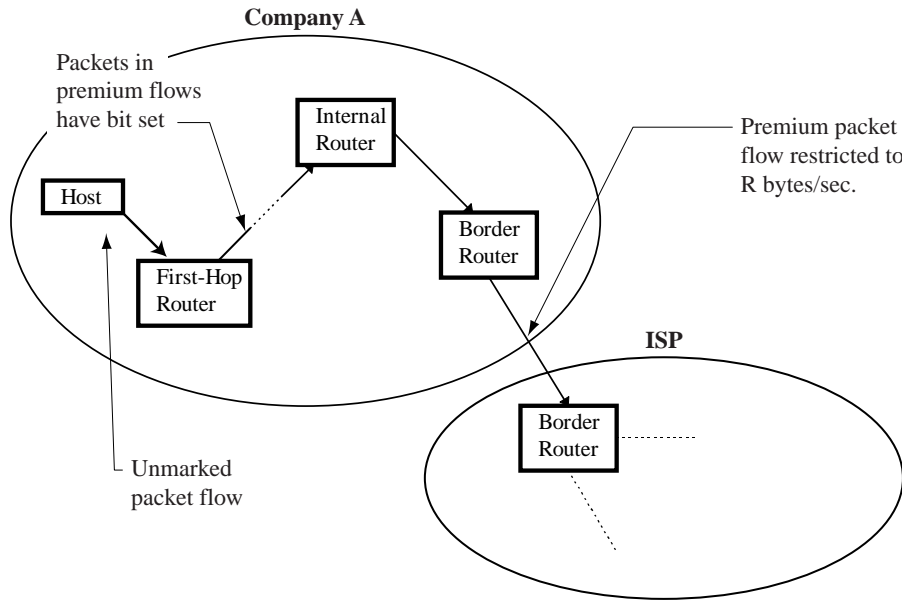
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)LJXUHýi ij3UHPLXPýWUDIILFýI0RZýIURPýHQGðKRVMýWRýRUJDQL]DMLRQðVý, 63j



ëriëý7ZRðELWýGLI IHUHQWLDWHGýVHUUYLFHVýDUFKLWHFWXUH

&0DUN@ýDQGY-DFREVRO@ýVSURSRVD0ýDUHyPDUNHG0ýýVLP0DUýLQýWKHy0RFDMLRQýDQGY\N\SHýRiýIXQFMLRQD0
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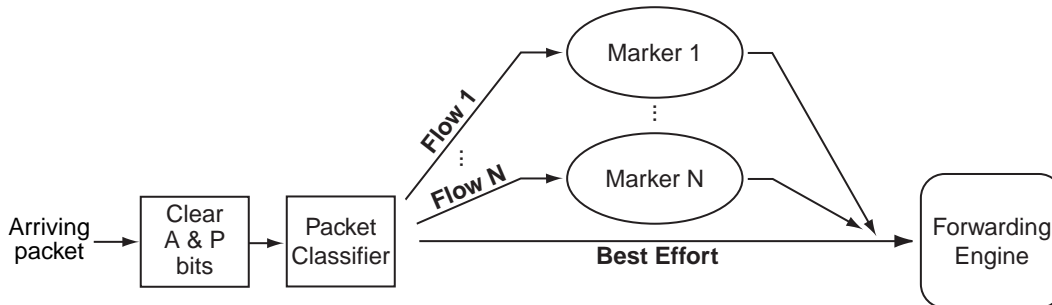
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/HDlyURXWHUyDUHyFRQILJXUHgyZLWKyDyWJDIILFySURIL0HyIRUyDySDUMLFX0DUyI0RZyEDVHGyRQyLWY SDFNHW KHDGHUy7KLvyIXQFMLRQD0LW\yKDVyEHHQyGHILQHGyE\yWKHy5693y: RUNLQJy*URXSyLQy5)&yëëiëiy)LJXUHye VKRZVyZKDWyKSSHQVYWRyDySDFNHWyWKDHyDUULYHVyDWYWKHy0HDIdyURXWHUyEHIRUH yLVySDVVGyWRyWKHyIRUZDUGLQJ HQJLQHny\$00yDUULQJySDFNHWyPXVWYKDYHyERWKyWKHy\$ðELWYDQGyWKHy3ðELWYF0HDUHgyDIWHUyZKLFKySDFNHWyDUH F0DVVILHGyRQyWKHLUyKHDGHUy, IyWKHyKHDGHUyGRHVyQRWY PDMFkyDQ\yFRQILJXUHgyYD0XHVnyLVyLPLPHGLDWH0\ IRUZDUGHyODMFKHyI0RZVySDVYyWKURXJKyLQGLYLGX0yODUNHUyWKDHyKDYHyEHHQyFRQILJXUHgyIURPyWKH XVDJHySURIL0HyIRUyWKDHyI0RZayVHUUYLFHyF0DVVY03UHPLXPyRy\$VXUHG0nyUDHy0SHDNyIRUy3UHPLXPni ùH[SHFVHGyIRUy\$VXUHG0nyDQGySHUPLVLE0HyEXUVWYVL]Hy0PD\yEHyRSMLRQD0yIRUy3UHPLXP0ny\$VXUHGyI0RZ SDFNHWyHPUJHyIURPyWKHyODUNHyZLWKyWKHLUy\$ðELWYVHWY ZKHQyWKHyI0RZyLVyLQyFRQIRUPDQFHyWRyLW 3URIL0HyEXWYWKHyI0RZyLVyRWKHUZLVHyXQFKDQJHy)RyDy3UHPLXPyI0RZnyWKHyODUNHyZL00yKR0GySDFNHW ZKHQyQHfVVDU\yWRyHQIRUFHyWKHLUyFRQILJXUHgyUDWHy7KVy3UHPLXPyI0RZySDFNHWyHPUJHyIURPyWKH ODUNHyLQyDyVKDSHyI0RZyZLWKyWKHLUy3ðELWYVHWY0, WYLVySRVLE0HyIRUy3UHPLXPyI0RZySDFNHWyWRyEH GURSSHGyLQVLGHyRi yWKHyODUNHyDVyZHyGHVFULEHyEH0RZiy3DFNHWyDUHySDVVGyWRyWKHyIRUZDUGLQJyHQJLQH ZKHQyWKHyHPUJHyIURPyODUNHy3DFNHWyWKDHyKDYHyHLKHyWKHLUy3yRy\$yELWYVHWY ZHyZL00yUHIHyWRyDV ODUNHySDFNHWy

