@]b_AUghYf'<Y`d

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%	; Yhh]b['GhUfhYX''''''''''''''''''''''''''''''''''''
	<y`d`7cbhybhg '''''<="" th=""></y`d`7cbhybhg>
	=bhfcXiWh]cb
&	6Ug]W`@]b_AUghYf`7cadcbYbhg'**************++
	6Ug]W`@]b_AUghYf`7c a dcbYbhg'''''+
•	@]b_AUghYf`: YUh i fYg"""""""""""+
	@]b_AUghYf`: YUhifYg''''+
	DfcWYgg]b[`5ffUm`8UhU`=b`5`889`7`]Ybh'''''
	7 i ghc a `FY a chY`AUW\]bYg************************************
	B9H889 **********************************
	GmghY a ʿHU[g ''''''''''''''''''''''''''''''''''''
	8fU['UbX'8fcd'=hY a g''''''''''%&
	7GJ ⁻ =a dcfh ⁻ UbX ⁻ 9 I dcfh %'
	FYX i bXUbWm """"%*
	H\Y`I gYf`AUbU[Yf''''''%**
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	8Yg][b˙U˙Dfc⁴YWhʿflGhYd˙%ť˙!˙F i bb]b[˙H\Y˙@]b_AUghYf''''''''''''''''''''''''''''''''''''
	8Yg][b'U'Dfc^YWh'flGhYd'&L'!'GhUfh]b['5'BYk'Dfc^YWh''''''''''''''''''''''''''''''''''''
	8Yg][b'U'Dfc^YWh'flGhYd''L'!'5XX]b[`5`@]b_`;fcid""""""""""""""""""""""""""""""""""""
	8Yg][bˈUˈDfc^YWhˈflGhYdˈ(ピ!・5XX]b[ˈ5'@]b_ˈ=hYa''''''''''''''''''''''''''''''''''''
	8Yg][b'U'Dfc^YWh'flGhYd')t'!'GUj]b['UbX'HYgh]b['h\Y'Dfc^YWh''''''''''''''''''''''''''''''''''''
)	
	7fYUh]b['@]b_g''''''''''''''''''''''''''''''''''''
	= a dcfh]b [`UbX`9 I dcfh]b [`@]b_`=hY a g`Zfc a `7GJ ''''''''''''''''''''''''''''''''''''
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@]WYbgY`HfUbgZYf`!`GhYd`'.`HfUbgZYf`@]WYbgY`Zfc a`Gc i fWY`D7`hc`8]g_YhhY''''''''''''''''''''''''''''''''''	""" *	•
@]WYbgY`HfUbgZYf`!`GhYd`(.`HfUbgZYf`@]WYbgY`Zfc a`8]g_YhhY`hc`HUf[Yh`D7""""""""""""""""""""""""""""""""""""	""" *)
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5 Wrcgg a UbmgcZrk UfY:X]gWJd']bYg'UbX:Vi g]bYgg gY[a Ybhg']h']g'] YfmWta a cb'hc'\YUf'h\Y'hYfa 'W]Ybh#gYfj Yf'Udd']Wh]cb" =b'h\Y']bXi ghf]U''a Uf_Yhz']h'i gi U'`mfYZYfg'hc'h\Y'g\Uf]b['cZa Ubi ZUWfi f]b['cf'dfcXi Wh]cb'XUhU'VYhk YYb'U'j Uf]YhmcZ
Udd']Wh]cbg'fUb[]b['Zfca' gcZhk UfY:UbX:XUhU'\]ghcf]Ubgz'hc'`Uf[Y'A 9G'UbX'9FD
Udd']Wh]cbg''FY[UfX'Ygg'cZh\Y'Vi g]bYgg'gY[a Ybh'gYfj YXz'W]Ybh#gYfj Yf'Udd']Wh]cbg'\Uj Y'cbY'h\]b[']b'Wta a cbz'U
ghUbXUfX]nYX'a Yh\cX'cZg\Uf]b['XUhU''=b'h\Y']bXi ghf]U''gY[a Ybh'za UbmWJYbh#gYfj Yf'hYW.bc'c[]Yg'\Uj Y'VYYb'XYj Y'cdYX
cj Yf'h\Y'UfWh'b'mYUfg''=b]hJU`mgca Y'cZh\YgY'hYW.bc'c[]Yg'k YfY'dfcdf]YhUfm''=b'a UbmWJgyg'h\YgY'dfcdf]YhUfmWJYbh#
gYfj Yf'UfW,]hYWfi fyg'k YfY']b'k]XY'i gYz'Vi h'fYa UJbYX'i bUj U]'UV'Y hc'h\]fX'dUfhmUdd']Wh]cbg'''9Uf'm]b'h\Y'XY'j Y'cda Ybh'cZ
k]bXck gz'A]WfcgcZhdfcj]XYX'U'[YbYf]WWJYbh'gyfj Yf'hYW.bc'c[m'WD'YX'
dfcj]XY'U'VUgJWUfW,]hYWfi fY'h\Uh'k ci 'X'U'`ck a UbmK]bXck g'Udd']Wh]cbg''Zfca 'U'k]XY'fUb[Y'cZj YbXcfg'hc'g\UfY'XUhUz'
vi h'h\YfY'k Ug'cbY'dfcV'Ya "'889'k Ug'bch'XYg][bYX'Zcf'h\Y']bXi ghf]U''a Uf_Yh']h'`UW_YX'a i W'cZ'h\Y'gdYYX'UbX
fcVi ghbYgg XYg]fYX]b'Ub']b'Jb' ghf]U''gYh]b['''ck Yj Yfz'h\]g'X]X'bch'ghcd 889'Zfca 'VYWa]b['Xca]bUbh'WJYbh#gYfj Yf
UfW]hWWfi fYz'Uf['YmXi Y'hc']b'g'Uj']mm]b'a cgh'K]bXck g'Udd']Wh]cbg'''-b'ha Yz'j Uf]Uh]cbg'cb' A]WfcgcZhfig 889'k YfY
XYj Y'cdYX'Vmgca Y'cZ'h\Y'YUX]b[''j YbXcfg']b'h\Y'a Uf_Yh''-H\YgY'j Uf]Uh]cbg'UXXfYggYX'gca Y'cZ'h\Y'gdYYX'UbX'fY']Uy']mm]ggi Yg'cZ'889'z'i h'a UbmdYcd'Y']b'h\Y']bXi ghf]U''gY[a Ybh'U[fYYX'h\Uh'U'VYh\f'f'gnghYa 'Zcf'g\Uf']b'(YyXYX''

=b '% - ('U'[fci d'cZj YbXcfg'fYdfYgYbh]b['U'VfcUX'gdYWffi a 'cZ X]gW]d']bYg`]b'h\Y`]bXi ghf]U``gY[a Ybh'Zcfa YX`k \Uh']g'bck _bck b'Ug h\Y` "'H\Y'CD7': ci bXUh]cb'di h'Zcfh\'h\Y'[cU'`cZ'XY] Y'cd]b['U'g]b['Y'W]Ybh#gYfj Yf'gdYV]Z]WUh]cb h\Uh'k ci 'X'U`ck 'Ubmj YbXcf'hc 'XYj Y'cd'gcZhk UfY'UbX'Udd`]WUh]cbg'h\Uh'Wci 'X'g\UfY'XUhU']b'U'ZUghz'fcVi gh'ZUg\]cbz'UbX'Xc]h']b'U'k Umh\Uh'k ci 'X'Y`]a]bUhY'h\Y'dfcdf]YhUfmgW\Ya Yg'h\Uh'ZcfWYX'h\YgY'gUa Y'j YbXcfg'hc 'Xi d`]WUhY'XYj Y'cda Ybh YZCfhg"'H\Y'CD7': ci bXUh]cb'XYj Y'cdYX'h\YZ]fgh'gdYV[Z]WUh]cb'WD`YX'8 UhU'5WWYgg'GdYW]Z]WUh]cb''%\$U'h\Uh'k Ug'fY`YUgYX']b YUf`m'% - *"'I g]b['h\]g'gdYV[Z]WUh]cbz'j YbXcfg'k YfY'UV'Y'hc 'ei]\W_`mXYj Y'cd'W]Ybh'gyfj Yf'gcZhk UfY"