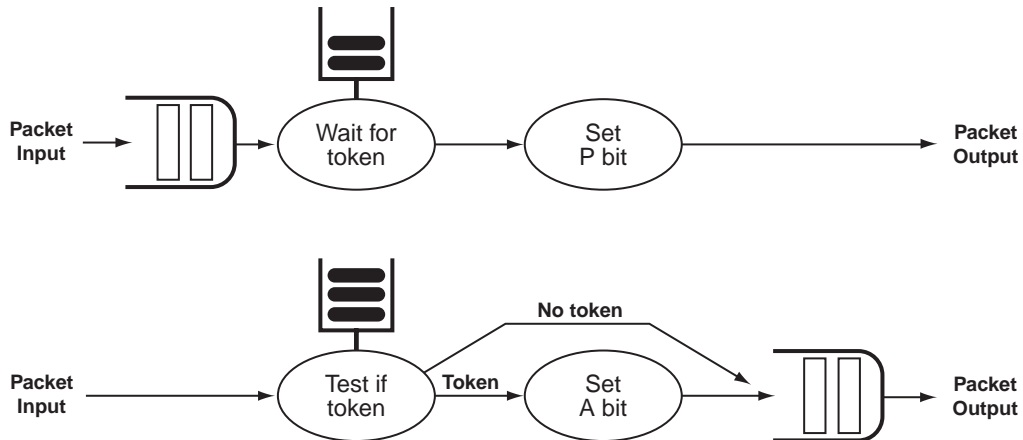
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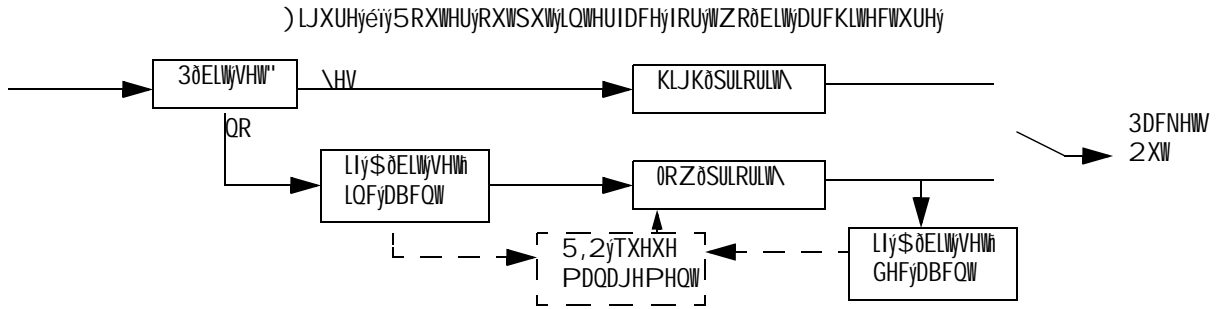
GHSWKý P XVWý EHýOLPLWHGýWRýMKHyHTXLYD0HQWýRiýRQ0ýRQHyRUýWZ RýSDFNHWýiô: HyVXJJHVWýDýGHSWKýRiýRQH SDFNHWýLQýHDO\ýGHSOR\PHQWýiôj: KHQýDýWRNHQýLVýSUHVHQWý\$VWXUHGýI0RZýSDFNHWýKDYHyMKHLUý\$ðELWýVHW WRýRQHýRWKHU ZLVHyMKHySDFNHWýLVýSDVHGýWRýMKHyIRUZDUGLQýJýHQJLQHiý) RUý3UHPLXPðFRQILJXUHGýODUNHUñ DUULYLQJýSDFNHWýWKDýVHHýDýWRNHQýSUHVHQWýKDYHyMKHLUý3ðELWýVHWýDQGýDUHyIRUZDUGHGñEXWýZKHQýQR WRNHQýLVýSUHVHQWý3UHPLXPýI0RZýSDFNHWýDUHyKH0GýXQMLQýDýWRNHQýDUULYHVý, IýDý3UHPLXPýI0RZýEXUVW HQRXJKýWRýRYHU I0RZýWKHyKR0GLQJýTXHXHyLVýSDFNHWýZL00ýEHýGURSSHGý7KRXJKýWKHyI0RZýVHWýXSýGDWD FDQýEHýXVHGýWRýFRQILJXUHýDýVL]Hy0LPWýIRUýMKHyKR0GLQJýTXHXHy0MLVýZRX0GýEHýMKHyPHDQLQJýRiýDýEXUVW LQý3UHPLXPýVHUYLFHñýLVýLVýQRWýQHFWVDU\ý8QFRQILJXUHýKR0GLQJýTXHXHyVKRX0GýEHýFDSDE0HyRI KR0GLQJýDýOHDVWýWZ RýEDQGZLGWKðGH0DýSURGXFWýDGHTXDWHýIRUý7&3ýFRQHFWRQVý\$ýVPD00HýYD0XH PLJKHyEHýXVHGýWRýVXLWýGH0DýJUHTXLUHPHQWýRiýDýVSHFLILFýDSS0LFDMLRQí

)LJXUHýëiýODUNHUVýWRýLPS0HPHQWýMKHyWZRýGLI THUHQWýVHUYLFHVý



, QýSUDFWLFHyMKHyWRNHQýEXFNHWýVKRX0GýEHýLPS0HPHQWýLQýE\WVýDQGýDýWRNHQýLVýFRQVLGHUHGýWRýEH SUHVHQWýLIýWKHyQXPEHýRiýE\WVýLQýWKHyEXFNHWýLVýHTXD0ýRUýODUJHUýWRýWKHyVL]HyRiýWKHySDFNHWý)RU 3UHPLXPýWKHyEXFNHWýFDQýRQ0ýEHýD00RZHGýWRýI00ýWRýMKHyPD[LPXPýSDFNHWýVL]HýZKL0Hý\$VWXUHGýPD\ I00ýWRýMKHyFRQILJXUHýEXUVWýSDUDPHWUý3UHPLXPýWUDIILFýLVýKH0GýXQMLQýDýVXIILFLHQWýE\WVýFUHGLWýKDV DFFXPXDWHGýDQGýWKLVýKR0GLQJýEXIIHUýSURYLGHVýMKHyRQ0ýUHD0ýTXHXHyMKHyI0RZýVHVýLQýWKHyOHWZRUNi)RUý\$VWXUHGýWUDIILFýZHyMKVWýVHWýLIýWKHyE\WVýLQýWKHyEXFNHWýDUHyVXIILFLHQWýIRUýMKHySDFNHWýVL]HyDQGýVHW \$ýLIýVRý, IýQRWýMKHyRQ0ýGLI THUHQFHyLVýWKDý\$ýLVýQRWýVHWý\$VWXUHGýWUDIILFýJRHVýLQWRýDýTXHXHyIR00RZLQJ WKLVýVWHSýDQGýSRWHQMLD00ýVHVýDýTXHXHyDýHYHUýKRSýD0RQJýLVýSDWKí

(DFKýRXWSXWýLQWUIDFHýRiýDýURXWUýP XVWýKDYHyWZRýTXHXHyDQGýP XVWýLPS0HPHQWýDýVHWýRQýMKHy3ð ELWýWRýVH0HFVýDýSDFNHWýRXWSXWýTXHXHy7KHýWZRýTXHXHyP XVWýEHýVHUYLFHGýE\ýVLPS0HySULRULWñ 3UHPLXPýSDFNHWýILUVWý(DFKýRXWSXWýLQWUIDFHýP XVWýLPS0HPHQWýMKHy5('ðEDVHGý5,2ýPHFKDQLVP GHVFULEHGýLQý>ë@RQýMKHy0RZHUýSULRULWýTXHXHy5,2ýXVHVýWZRýMKUHVKR0GVýIRUýZKHQýWRýEHJLQýGURSSLQJ SDFNHWýDý0RZHUýRQHyEDVHGýRQýWRND0ýTXHXHyRFFXSDQFýIRUýRUGLQDUýEHVWýHIIRUWýWUDIILFýDQGýRQHyEDVHG RQýWKHyQXPEHýRiýSDFNHWýHOTXHXHGýWKDýKDYHyMKHLUý\$ðELWýVHWý7KLVýPHDQVýWKDýDQýDFMLRQ SUHTUHQMLD0ýWRý\$VWXUHGýVHUYLFHyWUDIILFýZL00ýRQ0ýEHýMDNHQýZKHQýMKHyTXHXHyFDSDFLWýH[FHHGýVWKH MKUHVKR0GýYD0XHýIRUýRUGLQDUýEHVWýHIIRUWýVHUYLFHiý,QýWKLVýFDVHýRQ0ýXQPDUNHGýSDFNHWýZL00ýEH GURSSHGýXVLQJýMKHy5('ýD0JRULWK P0ýXQ0HVýMKHyMKUHVKR0GýYD0XHýIRUý\$VWXUHGýVHUYLFHyLVýD0VRýUHDFKHGí .HHSLQJýDQýDFFXUDWýFRXQWýRiýWKHyQXPEHýRiý\$ðELWýSDFNHWýFXUHQW\ýLQýDýTXHXHyUHTXLUHVýHLWKHU WHVWLQJýMKHy\$ðELWýDýERWKýHQW\ýDQGýH[LWýRiýMKHyTXHXHyRUýVRPHýDGGLWRQD0ýVMDWýLQýMKHyURXWUý)LJXUHýE LVýDýE0RFNýGLDJUDPýRiýMKHyRXWSXWýLQWUIDFHýIRUýD00ýURXWUý