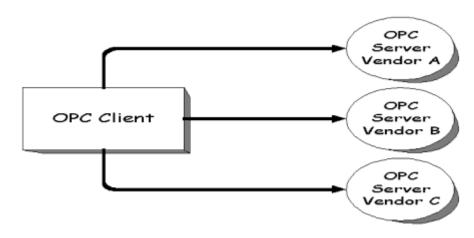
 $\begin{array}{lll} 5\text{`a} \ U\text{`cf'}[\ cU\text{``cZ'h\Y'CD7': ci} \ b\text{XUh]cb'UbX'h\Y'} & \text{k} \ Ug'hc'Y']a \]b\text{UhY'h\Y'bYYX'cZ'W]Ybh'Udd']Wh]cb } j \ Yb\text{Xcffij'hc'XYj'Y'cd'h\Y']f'ck b'dfcdf]YhUfmgYh'cZ'Wta a i b]Wh]cbg'Xf]j \ Yfg'': cf'a \ Ubmj \ Yb\text{Xcfgz'h\Y'YZcfh'fYei} \]fYX'hc XYj \ Y'cd'bi a \ Yfci g'Wta a i b]Wh]cbg'Xf]j \ Yfg'ci \ h\ Y'\X'j \ Y'cda \ Ybh'YZcfh']bj c'j \ YX']b'h\ Y'W]Ybh'Udd']Wh]cb']hgY'Z' K \]h\ Y'\X'j \ Y'\xcda \ Ybh'YZcfh']bj c'j \ YX']b'h\ Y'\X'j \ Y'\xcda \ Ybh'YX'j \ Y'\xcda \ Ybh'YZcfh']bj c'j \ YX']b'h\ Y'\X'j \ Y'\xcda \ Ybh'Z\ Y'\xcda \ Ybh'YXYj \ Y'\xcda \ Ybh'Z\ Y\xcda \ Ybh'YXYj \ Y'\xcda \ Ybh'YXYY'\xcda \ Ybh'YX'\xcda \ Ybh'YX$

`cb[Yf`fYghf]WhiUdd`]WUh]cbg`hc`k \]W. UbmCD7`Wta dUh]V`Y`Udd`]WUh]cb`Wub`UXXfYgg"`CD7`\Ug`[]j Yb`h\Y`YbX`i gYf`h\Y UXX]h]cbU`VYbYZ]hcZ'VY]b['UV`Y`hc`gY`YWh'h\Y`VYghcZ'VfYYX`gcZhk UfY`hc`gc`j Y`Udd`]WUh]cb`dfcV`Ya g"`<]ghcf]WU`nz`jZ'h\Y Udd`]WUh]cb`gcZhk UfY`X]X`bch`\Uj Y`h\Y`XYg]fYX`Wta a i b]WUh]cb`Xf]j Yf`cf`]Z'h\Y`Uj U]`UV`Y`Xf]j Yf`X]XbfhidYfZcfa 'UXYei UhY`nz`h\Y`cb`mgc`i h]cb`k Ug`hc`hfmhc`dYfgi UXY`h\Y`Udd`]WUh]cb`j YbXcf`hc`Y]h\Yf`XYj Y`cd'h\Y`XYg]fYX`Xf]j Yf`cf`fYdU]f`Ub`Yl]gh]b[Xf]j Yf"'H\Y`h]a Y`fYei]fYX`]b`Y]h\Yf`cZ'h\YgY`WugYg`k Ug`i gi U`mbYj Yf`g\cfh`K]h\CD7z`h\Y`YbX`i gYf`]g`bc``cb[Yf`h]YX`hc h\Y`fYgci fWf``]a]hUh]cbg`cZ'h\Y`W]Ybh`Udd`]WUh]cb`j YbXcf"H\Y`i gYf`Wub`bck 'W\ccgY`Zfca 'U'j Uf]YhmcZ'CD7`gYfj Yf`j YbXcfg hc`UXXfYgg`U'bYk 'Xf]j Yf`fYei]fYa Ybh'cf`fYa YXm'U'dYfZcfa UbWf`]ggi Y"`9ei U`mz`h\Y`W]Ybh'Udd`]WUh]cb`j YbXcf`WUb`bck ZcW g`cb`h\Y`Wbh]bi YX`]a dfcj Ya Ybh'cZ'h\Y]f`WcfY'dfcXi Wh`k]h\ci h'h\Y`X]gfi dh]j Y`YZZcfh`fYei]fYX`hc`UXXfYgg Wta a i b]WUh]cb`]ggi Yg`UbX`bYYXg"`?Ydk UfYfig'[cU``k]h\]b`h\Y`CD7`Ybj]fcba Ybh']g`hc`VY`U``YUX]b['dfcj]XYf`cZ'h\Y`gYfj Yf Wta dcbYbh'cZ'h\Y`CD7`Yei Uh]cb`UbX`hc`Xc`gc`Vmdfcj]X]b[`U`dfcXi Wh`h\Uh`]g`fY`]UV`Y`UbX`YUgm'hc`i gY"`@]b_A UghYf`]g`Vi]`h i dcb`Zci f`mYUfg`cZ'XYj Y`cda Ybh'YZZcfhg']b`Wta a i b]Wuh]cbg`Xf]j Yf`XYj Y`cda Ybh'UbX`CD7`HYW\bc`c[m'

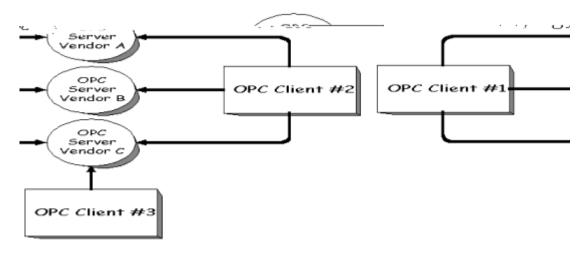
 $5\text{``ch'} \text{Ug'} \text{VYYb'} \text{gU]X'} \text{Vff'} \text{UVci} \text{ h'CD7} \text{\'e'} \text{h'kk} \text{ 'XcYg'h', Y'CD7'} \text{gd} \text{YW}} \text{ZW} \text{h|cb'kcf_3''H\Y'CD7'} \text{ ci} \text{ bXUh]cb''k } \text{V'Uj' Y'dfcj} \text{JXYX'h', Y'Zc'`ck } \text{b['gYWh]cb'cZ'h', Y'CD7']} \text{ ci} \text{ bXUh]cbz''k } \text{Y'\Uj' Y'dfcj} \text{JXYX'h', Y'Zc'`ck } \text{b['gYWh]cb'cZ'h', Y'SUh', Y'SUh', Y'Zb'']} \text{WYgg'} \text{gd} \text{YW}} \text{ZW} \text{bc'c} \text{b'} \text{b''} \text{b'$

H\]g'gYVM]cb']bhfcXi Wrg'CD7'8UhU'5WWrgg'UbX'Wcj Yfg'hcd]Wg'h\Uh'UfY'gdYW[Z]Whc'CD7'8UhU'5WWrgg"

 $\label{eq:hamiltonian} $$H^{\g'}gdYW_ZWh_0cb^XYgW^7VYg^Th,Y^CD7^7CA^CV^YW_g^TUbX^h,Y^f^TJbhYfZUW^rg^Tad^YaYbhYX^Vm^CD7^GYffYfg^T5b^CD7^7^TYbh^WubWbbYWh^c^CD7^GYffYfg^dfcj_XYX^Vm^cbY^cf^acfY^fYbXcfg''$



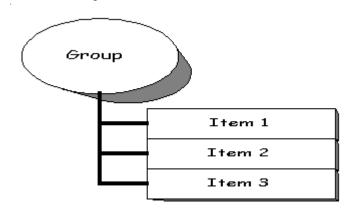
8]ZZYfYbh'j YbXcfg'a Um'dfcj]XY'CD7'GYfj Yfg"'J YbXcf'gi dd`]YX'WcXY'XYhYfa]bYg'h\Y'XYj]Wrg'UbX'XUhJ'hc'k\]W\'YUW\\gYfj Yf'\Ug'UWWrggZ'h\Y'XUhJ'bUa Yg'UbX'h\Y'XYhJ]`g'UVci h'\ck 'h\Y'gYfj Yf'd\mg]Wu``m'UWWrggYg'h\Uh'XUhJ'''GdYWJZ]Wg'cb bUa]b['Wcbj Ybh]cbg'UfY'gi dd`]YX']b'U'gi VgYei Ybh'gYWf]cb"



5h'U`\][\``Yj Y`ž'Ub`CD7`gYfj Yf`]g`Wta df]gYX`cZ`gYj YfU``cV^YWfg.`h\Y` ž'h\Y` ž'UbX`h\Y` "'H\Y`CD7`gYfj Yf cV^YWfa U]bhU]bg`]bZcfa Uh]cb`UVci h'h\Y`gYfj Yf`UbX`gYfj Yg`Ug`U'WtbhU]bYf`Zcf`CD7`[fci d`cV^YWfg"'H\Y`CD7`[fci d`cV^YWha U]bhU]bg`]bZcfa Uh]cb`UVci h']hgY`Z'UbX`dfcj]XYg`h\Y`a YW\Ub]ga `Zcf`WtbhU]b]b[`UbX``c[]WU``mcf[Ub]n]b[`CD7`]hYa g"

$$\label{eq:hamiltonian} \begin{split} H \setminus Y \cap D \cap T_{i} &\text{ fci dg'dfcj }] XY' \cup K \cup Um'Z \cap T' W] Y b hg' hc' \cap C \cap T' Ub \mid N Y \cup T' Ub \mid N$$

H\YfY`UfY`hk c`hmdYg`cZ`[fci dgž` `UbX` `fbf`fdlf]j UhYfbL"`Di V`]W]g`Zcf`g\Uf]b[`UWfcgg`a i `h]d`Y`W]Ybhgž``cWU`]g `cWU]nYX`hc`U`W]Ybh'`FYZYf`hc`h\Y`gYWh]cb`cb`di V`]W[fci dg`Zcf`h\Y`]bhYbhž'di fdcgYž`UbX`Z bWh]cbU`]hm`UbX`Zcf`Z fh\Yf XYhU]`g"`H\YfY`UfY`U`gc`gdYW]Z]Wcdh]cbU``]bhYfZUWfg`Zcf`h\Y`di V`]W[fci dg"`K]h\]b`YUW\`[fci dž`h\Y`W]Ybh`Wub`XYZ]bY`cbY`cf a cfY`CD7`=hYa g"

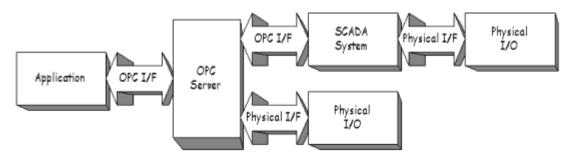


H\Y`CD7`=hYa g`fYdfYgYbh`WebbYWh]cbg`hc`XUhU`gci fWrg`k]h\]b`h\Y`gYfj Yf"`5b`CD7`=hYa ž`Zfca `h\Y`W`ghca `]bhYfZUWY dYfgdYWh]j Yž`]g`bch`UWWYgg]V`Y`Ug`Ub`cV^YWh`VmUb`CD7`7`]Ybh"`H\YfYZcfYž`h\YfY`]g`bc`YI hYfbU``]bhYfZUWY`XYZ]bYX`Zcf`Ub`CD7 =hYa "`5```UWWYgg`hc`CD7`=hYa g`]g`j]U`Ub`CD7`; fci d`cV^YWh`h\Uh`WebhU]bg`h\Y`CD7`]hYa `cf`g]a d`mk\YfY`h\Y`CD7`=hYa `]g XYZ]bYX"

 $5ggcVIJUhYX`k]h\ YUVX`]hYa`]g`U` \quad \check{z}` \qquad `UbX` \qquad "`H\Y`j U`i Y`]g`]b`h\Y`Zcfa `cZ`U` \qquad \check{z}`UbX`h\Y`E i U`]hm \\ [g`g]a]`Uf`hc`h\Uh`gdYVIZ]YX`Vm` \qquad "$

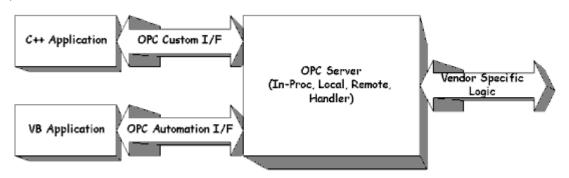
 $HU_Y`bchY`h\Uh`h\Y`]hYa g`UfY`bch`h\Y`XUhU`gci fWfg/`h\YmUfY``¹ gh`WcbbYWf]cbg`hc`h\Ya "`: cf`Yl Ua d`Yž`h\Y`hUl [g`]b`U`87G gmghYa `Yl]gh`fY[UfX`Ygg`cZ'k \Yh\Yf`Ub`CD7`W]Ybh`]g;W\ffYbh`mUWMYgg]b[`h\Ya "`H\Y`CD7`=hYa `g\ci `X`VY`h\ci [\h`cZ'Ug g]a d`m`gdYW]Zh]b[`h\Y`UXXfYgg`cZ'h\Y`XUhUž`bch`Ug`h\Y`UVMi U``d\mg]WU``gci fWf`cZ'h\Y`XUhU`h\Uh`h\Y`UXXfYgg`fYZYfYbWfg"$