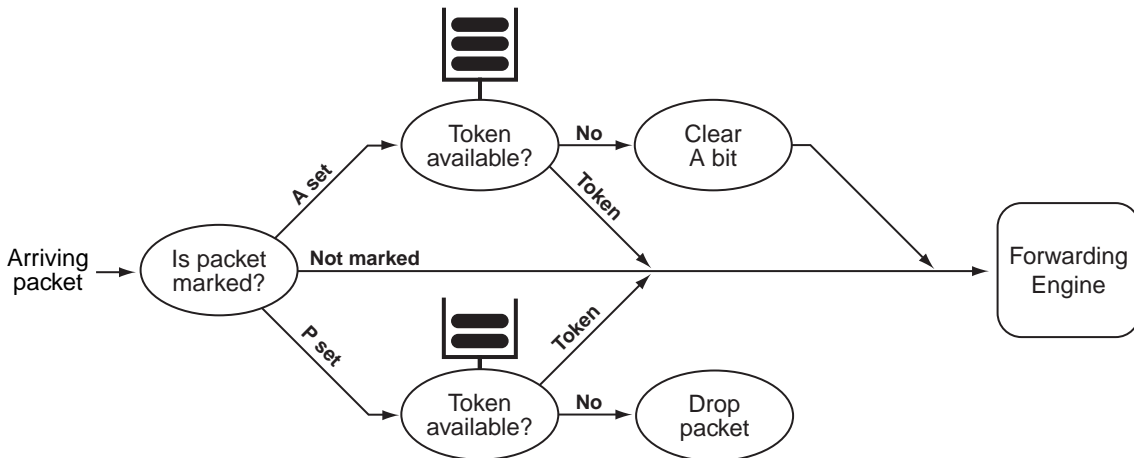


7KHýSDFNHWýRXWSXWýRIýDý0HD IýURXWHUýLVýWKXVýDýVKDSHGýVMUHD PýRIýSDFNHWýZLWKý3ðELWýVHWýPLQJ0HG ZLWKýDQýXQVKDSHGýEHVWýHIIRUWýVMUHD PýRIýSDFNHWýVRPýRIýZKLFKýPDýKDYHý\$ðELWýVHWý3UHPLXP VHUUYLFýF0HDU0ýFDQQRWýVNDUYHýEHVWýHIIRUWýWUDIILFýEHFDXVHýLWýLVýERNKýEXUVWýDOGýEDQGZLGWKýFROUUR00HGý \$VXUHGýVHUUYLFýPLJKWýUH0ýRQ0ýRQýDýFROVHUÝDMLYHýD00RFDMLRQýWRýSUHYHQWýVNDUYDMLRQýRIýXQPDUNHG WUDIILFýEXWýEXUVWýRIý\$VXUHGýWUDIILFýPLJKWýWKHQýF0RVHýRXWýEHVW0HIIRUWýWUDIILFýDWýERNW0HQHFñýTXHXHV GXULQJýFROJHVWLYHýSHULRGvi

\$IWHUý>éñýZHyGHVLJQDWHýWKHyIRUZDUGLQJýSDWKýREMFWýWKDWýWHVWýI0RZVýDJDQVWýWKHLUýXVDJHýSURIL0HV ù3URIL0HyOHWHUVüiý%RUGHUýURXWHUýZL00ýUHTXLUHý3URIL0HyOHWHUVýDWýWKHLUýLQSWXWýLQWHUIDFHVý7KHýEL0DWHUD0 DJUHHPHQWýEHWýZH0QýDGMDFHQWýDGPLQLWUDMLYHýGRPDQVýPXVWýVSHFLIýDýSHDNýUDWHýRQýD00ý3ýWUDIILFýDQGýD UDWHýDQGýEXUVWýIRUý\$ýWUDIILFýDQGýSRVVE0ýDýVNDUWýMLPýDQGýGXUDMLRQý\$ý3URIL0HyOHWHUýLVýUHTXLUHGýDW WKHyLQJUHVVýRIýDýWUXVWýUHJLRQýWRýHQVXUHýWKDWýGLITHUHQMLDWHGýVHUUYLFýSDFNHWýI0RZVýDUHýLQýFRPS0LDQFH ZLWKýWKHLUýDJUHHGðXSROýUDWHvi 1RQðFRPS0LDQWýSDFNHWýRIý3UHPLXPýI0RZVýDUHýGLVFDUGHGýZKLOHyQRQð FRPS0LDQWýSDFNHWýRIý\$VXUHGýI0RZVýKDYHýWKHLUý\$ðELWýUHVHWý)RUýH[DPS0HñLQýILJXUHýññLIýWKHy, 63 KDVýDJUHHGýWRýVXS0ý&RPSDQý\$ýZLWKýUýE\WHVýVHFýRIý3UHPLXPýVHUUYLFñý3ðELWýPDUNHGýSDFNHWýWKDW HQWHUýWKHy, 63ýWKURXJKýWKHy0LQñIURPý&RPSDQý\$ýZL00ýEHýGURSSHGýLIýWKHýH[FHHGýUý, IýLQVH0GñýWKH VHUUYLFýLQýILJXUHýññZDVý\$VXUHGýVHUUYLFñýWKHySDFNHWýZR0GýVLP\$0ýEHýXQPDUNHGñýIRUZDUGHGýDV EHVWýHIIRUWý

7KHýVLP\$0HñýERUGHUýURXWHUýLQSWXWýLQWHUIDFHýLVýDý3URIL0HyOHWHUýFROVWUXFWHGýIURPýDýWRN0QýEXFNHW FRQILJXUHýZLWKýWKHyFROUWDFHGýUDWHýDFURVVýWKDWýLQJUHVVý0LQñVHHýILJXUHýéñý(CFKýW\SHñý3UHPLXPýRU \$VXUHGñýDQGýHDFKýLQWHUIDFHýPXVWýKDYHýLWýRZQýSURIL0HyPHWHUýFRUHVSRQGLQJýWRýDýSDUMLFX0DUýF0DVV DFURVVýDýSDUMLFX0DUýERXQGDUýññ7KLýLVýLQýFROUWVWýWRýPRGH0VýZKHUHýHYHUýI0RZýWKDWýFURVVHVýWKH ERXQGDUýPXVWýEHýVHSDUDWH0ýSR0LFHGýDQGýRUýVKDSHGññ7KHýH[DFWýPHFKDQLVPýUHTXLUHGýDWýDýERUGHU URXWHUýLQSWXWýLQWHUIDFHýGHS0GýRQýWKHyD00RFDMLRQýSR0LFýGHS0R\HGáýDýPRUHýFRPS0H[CýDSSURDFKýLV SUHVH0WHGýLQýVHFILRQýéñý

) LJXUHjeyi%RUGHUyURXWHUyLQSDXWjLQWHUIDFHy3URILOHjOHWHUVy



ęjyOHFKDQLVPV

ęit y) RUZDUGLQJy3DWKy3ULPLWLYHV

6HFVLRQy ęięyLQWURGXFGyWKHy IRUZDUGLQJy SDWKy REMFWy RIy ODUNHUVy DQGy 3URILOHj OHWHUVy , Qy WKLV VHFVLRQy ZHy VSHFLI \y WKHy SULPLWLYHy EXLOGLQJy EORFNy UHTXLHGyWRy FRPSRVHyWKHPy 7KHy SULPLWLYHy DUHa JHQHUDy FODVVLILHujy ELWSDWWHUQy FODVVLILHujy ELW VHWWHUjy SULRULWjy TXHXHVjy SRðLFQJy WRNHQy EXFNHWy DQG VKDSLQJy WRNHQy EXFNHWy 7KHVHy SULPLWLYHy FDQy FRPSRVHy Dy ODUNHujy ðHLWKHy Dy SRðLFQJy RUj Dy VKDSLQJ WRNHQy EXFNHWy SðXVj Dy ELWj VHWWHUjy DQGy Dy 3URILOHj OHWHUjy ðDy SRðLFQJy WRNHQy EXFNHWy SðXVj Dy GURSSHUjy RUj ELW VHWWHUjy

* HQHUDy & ðDVVLILHujy / HDIy RUj ILUVWKRy URXWHUVy PXVWj SHUIRUPy Dy WUDQVSRUWðHYHy VLJQDWHUVy PDWFKLQJ EDVHGy RQy Dy WXSDHyLQyWKHy SDFNHWjy KHDGHUjy Dy IXQFVLRQDðLWjy ZKLFKyLVySDUWjy RIyDQy 5693ðFDSDEHyURXWHUjy \$Vy GHVFULEHGy DERYHjy SDFNHWjy ZKRVHy WXSDHy PDWFKy RQHy RIy WKHy FRQILJXUHgy IORZVy DUHy FRQIRUPDQFH WHVWHGy DQGy KDYHyWKHy DSSURSULDWHyVHUYLFHyELWjVHWWHUjy 7KLVy IXQFVLRQyLVyPHPRU \ðyDQGySURFHVVLQJðLQWQVLYHy EXWjLVjNHSWjDyWKHyHGJHVjyRIyWKHyQHYZRUNjy ZKHUHyWKHUHyDUHyIHZHyIORZVi

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%LVjVHWWHUjy 7KH \$ðELWjDQGy 3ðELWj PXVWjEHyVHWjyRUjFðHDUHgyLQyVHYHUDySDFHVjy \$yIXQFVLRQDyEORFNyWKDW VHWjyWKHyDSSURSULDWHyELWjyRIyWKHy , 3yKHDGHUjyWRyDyFRQILJXUHgyELWSDWWHUQyZRXGyEHyWKHyPRVWjyJHQHUDjy

3ULRULWjyTXHXHVjy (YHUjy QHWZRUNy HðPHQWjy PXVWj LQFðXGHy ðDy ðHDVWjy WZRy ðHYHðVjy RIy VLPSðHy SULRULW TXHXHLQJy 7KH KLJKy SULRULWjy TXHXHy LVj IRUj WKHy 3UHPLXPy WUDIILFy DQGy WKHy VHUYLFHy UXðHy LVj WRy VHQG SDFNHWjy LQy WKDy TXHXHy ILUVWjy DQGy WRy H[KDXVLRQy 5HFDðy WKDy 3UHPLXPy WUDIILFy PXVWj QHYHy EH RYHUVXEVFULEHGjyWKXVj3UHPLXPyWUDIILFyVKRXGyVHHyðLWðHyRUyQRyTXHXHy

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VMDQGDUGyZRUNy

ejy' LVFXVLRQ

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VFKHGXLQJyFRX0GyEHyDGGHyIRUy3dELWYWUDIILFyDQGyPRUHy0HYH0VYRlyGURSySULRULWYFRX0GyEHyDGGHyIRUy\$
ELWYWUDIILFyLlyH[SHULHQFHyVKRZVYWKHPyWRyEHyQHFHVVDU\yDQGySURFHVVLQJyVSHHGyDUHyVXIILFLHQWY: H
SUSRVHyWKDyWKHyVHUUYLFHyGHVULEHGyKHUHyEHyFRQVLGHUHGyDVy0Dy0HDVWYVHUUYLFHy7KXVnyDyQHWZRUN
H0HPHQWYVKRX0GyDy0HDVWYEHyFDSDE0HyRlyPDSSLQJyD00y3dELWYWUDIILFyWRy3UHPXPYVHUUYLFHyDQGyRlyPDSSLQJ
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GLIITHUHQML\y,ly\$VXUHGyVHUUYLFHyLVyQRWYXVHGnyYHU\y0LW0HyLVy0RVWny\$y5('dPDQDJHGyEHVWYHIIRUWYTXHXH

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ëiy7KH\$UFKLMHFVXUD0y) UDPHZRUNyIRUyODUNHGy7UDIILFy\$00RFDMLRO

7KXVYIDUyZHyKDYHyIRFXVHGyRQyMKHyVHUUYLFHyGHILQMLRQVYDQGYMKHyIRUZDUGLQJySDWkyPHFKDQLVPIy: H QRZyWXUQyWRyMKHySURE0HPyRiyD00RFDMLQJyMKHy0HYH0yRiyODUNHGyWUDIILFyMKURXJKRXWYMKHy, QMHUQHñy: H REVHUyHyWKDwyPRVWYRUJDQL]DMLRQVYKDYHyIL[HGySRUMLRQVYRiyMKHLyEXGJHWñyLQFOXGLQJyGDWD FRPPXQLFDMLRQVñyWKDwyDUHyGHUHUPLQHGyRQyDQyDQXQD0yRyTXDUWU0\yEDLVñy6RPHyDGGMLRQD0yPRQLHV PLJKWYEHYDWMDFKHGyWRyVSHFLILFySURMFWñyIRUyGLVFUMLRQDU\yFRVWYMKDyDULVHyLQyMKHyVKRUWUñyVHUyPiy, QyWXUQñ VHUUYLFHySURYLGHyV0, 63VYDQGY163V0yPXVWYGRYMKHLyS0DQQLQJyRQyDQXQD0yDQGYTXDUWU0\yEDVHyDQGYMKXV FDQQRWYEHYH[SHFVHGyWRySURYLGHyGLI THUHQMLDWHGyVHUUYLFHVySXUHO\yúRQyFD00ñy3URYLVLRQQLQJyVHWñyXSyVMDLWF 0HYH0yRiyODUNHGyWUDIILFyZKLOHyFD00yVHW0XSyFUHDWHyDQyD00RFDMLRQyRiyODUNHGyWUDIILFyIRUyDyVLOJ0H I0RZ@yGXUDMLRQy6MDLWFy0HYH0yFDQyEHySURYLVLRQHGyZLWkyVLPH0Ri0GD\yVSHFLILFDMLRQVñyEXWYFDQQRWYEH FKDQJHGyLQyUHSRQVHyWRyDyG\QDPLFyPHVVDJHy: HyH[SHFVYERWkyNLQGVyRiyEDQGZLGWkyD00RFDMLRQyWRyEH LPSRUWQWñy7KH\$UXFKDVHUyRiyODUNHGyVHUUYLFHVyDQyJHQH00\yEHYH[SHFVHGyWRyZRUNyRQy0RQJHU0WUyP EXGJHWY\F0HVyZKHUHyMKHVHyVHUUYLFHyZL00yEHYDFFRXQHGyIRUyVLP0DU0\yWRyPDQ\yLQIRUPDMLRQyVHUUYLFHV WRGD\y\$yPDL00RUGHyKRXVHyPD\yZLVKyWRySXUFKDVHyDyIL[HGyD00RFDMLRQyRiyEDQGZLGWkyLQyDQGYRXWYRiyLW ZHE0VHUyHyWRyJLYHySRM0MLD0yFXVWRPHUyDyúIDVWñyIHH0yZKHQyEURZVLOJyMKHLyVLMHy7KLVyD00RFDMLRO PLJKWYEHYEDVHGyRQyKLWYUDWHyRiyMKHySUHYLXXVYTXDUWUyRyVRPHyVRUWYRiyLQGXVWU\0EDVHGyDYHUDJHy, Q DGGMLRQñyMKHUHyQHVGyWRyEHYDyG\QDPLFyD00RFDMLRQyFDSDELOLW\yWRyUHSRQGYWRySDUMLFX0DUyHYHQWñyVXFkyDV DyGHPRQVMDLROñyDyQHWZRUNyEURDGFVWYEvDyFRPSDQ@y&(2ñyRyDySDUMLFX0DUyQHWZRUNyVHWñy) XUMKHUPRUHyDyG\QDPLFyFDSDELOLW\yPD\yEHYQHGHGyLQyRUGHUyWRyPHHWYDySUHFRRPLMHGyVHUUYLFHy0HYH0 ZKHQyMKHySDUMLFX0DUyVRXUFHyRyGHVMLQDMLRQyLVyD00RZHGYWRyEHYúDQ\ZKHUHyRQyMKHy, QMHUQHñyú' \QDPLFú FRYHUyMKHyUDQJHyIURPyDyWH0SKROHGyRyH0PDL0HGyUHTXHVWYWRyDyVLJQD00LQJyWASHyPRGH0y\$yVWUFW0\ VMDLFD00\yD00RFDMLHGyVFHODULRyLVyH[SHFVHGyWRyEHyXVHX0yLQyLQMLD0yGHS0R\PHQWYRiyGLI THUHQMLDWHG VHUUYLFHVyDQGYWRyPDNHYXSyDyPDMRUySRUMLRQyRiyMKHyODUNHGyWUDIILFyIRUyMKHyIRUVHHE0HyIXWUHñy

: LMKRWYDyúSHUyFD00ñyG\QDPLFyVHWYXSñyMKHySUHFRRQILJXULQJyRiyXVDJHySURILOHVyDQyD0ZD\yEH FRQVWXHGyDyúSD\QJyIRUyELWY\RXyGRQ@yXVHyZKHUHyMKHyWASHYRiyVHUUYLFHyLVy3UHPLXPYRy\$VXUHGi : HySUHILHyWRyMKLQYRiyMKLVyDVySD\QJyIRUyMKHy0HYH0yRiyVHUUYLFHyMKDwyRQHyH[SHFVWYWRyKDYHyDYDLODE0HyDW DQ\yMLPHñyIRUyH[DPSoHySD\QJyIRUyDyWH0SKROHy0LQHy\$yFXVWRPHUyPLJKWYSD\yDQyDGGMLRQD0yI0DñyIHHyWR KDYHyMKHySULY0HJHyRiyFD00LQJyDyZLGHy0RFD0yDUHDyIRUyQRyDGGMLRQD0yFKDUJHyRyPLJKWYSD\yEvMKHyFD00i \$0MKRXJKyDyFXVWRPHUyPLJKWYSD\yRQyDyúSHUyFD00ñyEDLVyIRUyHYHU\yFD00yPDGHYDQ\ZKHUHyLVyJHQH000\ WXUQYRXWYQRWYWRyEHYMKHyPRVWYHFRQRPLFD0yRSMLRQyIRUyPRVWYFXVWRPHUyVñy,W@ySRVLE0HyVLP0DUySULFLOJ VWXFWXUHñyPLJKWYDULVHyLQyMKHyLQMHUQHñy