 $\label{eq:condition} 5\h' ci [\\CD7']g'df]a\ Uf]'mXYg][\ bYX'Zcf'UWW'gg]b[\ XUHU'Zfca \ 'U'bYhk cf_YX'gYfj Yfž'CD7']bhYfZUW'g'Wb'VY'i gYX']b'a Ubm d'UW'g'k]h\]b'Ub 'Udd']WUh]cb"'5h'h\Y'`ck Ygh'`Yj Y`'h\YmWb'[Yh'fUk \XUHU'Zfca \ 'h\Y'd\mg]WU`XYj]W'g']bhc 'U'G7585'cf'87GZ cf'Zfca \ 'h\Y'G7585'cf'87G'gmghYa \]bhc 'h\Y'Udd']WUh]cb"'H\Y'UfW\]hYWi fY'UbX'XYg][b'a U_Yg']h'dcgg]V'Y'hc 'Wcbghfi Wh'Ub CD7'GYfj Yf'k \]W\"U`ck g'U'W]Ybh'Udd']WUh]cb 'hc 'UVWYgg'XUhU'Zfca 'a Ubm'CD7'GYfj Yfg'dfcj]XYX'Vm'a UbmX]ZZYfYbh'CD7 j YbXcfg'fi bb]b['cb'X]ZZYfYbh'bcXYg'j]U'U'g]b['Y'cV'YW'']$



".5

CD7`]g`U`gdYVJZJWUh]cb`Zcf`hk c`gYhg`cZ`]bhYfZUWfg/`h\Y` fYj`]gYX`Ui hca_Uh]cb`]bhYfZUWf`k]``VY`dfcj]XYX`k]h\ fY`YUgY`&"\$`cZ`h\Y`CD7`gdYVJZJWUh]cb"



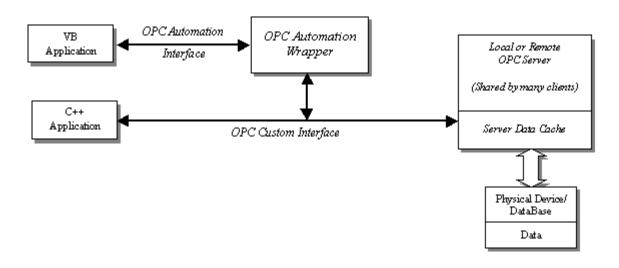
 $H Y C D T G d Y W Z W h c '] X Y b h Z Y b h Z Y b h Y T C A '] b h Y T Z U W g ` U f Y Z ' b C h ' h Y '] a d ` Y a Y b h U h C C Z h C g Y '] b h Y f Z U W g ` ' = h Y I d ` U] b g ' h Y Z b W h C b U] h M N U h M Y '] b h Y f Z U W g ` U f Y Y I d Y W Y X ' h C ' d f c j] X Y h C W] Y b h U d d `] W h C b G h \ U h i g Y h Y a "$

 $= bWi XYX`UfY`XYgWf]dh]cbg`cZ`UfW.]hYWfi fYg`UbX`]bhYfZUWfg`h\ UhigYYa YX`a cgh`Uddfcdf]UhY`Zcf`h\ cgY`UfW.]hYWfi fYg`UbX`]bhYfZUWfg`h\ UhigYfj Yf`a cXY`k\ YfY`h\ Y`CD7`GYfj Yf`Wca dcbYbh'dfcj]XYg`Ub]bhYfZUWf`hc`h\ Y`CD7`cV`YWfg`UbX`a UbU[Yg`h\ Ya "$

H\YfY`UfY`gYj YfU``i b]ei Y`Wcbg]XYfUh]cbg`]b`]a d`Ya Ybh]b[`Ub`CD7`GYfj Yf"`H\Y`a U]b`]ggi Y`]g`h\Y`ZfYei YbWn`cZ`XUhU hfUbgZYf`cj Yf`bcb!g\UfV`Y`Wca a i b]WUh]cbg`dUh\g`hc`d\mg]WU``XYj]WYg"`H\i gž`k Y`YI dYWn`h\Uh`h\Y`CD7`GYfj Yf`k]```Y]h\Yf VY`U`cWU``cf`fYa chY`9L 9ž`k \]W\`]bWi XYg`WcXY`h\Uh`]g`fYgdcbg]V`Y`Zcf`YZZ]W}bh`XUhU`Wc``YWn]cb`Zfca `U`d\mg]WU``XYj]WY"

5b°CD7°W]Ybh'Udd`]Wuh]cb°Wcaaib]WuhYgʻhc°Ub°CD7°gYfjYfʻh\fci[\`h\Y`gdYW]Z]YX°CD7°W ghca°UbX`UihcaUh]cb°]bhYfZUWYg"CD7°gYfjYfgʻaigh`]ad`YaYbh'h\Y`W ghca°]bhYfZUWYž'UbX`cdh]cbU``maUm]ad`YaYbh'h\Y`UihcaUh]cb°]bhYfZUWY"

5b` ž'cf'CD7`\UbX`Yfž'a Um'VY'i gYX`hc'a Ufg\U`'h\Y`]bhYfZUWY'UbX`dfcj]XY`h\Y`UXX]h]cbU``]hYa ``Yj Y``Zi bWh]cbU`]hmicZ h\Y`CD7`5i hca Uh]cb'=bhYfZUWY"'FYZYf'hc'h\Y`Z[[i fY`VY`ck "

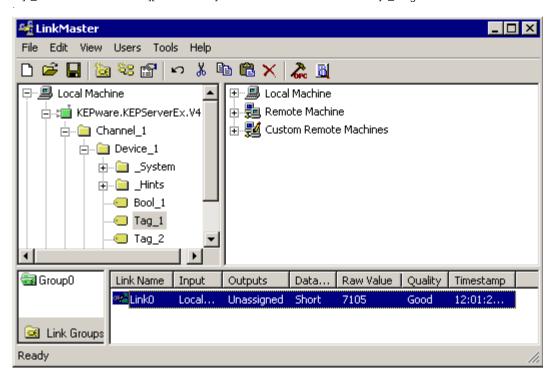


=h]g'U'gc'Yl dYVMYX'h\Uh'h\Y'gYfj Yf'k]'``Webgc`]XUhY'UbX'cdh]a]nY'XUhU'UWWYggYg'fYei YghYX'Vmh\Y'j Uf]ci g'W]Ybhg'hc dfca chY'YZZJv\Ybh'Wea a i b]v\Uh]cbg'k]h\'h\Y'd\mg]\W'`XYj]\W''': cf' ffYUXgbz`XUhU']g'fYhi fbYX'Vmh\Y'XYj]\W'']g Vi ZZYfYX'Zcf'Ugmb\W\fcbci g'X]ghf]Vi h]cb'cf'gmb\W\fcbci g'\W'``Y\M]cb'Vmj Uf]ci g'CD7'\W]Ybhg''': cf' fk f]hYgbz`h\Y'CD7 GYfj Yf'i dXUhYg'h\Y'd\mg]\W'`XYj]\W'XUhU'cb'VY\U`Z'cZ'CD7'7`]Ybhg''

?Ydk UfY`fYWc[b]nYg`h\Uh'U`bi a VYf`cZ`Y[UWh`Udd`]WUh]cbgʻgh]``XYdYbX`i dcb`889`Zcf`h\Y]f`i bXYf`m]b[`W]Ybh'gYfj Yf hYW\bc`c[m''Hc`UXXfYgg'h\YgY`Udd`]WUh]cbgž`@]b_A UghYf`\Ug`VYYb`XYg][bYX`hc`dfcj]XY`h\Y`gUa Y`UWWYgg'hc`XYj]W'`XUhU`j]U 889ž'Ug`WUb`VY`UW\]Yj YX`i g]b[`CD7"

- ∉ 7: SHYI h
- ∉ L@SHUV`Y
- ∉ 5Xj UbWYX889
- ∉ BYh889

 $7`]\underline{W}_cb_Ubm_UfYU_cZ_h\backslash Y_Z][i_fY_VY_ck_]b_cfXYf_b_``YUfb_a_cfY_UVci_h@]b_A_UghYf"$



@jb_A UghYf`\Ug`VYYb`XYg][bYX`k]h\`h\Y`[cU``cZ'dfcj]X]b[`U'Zi ``m'ZYUhi fYX`XUhU! Vf]X[]b[`dfcXi VM`h\ Uh`XYa cbghfUhYg i bdUfU``Y`YX`Wta dUh]V]]hm`UbX`dYfZcfa UbWf"`6i]`h`i dcb`? Ydk UfYffg`C D7`W]Ybh#gYfj Yf`hYW\ bc`c[mž`h\ Y`@]b_A UghYf`\Ug`U`gc]bWtfdcfUhYX`U``cZ'h\ Y`Zc``ck]b[`ZYUhi fYg.