: HyXVHy\$00RFDMLRQyWRyUHIHUyWRyMKHySURFHVYRiyPDNLQJyODUNHGyWUDIILFyFRPPHWPQWYDQ\ZKHUH D0RQJyMKLVyFROMLQXPyIURPyVWUFW0\ySUHD00RFDMLHGyWRyG\QDPLFyFD00yVHW0XSyDQGYZHyUHTXLUHyDQ \$00RFDMLRQyDUFKLMHFVXUHñyFDSDE0HyRiyHQFRPSDVLQJyMKLVyHQMLUHyVSHFWXPyLQyDQ\yPL[ñy: HyIXUMKHU REVHUyHyWKDwy\$00RFDMLRQyPXVWYI00RZyRUJDQL]DMLRQD0yKLH0DUFKLHVñyMKDwyLVyHDFKyRUJDQL]DMLRQyPXVW KDYHyFRPS0HWñyUHSRQVLELOLW\yIRUyMKHy\$00RFDMLRQyRiyMKHyODUNHGyWUDIILFyUHVXUFHyZLWkLQyLVyGRPDQI)LQD00\ñyZHyREVHUyHyWKDwyMKHyRQ0\yFKDQFHyRiyVXFFHVYIRUyLQFUHPHQMD0yGHS0R\PHQWY0LVHyLQyDQ \$00RFDMLRQyDUFKLMHFVXUHñyMKDwyLVyPDGHYXSyRiyELODWHUD0yDJUHHPHQWñyDVyPX0ML0DWHUD0yDJUHHPHQWYDUH PXFkyWRyFRPS0H[ñyWRyDGPLQVHUñy7KXVñyMKHy\$00RFDMLRQyDUFKLMHFVXUHñyLVyPDGHYXSyRiyDJUHHPHQW DFURVYyERXQGDULHVyDVyWRyMKHyDPRXQWYRiyODUNHGyWUDIILFyMKDwyZL00yEHYD00RZHGYWRySDVñy7KLVyLVyVLP0DU WRyúVHW0HPHQWñyPRGH0yXVHGyWRGD\i

ëit y%DQGZLGWky%URNHUyDy\$00RFDMLQJyDQGY&RQWUR00LQJy%DQGZLGWky6KDUHV

7KH\$JR0yRiyGLI THUHQMLDWHGyVHUUYLFHVyLVyFROWUR00HGyVKDULQJyRiyVRPHyRUJDQL]DMLRQ@y, QMHUQHñy

EDQGZLGMKiy 7KHý FRQWURðy FDQý EHý GRQHý LQGHSHQGHOQD\y E\y LQGLYLGXDOVny LiHiñy XVHUVy VHWy ELWöVöy LQy WKHLU SDFNHWý WRý GLVWLOJXLVKý WKHLUý PRVWý LPSRUWDQWý WUDI ILFny RÜy LWý FDQý EHý GRQHý E\y DJHQWý WKDWý KDYHy VRP H NQRZOHGJHy Rly WKHy RUJDQL]DMLRQVý SULRULMLHVý DOGý SROLFHVý DOGý D00RFDWHý EDQGZLGMKý ZLWKý UHVSFHWý WR WKRVHy SROLFHViy ý , QGHSHQGHOQWý ODEHOLQJý E\y LQGLYLGXDOVny LVý VLPSoHy WRý LPS0HPHQWý EXWý XQOLNHO\y WRý EH VXIILFLHQWý VLOFHy LWVý XQUHDVRODE0Hy WRý H[SHFWý D00ý LQGLYLGXDOVny WRý NQRZý D00ý WKHLUý RUJDQL]DMLRQVý SULRULMLHVý DOGý FXUUHQWý QHWZRUNý XVHy DOGý D0ZD\y PDUNý WKHLUý WUDIILFý DFFRUGLQJ0\iy ý 7KXVý WKLVDUFKLWHFWXUHyLVý GHVLJQHGý ZLWKý DJHQWý FD00HGý EDQGZLGMKý EURNHUVý 0%0ý>è@ny WKDWý FDQý EHý FRQILJXUHG ZLWKý RUJDQL]DMLRQD0ý SROLFHVny NHHSý WUDFNy Rly WKHy FXUUHQWý D00RFDMLRQý Rly PDUNHGý WUDIILFny DOGý LQWHUSUHW QHZý UHTXHVWý WRý PDUNý WUDIILFý LQy0LJKWý Rly WKHy SROLFHVý DOGý FXUUHQWý D00RFDMLRQý

: Hy QRWHy WKDWý VXFký DJHQWý DUHy LOKHUHQWý LQy DQ\y EXWý WKHy PRVWý WULYLD0ý QRWROVý Rly VKDULQJiy ý 1 HLWKHU LQGLYLGXDOVny QRWý WKHy URXWHUVý WKHLUý SDFNHWý WUDQVLYý KDYHy WKHy LQIRUPDMLRQý QHFHVVDU\y WRý GHFLGHý ZKLFK SDFNHWý DUHy PRVWý LPSRUWDQWý WRý WKHy RUJDQL]DMLRQiy ý 6LQFHy WKHVHy DJHQWý P XVWý H [LVWý WKH\y FDQý EHý XVHGý WR D00RFDWHý EDQGZLGMKý IRUý HQGðWRðHQGý FRQQHFWLRQVý ZLWKý IDUý 0HVý VMDWHý DOGý VLPSoHy WUXVWý UHODWLRQV KLSV WKDQý GHSOR\LOJý SHUý 10RZý RÜy SHUý 1L0WHUý JXDUDQWHVý LQy D00ý QHWZRUNý HOHPHQWý RQy DQý HQGðWRðHQGý SDMKi %Vý PDNHWý SRVLE0Hy IRUý EDQGZLGMKý D00RFDMLRQý WRý 1R00RZý RUJDQL]DMLRQD0ý KLHUDUFKLHVý DOGý LQy FROFHUW ZLWKý WKHy IRUZDUGLQJý SDWKý PHFKDQLVPý GLVFXVHGý LQy VHFMLRQý èny UHGXFHy WKHy VMDWHý UHTXLUHGý WRý VHWý XS DOGý PDQLQDQDý Dý 10RZý RYHUý DUFKLWHFWXUHy WKDWý UHTXLUHy KHFNLQJý WKHy I X00ý 10RZý KHGDGHUý DWý HYHU\y QHWZRUN HOHPHQWý 2UJDQL]DMLRQD00\y WKHy %ý DUFKLWHFWXUHyLVý PRMLYDWHGý E\y WKHy REVHUYDMLRQý WKDWý P XONL0WHUD0 DJUHHPHQWý UDUD0\y ZRUNý DOGý WKLVDUFKLWHFWXUHy D00RZVý HQGðWRðHQGý VHUyLFHVý WRý EHý FRQVWUXFHWGý RXWý Rl SXUH0\y EL0DWHUD0ý DJUHHPHQWiy %Vý RQ0\y QHHGý WRý HVWDE0LVKý UHODWLRQV KLSVý Rly 0LPLWHGý WUXVWý ZLWKý WKHLU SHHUý LQy DGMDFHQWý GRPDLOVny XQOLNHy VFKHPHVý WKDWý UHTXLUHy WKHy VHWMLQJý Rly 10RZý VSHFLILFDMLRQý LQy URXWHUV WKURXJKRXWý DOGý HQGðWRðHQGý SDMKiy , Qý SUDFWLFD0ý WFKQLFD0ý WUPVny WKHy %ý DUFKLWHFWXUHy PDNHVý LWý SRVLE0H WRý NHHSý VMDWHý RQy DQý DGPLQLVWUDILYý GRPDLOý EDVLVny UDWKHUý WKDQý DWý HYHU\y URXWHUý DOGý WKHy VHUyLFH GHILQLMLRQVý Rly 3UHPLXPý DOGý \$VXUHGý VHUyLFHy PDNHVý SRVLE0Hy WRý FRQILQHy SHUý 10RZý VMDWHý WRý MXVWý WKH 0HDly URXWHUViy