- ∉ 7ca d`]Yg`k]h\`CD7`%"\$U`UbX`CD7`&"\$) U`8UhU`5WWrgg`GdYW]Z]WUh]cb"
- ∉ Giddcfhg'Vch\'7CA'UbX'87CA"
- ∉ FibgʻUgʻUʻK]bXckgʻBH#&\$\$\$#LDʻ_____
- # Dfcj]XYg'Zi ```______''WUdUV]`]h]Yg"
- $\hspace{0.1in} \notin \hspace{0.1in} HfUbgZYfg`XUhU`ZUgh`UbX`YZZYVM]j\ Y`m'$
- € 5WWYgg _______. VmYbhYf]b['Y]h\Yf'Ub '=D'cf'A UW\]bY'bUa Y"
- ∉ 7fYUhYg``]b_g`cb`h\Y`Zmik]h\`Vch\`______UbX`HU[`6fckg]b[`VWdUV]`]h]Yg"
- ∉ Gi ddcfhgʻdfc′YVMja dcfhʻUbXʻYI dcfhʻUgʻUʻ7GJʻfM¢a a UʻgYdUfUhYXʻj Uf]UVʻYŁʻhYI hʻZjʻY"
- $\notin \ \ \, HfUW\underline{g}\, Yffcfg\, k\,]h\ \, `U\, `XYhU]\, \dot{\ \ }cf]YbhYX\, \dot{\ \, 9j}\, Ybh\, \dot{\ \ }JYk\, Yf\, \dot{\ \ }c[\, "$

- ∉ :ibVMjcbg:Ug:Ub:CD7:hc:CD7#889:W]Ybh;gYfjYf" ∉ Dfcj]XYg:_________gYhnjb[g:hc:fYZjbY:kf]hYg:hc:`]b_g"
- ∉ Gi ddcfhgʻ_____"

@b_A UghYf`gi ddcfhg`h\Y`Zc``ck]b['W]Ybh`gYfj Yf`hYW\bc`c[]Yg.

- ∉ CD7 8UHJ 5WW gg JYfg]cb %"\$U
- ∉ CD7 8 UhU 5 WW gg J Yfg]cb & "\$) U
- € 889: cfa Uh 7: SHYI h
 € 889: cfa Uh L @SHUV`Y
- ∉ 889': cfa Uh'5Xj UbWX'889

 $CD7 : 8 \ UHU : 5 \ WW : gg : \% : U : k \ Ug : h \ Y : cf][\]bU : gd Y \ WZ] \ Wh | cb : h \ Y : CD7 : ci b \ X \ Uhg : k \ Y : Y : cd Y X : V UW :]b : \% - * " A \ Ubm c Z : h \ Y : CD7 \\ W] Y bh : Udd :]W : h | cbg :]b : gY : h \ X : Umg i \ ddc fh : h | g : cf][]bU : gd Y \ WZ] \ Wh | cb : "CD7 : 8 \ UHU : 5 \ WW : gg : & "$:]g : h \ Y : UhY : gh ; Yfg] cb : cZ : h \ Y : CD7 \\]bh | fZ UW : " : H \ Y : & "$) U : Yfg] cb : cZ : h \ Y :]bh | fZ UW : \ Ug : V | Y : Y b \ UbW | X : hc : a \ U_Y : V | Hh | f : gY : cZ : h \ Y : b | X | fm | b : A | W : cg : Zh : 7 CA \\ HY : M : bc : c[m' : A : cgh : CD7 : W] | Ybh : Udd :] \ Wh | cbg : Uf : Y : V | b[: Web ; Yfh | X : hc : gi \ ddc fh ; Yfg] | cb : & "$) U : cZ : h \ Y : CD7 : gd | WZ | Wh | cbg : "H \ Y : 889 : Zcfa \ Uh : 7 : SHYI : h :]g : h \ Y : gh Ub X : X : 889 : Zcfa \ Uh : Ug : X | X | Y : X | X | Y : X | Y : X | X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y : X | Y$

 $6 \label{eq:condition} 6 \label{eq:conditio$

@b_A UghYf`Wub`]a dcfh`UbX`YI dcfh`dfc^YWh`XUhU`]b`U`7GJ`fWta a U`gYdUfUhYX`j Uf]UV`YŁ`hYI h`Zj`Y`Zcfa Uh'`H\]g`U`ck g`Zcf
`Uf[Y`dfc^YWhg`hc`VY`WfYUhYX`UbX`a cX]ZJYX`ei]W_`m`UbX`YUg]`m'': cf`YI Ua d`Yž`]Z`h\Y`gYfj Yfg``]b_]b[`XUhU`k]h\`Xc`bch`WtbhU]b
Vfck gYX`]hYa gž`h\Yb`i gYfg`k ci`X`\Uj Y`hc`YbhYf`YUW\`gYfj Yf`]hYa fbj`UWWYgg`dUh\`a Ubi U``m`]bhc`YUW\``]b_`]hYa `dfcdYfhm
dU[Y"`K]h\`h\Y`i gY`cZ`U`g]a d`Y`hYI h`YX]hcf`cf`k]h\`A]WfcgcZh`9I Wf`| `i gYfg`Wub`ei]W_`m`WfYUhY`UbX`a Ub]di`UhY`=bdi hgž
Ci hdi hg`cf`Ubmch\Yf`dfc^YWh`Uhff]vi hYg`YI]gh]b[`]b`h\Y`@]b_A UghYf`dfc^YWh`j]U`h\Y`7GJ`Z]`Y"

@]b	Αl	JahY	′f˙<	Y`d
-----	----	------	------	-----



 $\& "`9bhYf`h\Y`bUa~Y`cf`=\!D`UXXfYgg`cZ'h\Y`a~UW\]bY`h\Uh`]g`hc`VY`UXXYX`hc`h\Y`a~UW\]bY`h\Uh`]g`hc`VY`UXXYX`hc`h\Y`a~UW\]$





' "'9| dUbX'h\Y'W\ghca 'a UW\]bY'hc'WbbYWh'hc'h\Y'gYfj Yf"

 $GY^{Y}Wh^{\prime}h^{\prime}Y^{\prime}XYg]fYX^{\prime}a\ UW^{\prime}]bY^{\prime}UbX^{\prime}dfYgg^{\prime}h^{\prime}Y^{\prime}89@_{Y}m^{\prime}^{\prime}5^{\prime}h^{\prime}fbUh^{\prime}j\ Y^{\prime}m^{\prime}gY^{\prime}YWh^{\prime}h^{\prime}$

'Zfca 'h\Y'9X]h'a Ybi 'cf'hcc`VUf"