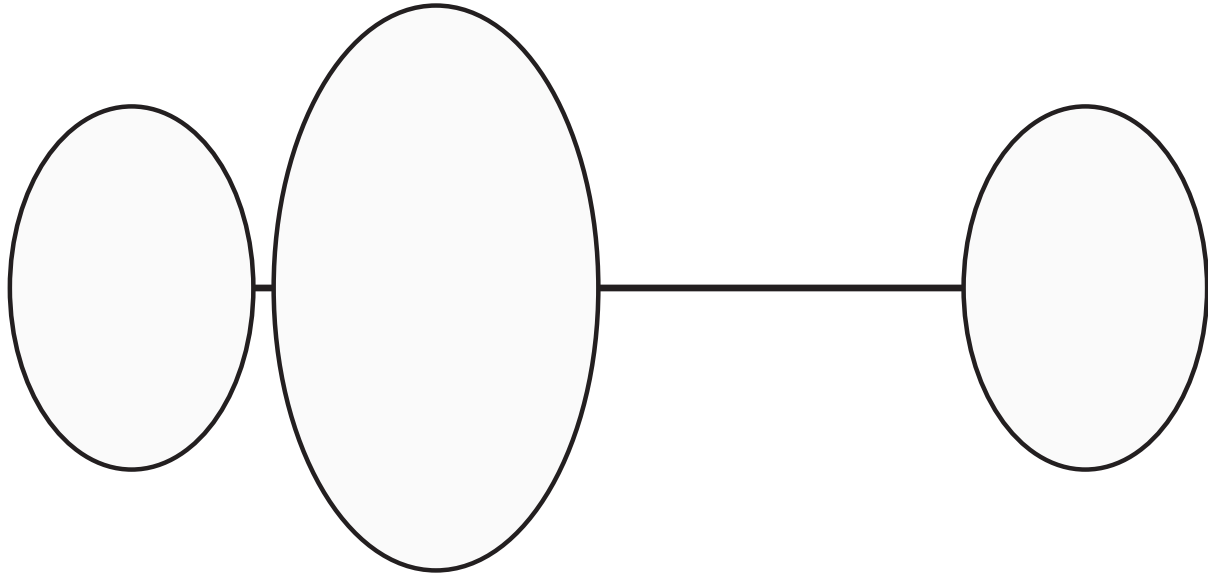
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: KHQý DQý D00RFDMLRQý LVý GHVLHGý IRUý Dý SDUWLFX0DUý 10RZny Dý UHTXHVWý LVý VHQWý WRý WKHy %ýiy 5HTXHVW LQF0XGHý Dý VHUyLFHy W\SHny Dý WDUJHWý UDWHny Dý PD[LPXPý EXUVWny DOGý WKHy WLPHy SHULRGý ZKHQý VHUyLFHy LV UHTXLUHGiy 7KHý UHTXHVWý FDQý EHý PDGHý PDQXD00\y E\y Dý QHWZRUNý DGPLQLVWUDWRUý Rly Dý XVHUý Rly LWý PLJKW FRPHý 1URPý DQRWKHUý UHJLRQ0ý %ýiy \$ý %ý ILUVWý DXWKHQMLFDWHVý WKHy FUHGQMLD0Vý Rly WKHy UHTXHVWUñy WKHQ YHULILHVý WKHUHyH [LVWý XQD00RFDWHGý EDQGZLGMKý VXIILFLHQWý PRVWý WKHy UHTXHVWý , ly Dý UHTXHVWý SDVVHy WKHVH WHVWny WKHy DYDLODE0Hy EDQGZLGMKý LVý UHGXFHGý E\y WKHy UHTXHVWGHGý DPRXQWý DOGý WKHy 10RZý VSHFLILFDMLRQý LV UHFURUGHy , Qý WKHy F0DVHy ZKHUHý WKHy 10RZý KDVý Dý GHVWLQDMLRQý RXWVLGHý WKLVDý WUXVWý UHJLRQny WKHy UHTXHVWý P XVW

i i , QMLD00\iy 7KLVý FDQý EHý H [SDQGHGý WRý Dý KLHUDUFK\y Rly %Vý ZLWKLQy Dý GRPDLOy EXWý RQ0\y WKHy WRSý 0HY0ý %ý ZRX0Gý EHý UHVSROVLE0Hy IRUý FRPPXQLFDMLQJý DFFURVý GRPDLOy ERXQGDULHViy

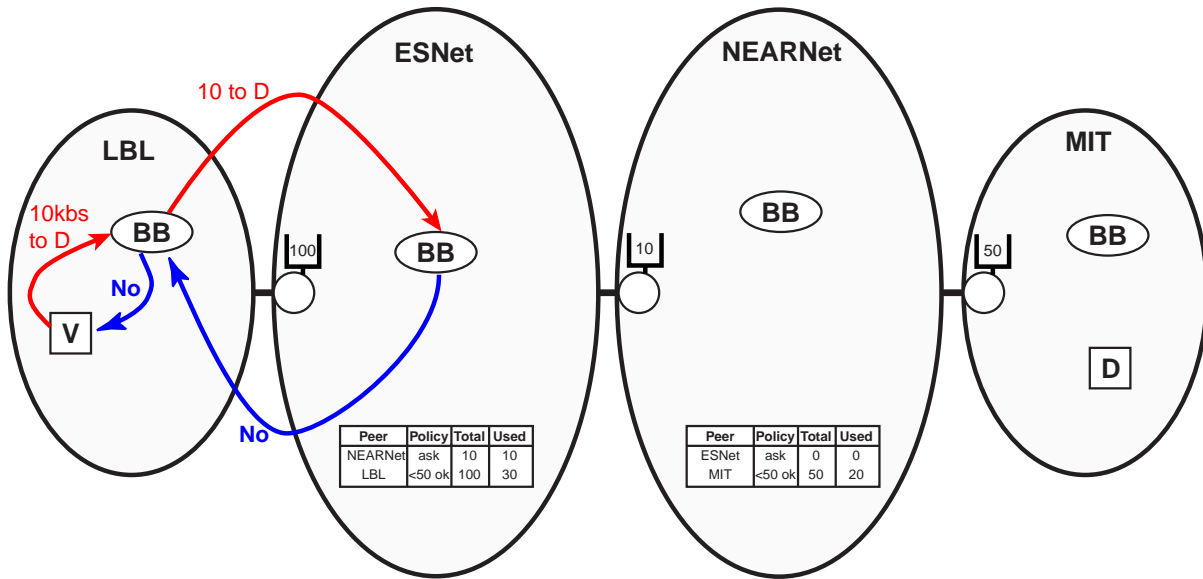
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) LJXUHýæíý (QGðWRðHOGýH[DPS0HyZLWKýVWDMLFýD00RFDMLRQí



&RQVLGHUý WKHy VDPHy H[DPS0Hy ZKHUHý WKHy (61HWð%%ý ILOGVý D00ý RÍý LWý ODUNHGý D00RFDMLRQý WR 1 (\$51HWñý ñí ýNESVñýLQýXVHíý: LNKýVWDMLFýD00RFDMLRQñý (61HWýPXVWýWUDQVPLWýDýúQRúýWRýWKLVýUHTXHVW EDFNýWRýWKHy /%/ð%%ýý 3UHVVPE0\ñýWKHy /%/ð%%ý ZRX0GýUHFRUGýWKLVýLQIRUPDMLRQýWRýFRPS0DLQýWR (61HWýDERXWýWKHyRYHUERRNLQJýDWýWKHyHQGýRÍýWKHyPROWñý2QHýVR0XMLRQýWRýWKLVýVRUWýRÍýúEXV\ýVLJQD0úýLV IRUý (61HWýWRýJHñýEHWHUýDWýDQWFLSDMLQJýLWýFXVMRPHUVýQHGGVýRUýUHTXLUHy0RQJýDGYDQFHýERRNLQJýIRU HYHU\ýTORZñýEXWýLWVýD0VRýSRVLE0HyIRUýEDQGZLGMýEURNHUJDJHyGHFLVLRQVýWRýEHFRPHýG\QDPLFíý

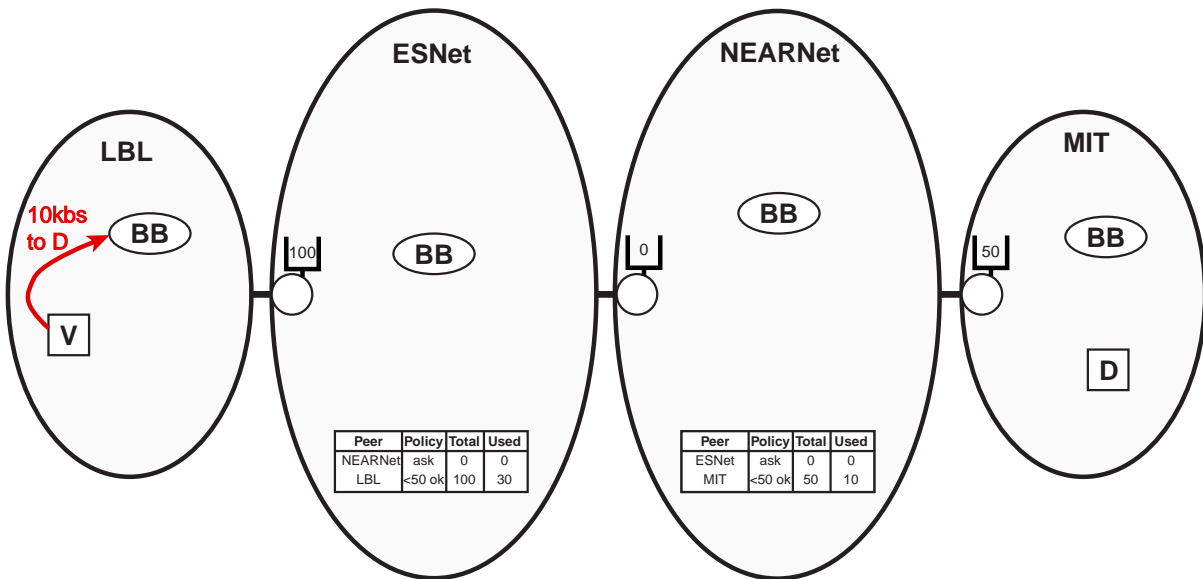
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' \QDPLFy\$00RFDWLRQyDQGyDGGLWLRQD0yPHFKDQLVP'iy\$Vy ZHy VKD00y VHHñy G\QDPLFy D00RFDWLRQy UHTXLUHV PRUHj FRPS0H [y %Vj DVy ZH00y DVy PRUHj FRPS0H [y ERUGHUj SR0FLQJñy LQF0XGLQJy WKHy QHFHVVLW\j WRy NHHS PRUHjVNDWHiy + RZHYHUñLWjHQDE0HVyDQyLPSRUWDQWjVHUYLFHyZLWKyDyVPD00yLQFUHDVHyLQyVNDWHi

7KHj QH [Wj VHHñ Rty ILJXUHj ðVNDUMLQJy ZLWKy ILJXUHj ä0y VKRZy ZKDWj KDSSHQVjLQyWKHy FDVHy Rty G\QDPLF D00RFDWLRQiy \$Vy EHIRUHñy 9yUHTXHVWjti í NESVjWRyND0NjWRy' yDWjO, 7iy6LQFHjWKHyD00RFDWLRQyLVyG\QDPLFñWKH ERUGHUj SR0LFHUVjGRyQRWj KDYHyDy SUHVHñy YD0XHñyLQVWHDGy EHLQJy VHHñWRyUHI0HFWjWKHyFXUUHQWj SHDNy YD0XHjRI ODUNHGyWUDIILFySHUPLWWHGyWRyFURVVñKDWjERXQGDU\iy 7KHjUHTXHVWjLVyVHQWjWRyWKHy/%/ð%iy

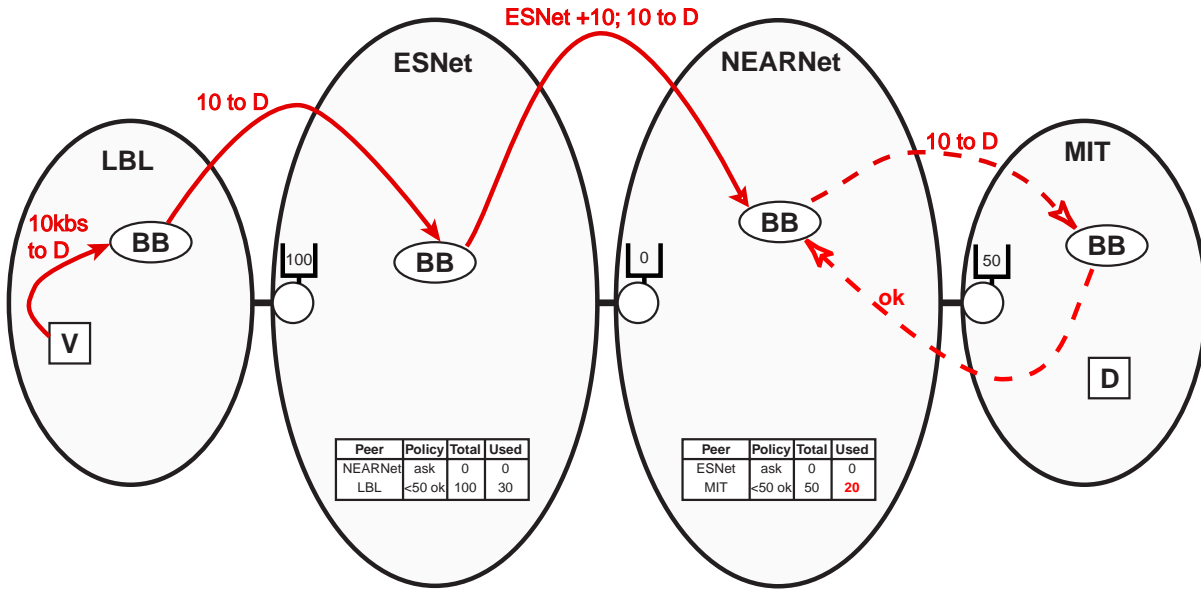
) LJXUHjäij) LUVWjVHHSyLQyHQGðWRðHQGyG\QDPLFyD00RFDWLRQyH [DPS0H



,QyILJXUHjti í ñyQRWHñWKDWj (61HWjKDyVjQRyD00RFDWLRQyVHHñXSñWRy1 (\$51HWj7KLvV\WHPyLVyFDSDE0HyRI G\QDPLFyD00RFDWLRQyLQyDGGLWLRQyWRyVNDMLFñyVRyLWjDVNVj1 (\$51HWjLiyLVyFDQyúDGGyiti úyWRyLWjD00RFDWLRQ IURPj (61HWj \$VyLQyWKHyILJXUHjæyH [DPS0HñyO, 7VySR0LF\yLVyVHHñWRyúGRQWjDVNúyIRUjWKLvFDVHñyVRyWKH GRWHGy0LQHVjUHSUHVHQWj úLPS0FLWjWUDQVDFWLRQVúy ZKHUHj QRy PHVVDJHVj ZHUHjH [FKDQJHGiy + RZHYHUñ