889'dfcj]XYg'U'k Umhc'g\UfY'XUhU'VYhk YYb'K]bXck g'Udd`]Wh]cbgž'Ug'`cb['Ug'h\cgY'Udd`]Wh]cbg`Yl]gh'cb'h\Y'gUa Y a UW\]bY"'BYh'889']g'i gYX'hc'g\UfY'XUhU'Zfca 'U'889'gYfj Yf'cb'U'`cWU'D7'k]h\'W]Ybh'Udd`]Wh]cbg``cWUhYX'cb'fYa chY'D7g" Hc'Xc'h\]gz'h\Y'D7'a i gh'\Uj Y'U'i b]ei Y'Wta di hYf'bUa Y"'=Z'U'bYhk cf_']g'UfYUXm]bghU``YX'UbX'fi bb]b[ž'h\Yb'U``cZ'h\Y Wta di hYfg'k]``'U'fYUXm\Uj Y'i b]ei Y'bUa Yg"'l gYfg'Wb'Z]bX'h\Y'Wta di hYf'bUa Y'Vm``cc_]b['Uh'h\Y'bYhk cf_'gYh]b[g'Zfca h\Y'K]bXck g'7cbhfc``DUbY'"'Hc'Xc'gcž'g]a d`m'Xci V'Y!W]\w_cb'h\Y'bYhk cf_']wtb"'H\Y'Wta di hYf'bUa Y'g\ci 'X'VY']b'h\Y'Zfgh j]g]V'Y'Z]Y'X"'CbWf'i gYfg'\Uj Y'h\Y'Wta di hYf'bUa Y'Zcf'h\Y'D7'fi bb]b['@]b_A UghYfž'h\Ym\Wb'Ub\Wf\gg'h\Uh'XUhU'Zfca 'fYa chY W]Ybhg'i g]b['h\Y'Zc`ck]b['Zcfa Uh

 $\label{localization} I = gY \cdot h \cdot Y \cdot Zc \cdot ck \cdot b [\cdot Webj \cdot Ybh] cb \cdot hc \cdot YghUV \cdot]g \cdot U \cdot \\ \qquad \qquad \qquad \\ :]b _ Zf ca \cdot U \cdot fYa \cdot chY \cdot W] Ybh \cdot Udd \cdot]WUh] cb \cdot hc \cdot @fb _ A \cdot UghY f.$

 $0 \text{ fiPP} \sim \text{b8cYPB889}^{\circ} \text{ f2 p0 f$@A88985H5}^{\circ} \text{ f2 }^{\circ} 0 \text{ figlb}_{;} \text{ fci dg"}; \text{ fci d$"@b_$f2}$

5dd`]WUh]cb'1 'PP>c\b8cYPB889' Hcd]W1 S@A 88985H5' =hYa '1 @b_; fci dg"; fci d\$"@b_\$

`H\Y'02`W\UfUVMYfg`UVcjY`UfY`Zcf`WUf]hmcb`mUbX`UfY`bch`U`bcfaU``dUfhcZ`U`889``]b_`fYZYfYbW'"

`K\Yb`cjYff]X]b[`h\Y`XYZUi`h`WcbZ][ifUh]cb`cZ`U`XmbUa]WhU[`Zfca`U`889`Udd`]WUh]cbž;h\Y`JbhjfY`]hYa`bUaY`k]` bYYX`hc`VY`YbWcgYX`]b`g]b[`Y`eichYg"'@]_Y`h\Y`Xc``Uf`gmaVc`ž'h\Y`Uh`4`gmaVc``]g`bch'bcfaU``mfYWc[b]nYX`Ug`U`jU`]X W\UfUVMYf`]b`U`Zcfai`U"

dfc[fUa "

BYM889'a i gh'VY'YbUV'YX']b'@b_A UghYf'VYZcfY']h']g'WbbYWfYX'Vm'U'fYa chY'W]Ybh''Hc'YbUV'Y'BYh'889'gYfj]WYgž'W]W_'cb'
'UbX'gY'YWf' "'H\Ybž'W]W_'h\Y' 'hUV'UbX'gY'YWf' "': cf'a cfY']bZcfa Uh]cbž'fYZYf'hc'___

: cf'cdh]a i a 'gYfj Yf'dYfZcfa UbWY'i bXYf'K]bXck g'-) 'UbX'K]bXck g'BH'j Yfg]cbg'dfYj]ci g'hc'("\$ž'i gYfg'g\ci 'X'bch YbUV'Y'BYh'889'gYfj]WYg'i b'Ygg'bYYXYX"

 $= ZBYh'889'gYfj]WYg'UfY'YbUV'YXž'U'889'gVUfY']g'WfYUhYX'YUWX'h]a Y'U'W]Ybh'Udd']WUh]cb'WcbbYWfg'hc'h\Y'gYfj Yf''K \Yb'h\Y gYfj Yf'']g'hU_Yb'cZZ]bYž'h\YgY'g\UfYg'UfY'fYa cj YX''$

 $\label{eq:hc_fya} Hc_fYa\ cj\ Y_U_889_g\setminus UfY_i\ bXYf_K\]bXck\ g_BH\underline{z}_i\ gYfg_k\ ci\ X_i\ gY_h\setminus Y_dfc[\ fUa\ .889G<5F9_9L9_"Hc_fYa\ cj\ Y_U_889_g\setminus UfY_i\ bXYf_K\]bXck\ g_-)\ \underline{z}_i\ gYfg_a\ i\ gh_fYa\ cj\ Y_h\setminus Y_g\setminus UfY_bUa\ Y_\underline{z}_fca\ .h\ Y_fY[\]ghfmi\ bXYf_.$

"'6YZcfY'UhhYa dh]b['h\]g'cdYfUh]cbž'fYZYf'hc

 $\label{thm:conditional} $H_Y'' = H_Y'' = H_Y$

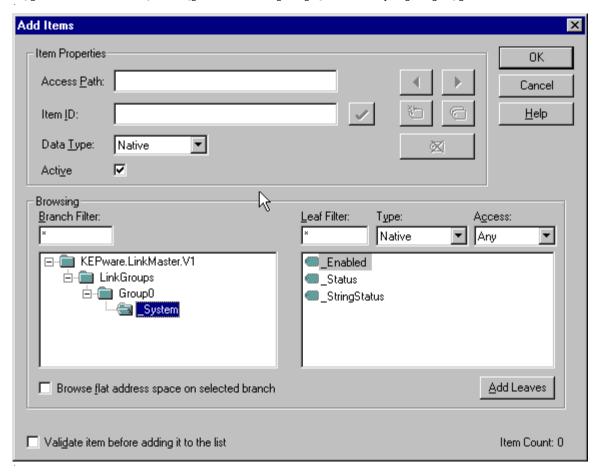
`]g`h\Y`cb`m`hU[`h\Uh`WUb`VY`k f]hhYb`hc"`⊨h`WUb`VY`X]gUV`YX`]b`______`i bXYf` p` "`H\YfY`UfY WYffYbh`m`h\fYY`Vi]`h]b`gmghYa`hU[g`Uj U]`UV`Y`cb`YUW\`______"'H\Ym`UfY`Ug`Zc``ck g.

S9bUV`YX fFYUX#K f]hYŁ	H\Y`S9bUV`YX`HU[`]g`U`6cc`YUb`HU[`H\Uh`U``ck g`h\Y UWhjj Y`ghUhY`cZh\Y`@jb_; fci d`hc`VY`hi fbYX`Cb`cf`CZ" K\Yb`h\]g`HU[`]g gYh hc: 5@G9žU``i gYf!XYZjbYX`@jb_ =\Ya g`]b`h\Y`@b_; fci d`k]``VY`a Uf_YX`Ug`]bj U`]X`UbX @jb_k f]hYg`k]```X]gWtbhjbi Y"`K\Yb`h\]g`HU[`]g`gYh`hc HFI 9ž`bcfa U```]b_Zi bWhjcbU`]hmk]```Wtbhjbi Y`k]h\]b h\Uh`@jb_; fci d"
SGHUhi g fF YUX 'C b`m'z	H\Y`SGHJHig`HJ[`]g`U`G\cfh`HJ[`H\Uh`fYHifbg`H\Y W\ffYbh`Yffcf`ghJHY`cZ`h\Y`@b_'; fcid"`K\Yb X]gd`Um]b[```\$``fhYfcŁ`H\Y`@b_'; fcid']g`cdYfUh]b[dfcdYf`m'`K\Yb`X]gd`Um]b[`U`jU`iY`ch\Yf`H\Ub`nYfcž h\Y`@b_AUghYf`\Ug`XYHYWhYX`Ub`Yffcf`k]h\]b`h\Y`@b_ ; fcid"
SGHJHi gGHf]b[fF YUX 'C b`m'L	H\Y`SGHJhi gGhf]b['hJ[']g'U'ghf]b['hmdY'HJ['h\Uh fYhi fbg'U`XYgWf]dh]cb'Zcf'h\Y`Yffcf'ghJhY'cZ'h\Y'@b_ ; fci d']b ghf]b['Zcfa Uh''K \Yb'h\Y'@b_'; fci d'fYUXg "; ccX"ž]h]g'cdYfUh]b['dfcdYf'm''Ch\Yfk]gYžh\Y'@b_ ; fci d'\Ug'XYhYWhYX'Ub'Yffcf"

@jb_`=hYa `gmghYa `hU[g`WUb`VY`Vfck gYX`]b`Ub`CD7`W]Ybhž`Vi h`WUb`U`gc`VY`X]gUV`YX`Zcf`Vfck g]b[`i bXYf`h\Y`__ H\YfY`UfY`W`ffYbh`m`hk c`Vi]`hI]b`gmghYa `hU[g`Uj`Uv`Y`Zcf`YUW\` "`H\Ym'UfY`Ug`Zc``ck g.

SGHUhi g	H\Y`SGHUHig`HU[`]g`U`G\cfh`HU[`H\Uh`fYHifbg`H\Y`W\ffYbh`Yffcf`gHUHY`cZ`H\Y`@jb_`=HYa "`K\Yb
fFYUX'Cb`mŁ	X]gd`Um]b[`"\$""fhYfcŁž'h\Y'@]b_'=hYa ']g`cdYfUh]b[`dfcdYf`m''K \Yb`X]gd`Um]b[`U'j U`i Y'ch\Yf h\Ub`nYfcž'h\Y'@]b_A UghYf`\Ug`XYhYVMYX'Ub`Yffcf`k]h\]b`h\Y'@]b_'=hYa "

SGhf]b[H\Y`SGhUhi gGhf]b['hU[']g'U'ghf]b['hmdY'hU['h\UhifYhi fbg'U'XYgWf]dh]cb'Zcf'h\Y`Yffcf'ghUhY'cZ h\Y`@b_'=hYa ']b'ghf]b['Zcfa Uh'' K\Yb'h\Y`@b_'=hYa 'fYUXg'''; ccX"ž']h']g'cdYfUh]b['dfcdYf'm' fFYUX'Cb`m'z ch\Yfk]gYž'@b_A UghYf'\Ug`XYhYWhYX`Ub'Yffcf"

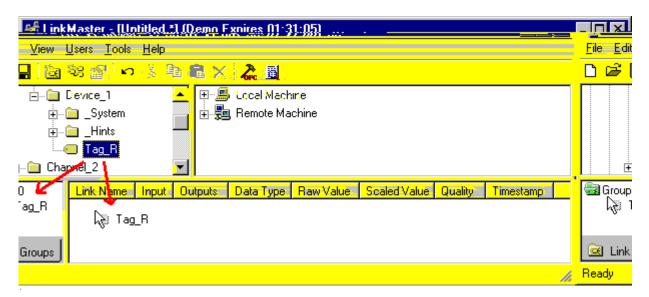


H\Y`SGmghYa `VfUbW\`Zci bX`i bXYf`h\Y`@b_`; fci d`VfUbW\`]g`U`k Umg`Uj U]`UV`Y"`=b`cfXYf`hc`fYZYfYbWf`U`gmghYa `hU[`Zfca `U 889`Udd`]\Wh]cb`[]j Yb`h\Y`Uvcj Y`YI Ua d`Y`UbX`h\Y`889`XYZUi `hgž`h\Y``]b_`k ci `X`UddYUf`Ug`Zc``ck g.

1 ``]b_a UghYfpS@A 88985H5 *@]b_; fci dg; fci d\$ SGmghYa S9bUV`YX

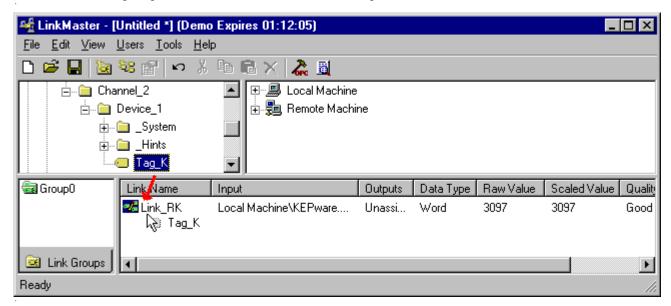
 $\label{eq:hamiltonian} $$ 'HY' $$ 'UbX $$ 'HU[g'Xc'bch'fYhi fb'HFI 9'k Yb'U'XYj]W']g'gYh']bUWh]j Y'j]U'hYYS9bUV'Y $$ HU["$

: cf`a cfY`Wcbj Yb]Ybh` WfYUh]cbž`i gYfg`WUb`U`gc`XfU[`]hYa g`Zfca `Ub`Uj U]`UV`Y`gYfj Yf`hfYY`]b`@b_A UghYffg`a U]b k]bXck `UbX`h\Yb`Xfcd`h\Uh`]hYa `cbhc`U`\][\`][\hYX`@b_`[fci d`]Wcbž`h\Y`@b_`]hYa `X]gd`Umcf`U``]b_`]hYa `]hYa `]hYa `]hYa `]hYa `Zfca `h\Y`gYfj Yf`hfYY`hc`Y]h\Yf`h\Y`\][\`][\hYX`@b_`[fci d`cf@b_`]hYa `X]gd`Umf`H\]g`WfYUhYg`h\Y`@b_`]hYa `"



H\Y'YI Ua d'Y'VY'ck 'g\ck g'\ck 'hc'UXX'U'

`cbhc`Ub`YI]ghYbh`\][\`][\hYX`@]b_`]hYa `f]]bdi hŁ"