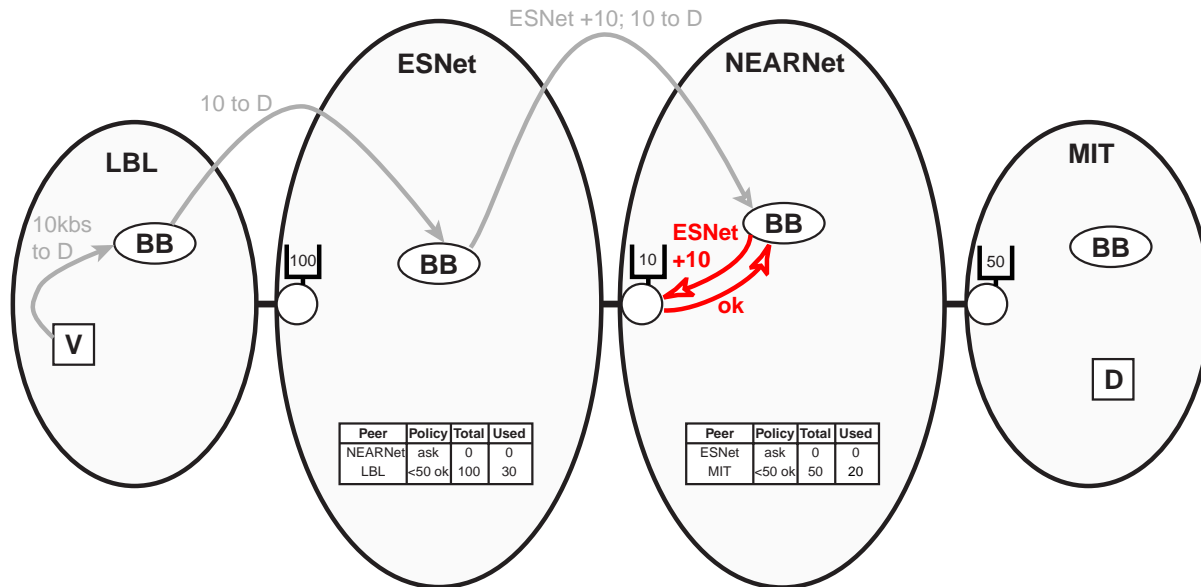
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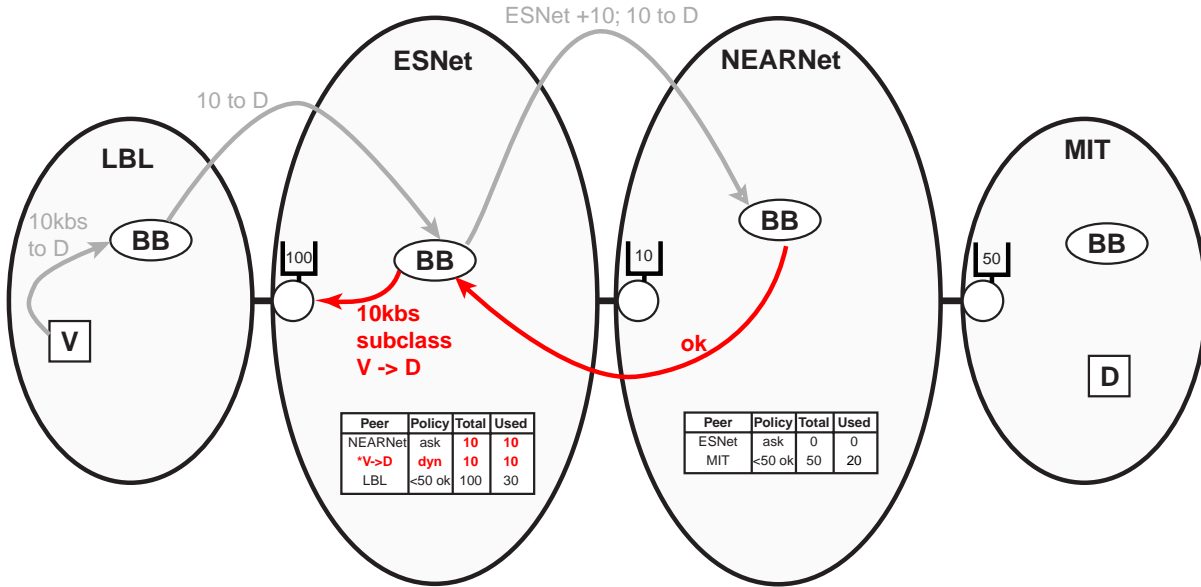
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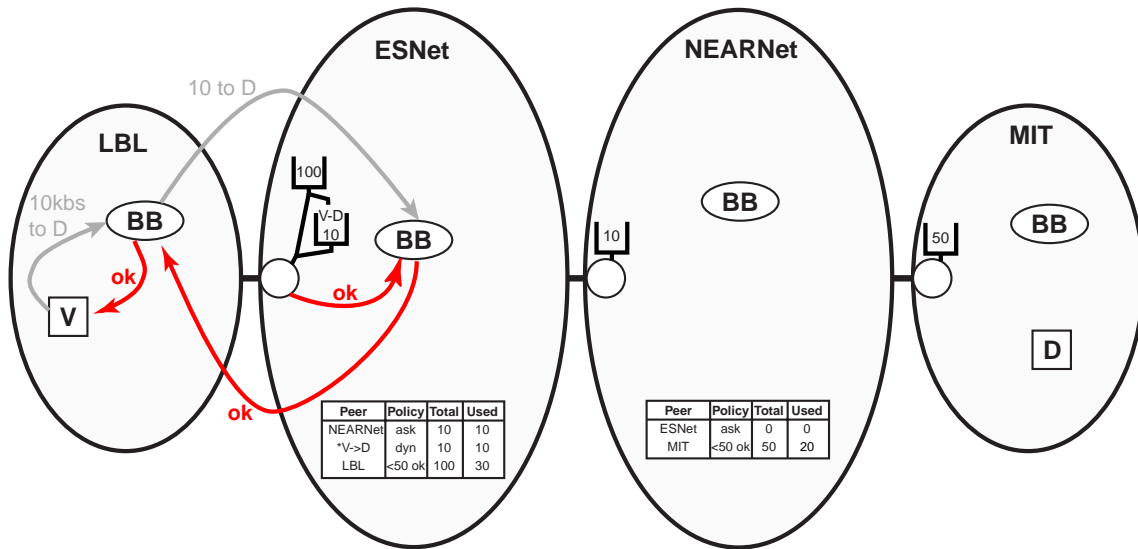


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A combined approach to differential service in Internet routers

David D. Clark
M.I.T. Laboratory for Computer Science
IETF
December 1997

The purpose of this talk

Describe mechanisms in routers (and elsewhere) that can form the basis of a range of application services.
(Specifically) describe a combination of two schemes presented at the last IETF -- "Van's scheme" and "Dave's scheme".

Proposal for action -- what do we do now?

Select some suitable mechanisms.

- General
- Implementable

Provide illustrations of how these are used to provide services.

Define how bits are used to select the mechanisms.

Vocabulary

What is implemented in a specific “box” (router, profile meter) we will call a mechanism with certain behavior.

What the user obtains, overall, by the specific use of these mechanisms, we will call a service.

In order that a mechanism can be used to build services, there must be enforced rules that limit how it is used.

The three (important) places where mechanism is implemented

The router (the point of congestion)

- Mechanism controls scheduling during congestion, etc.

Boundaries between networks

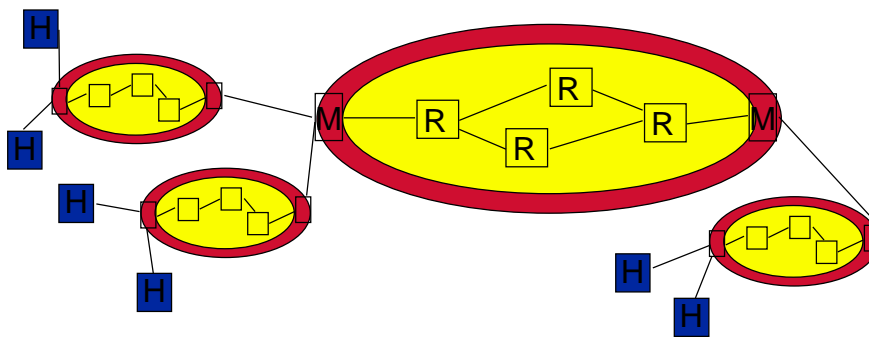
- Mechanism verifies usage patterns, tags packets, shapes flows, logs usage, etc. Enforces the rules.

End node -- source and destination

- Generates/sinks traffic
- Uses the mechanisms in ways that realize the service.

These parts, working together, can make a range of services out of the core mechanisms.

The placement of mechanism



Specifics		
Router mechanism	Profile meter mechanism	Resulting service
Queue with higher priority than other queues.	Token buffer with constant rate output.	Emulation of fixed capacity circuit
Queue with RIO dropper.	Tags packets <i>in</i> or <i>out</i> based on usage profile.	Allocated capacity profiles
	Host tagging of coded video (for example).	Application-controlled drop preference

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A note on traffic meters
<p>Meters enforce the rules.</p> <p>Different rules at different points</p> <ul style="list-style-type: none"> • Between two ISPs -- enforce bulk contract for access to “mechanism”. <p>Meters exploit the mechanism to obtain the desired service.</p> <ul style="list-style-type: none"> • Applies to meter near (at) the end-point. • Meters inside the network do not need to know what the application-visible service is.

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Conclusion for mechanisms

These two mechanisms (priority and RIO dropping) are not in conflict. Both can be implemented at once.

There seems to be a demand for the services that can be built from both mechanisms.

So -- put in both, and allow both sorts of services.

I named a specific dropping mechanism -- RIO dropping.

Claim: if a mechanism is to be used with a range of meters to produce a range of services, the mechanism itself needs to be carefully defined.

How to use bits in header of packet

Option 1: bits describe service.

Option 2: bits select/control mechanism .

My proposal: use bits to select/control mechanism. Why?

- Many more services than mechanisms. Run out of bits sooner if select services.
- New services invented all the time. Don't want to standardize them.
- Don't need/want to know what service is in "middle" of net if mechanisms work properly.

The "aggregate and forward" model, rather than the "segregate and bill" model.

Drawbacks -- selecting mechanism using header bits

A service might be built from different mechanism in different parts of the net.

Some services may be so universal that it is helpful to have a name for them.

When hoarding bits, it is better to be thoughtful than dogmatic.

Using bits to select mechanism.

A framework:

- Two parts:
 - Mechanism selection.
 - Per-packet control over what mechanism does.
- Mechanism:
 - Priority Queue
 - Queue with RIO dropper
- Per-packet control:
 - Priority -- nothing
 - Drop preference -- is this packet *in* or *out*

Bits in the header

My proposal

- Use a TOS value to select the mechanism..
- Use one or more precedence bits to select the per-packet treatment within the mechanism.

How many drop levels?

I proposed two drop preferences: *in* and *out*.

- Don't specify more unless it is proven that less will not do.

Why more?

- In military nets, where capacity may change wildly due to network attack, it may be important to shed load in several steps.
- For commercial nets, which are normally provisioned in a conservative way, no clear evidence that having more levels provides an increased range of interesting services.

Multiple drop levels, combined with **specific rules** for use, can create specialized services. See the Kaveli proposal.