@b_A UghYf`Wub`]a dcfh`UbX`YI dcfh`dfc^YWh`XUhU`]b`U`

'\ft | h`Z]Y`Zcfa Uhz`h\ i g`U``ck]b[
\'\ft | Y`dfc^YWhg`hc`VY`WfYUhYX`UbX`a cX]Z]YX`ei]\w_`mUbX`YUg]`m': cf`YI Ua d`Yž`]Z`h\Y`gYfj Yfg`h\UhU`i gYf`]g``]b_]b[`XUhU`k]h\
Xc`bch`WcbhJ]b`Vfck gYX`]hYa gz`h\Ymk ci `X`bcfa U``m`\Uj Y`hc`YbhYf`YUW\ 'gYfj Yf`]hYa fig`UWWYgg`dUh\`a Ubi U``m`]bhc`YUW\
`]b_`]hYa fig`dfcdYfhmdU[Y"`K]h\`h\Y`i gY`cZ`U`g]a d`Y`hYI h`YX]hcf`cf`k]h\`A]\WfcgcZh`9I \Wf`\ z`\ck Yj Yfz`i gYfg`\Wb`ei]\w_`m
\WfYUhY`UbX`a Ub]di `UhY`=bdi hgz`Ci hdi hg`cf`Ubm`ch\Yf`dfc^Y\WiUhYf]\i\Y\Y]gf]b[`]b`h\Y`@b_A UghYf`dfc^Y\Wij]\UhX`a Ub]di `UhY`=bdi hgz`Ci hdi hg`cf`Ubm`ch\Yf`dfc^Y\WiUhYf]\i\Y\Y]]\g\]b[`]b`h\Y`@b_A UghYf`dfc^Y\Wij]\UhX`a Ub\

 $H\Y'YUg]Ygh'k\ Um'hc`WYUhY`U`@]b_A\ UghYf`7GJ`Z]'Y`]g`hc`ghJfh'k\]h\`U`hYa\ d`UhY"`Hc`WYUhY`U`hYa\ d`UhY"`H\Y`VUg]W @]b_A\ UghYf`dfc^YWh]b`7GJ`Zcfa\ Uh'Vm'W]W_]b[p "`H\]g`gY`YWh]cb`k\]```WYUhY`U`hYa\ d`UhY"`H\Y`VUg]Wdfc^YWh g\ci`X`WcbhU]b`Uh``YUgh`cbY``]b_`[fci\dž`U``]b__`]hYa\`UbX`U``]b__`]hYa\`ci\hdi\h'$

5 '@b_A UghYf'7GJ 'Z]'Y`XYZ]bYg'U`Wca d`YhY`dfc^YWf'K \Yb`@b_A UghYf']a dcfhg'U'7GJ 'Z]'Yž']h'WfYUhYg'U'bYk 'dfc^YWf'h\Uh WcbhU]bg'cb`m'h\cgY`[fci dg'UbX`]hYa g'XYZ]bYX`]b'h\Y'7GJ 'Z]'Y"'Hc'UXX`]hYa g'hc'Ub'Yl]gh]b['dfc^YWfzZ]fgh'Yl dcfh'h\Y dfc^YWf'Ug'U'7GJ 'Z]'Yž'YX]h'h\Uh'Z]'Yž'UbX'h\Yb']a dcfh']h'VUW_`]bhc'@b_A UghYf"

 $H\]g'[YbYfUhYg'U'Z]Y'h\ Uh'WcbHJ]bg'U'fYWcfX'Zcf'YUW. ``]b_'[fci dž'`]b_']hYa' `Ci hdi h'XYZ]bYX']b'h Y'dfc'YWf'' \\$

 $\text{H\YfY'UfY'h\fYY'V`c}\underline{W}\underline{g}\text{`c}Z\text{`fYW}\text{`fXg']}b\text{`U'@]}b\underline{A}\text{ UghYf'7GJ'Z]}\text{`Y'''H\Ym'UfY'Ug'Zc``ck}\underline{g}.$

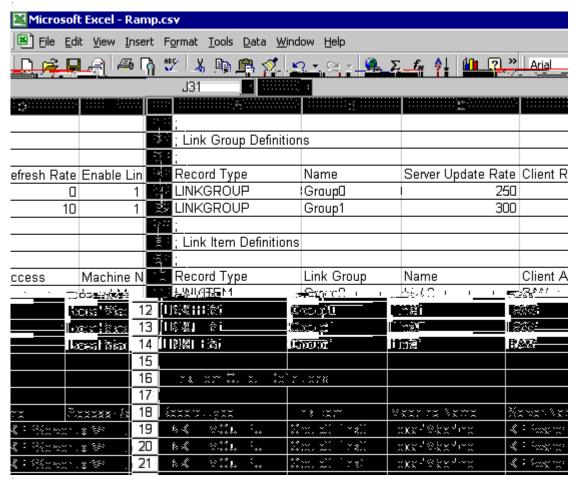
- $\notin H\Y'Z]fgh'V`cW_'WcbhU]bg'fYWcfXg'h\Uh'XYZ]bY'h\Y'`]b_'[fci dg''$

9UW\ 'V`cW_'\Ug'U'

 $\label{eq:cf'} $$ `cf' YUXYf'fYWcfX'' 5 `XYgWf] dh] cb'cZ'YUWX'] g'dfcj] XYX'] b'h\Y'hUV'Y'VY`ck'' $$$

F YWcfX HmdY	"@-B?; FCI D″	M/g'!'aigh'VY'%gh'Wt`iab
BUa Y	5bmj U`]X`[fci d'bUa Y'i b]ei Y'hc'dfc′YVM	₩g
GYfj Yf'I dXUhY'FUhY	8YWJa U`fla gŁ	Вс
7`]Ybh'FYZfYg\'FUhY	8YWJa U`fla gŁ	

]hYa 'V`cWg'O; fci d2"O=hYa 2	
A UWX]bY'BUa Y	BUa Y'cZ'a UVX]bY'CD7'gYfj Yf']g'fi bb]b['cb	MYg
GYfj Yf BUa Y	BUa Y'cZ'CD7'gYfj Yf	М∕g
5 WW gg DUh	5WW gg dUh\ 'Ug XYZ]bYX]b CD7 gYfj Yf	Вс
=hYa '=8	=hYa =8 'Ug'XYZ]bYX]b CD7 'gYfj Yf	MYg
8 UhU Hmd Y	"K cfX"ž'"G\cfh"ž'": `cUh"ž'YhW"fKUhU`hmdY'h\Uh'@]b_A UghYf k]```i gY'Zcf``]b_`]hYa `ci hdi h'XUhUŁ	Вс



 $% \label{eq:continuity} \\ \% \label{eq:continuity} \\ \$ \label{eq:continuity} \& \label{eq:continuity} \\ \& \label{eq:continuity} \& \label{eq:continuity} \\ \& \label{eq:continuity} & \label{eq:continuity} \\ & \label{eq:continuity} \\ & \label{eq:continuity} & \label{eq:continuity} \\ & \label{eq:continuity} & \label{eq:continuity} \\ & \label{$

&" 7c`i a b'bUa Yg'a i gh'VY'Yl UWhmh\Y'gUa Y'Ug'h\cgY'`]ghYX'UVcj Y"

' " 9I Wrdhk \YfY bchYX UVcj Yž Wc`i a bg a UmVY]b UbmcfXYf"

(" 7ci a bg' Zcf' Z]Y`Xg'bch'fYei]fYX'Vm@b_A UghYf'UfY'cdh]cbU'''

-) " DUfUa YhYfgʻbchʻYl d`]V\\h`mXYZ\bYX`]bʻh\Y`7GJ`Z\Y`k]```VY`Ugg][bYX`Uddfcdf]UhY`XYZUi `h`j U`i YgʻVm'@|b_A UghYf"
- $\begin{tabular}{ll} *"5```]b_']hYa g'a i gh'fYZYfYbWf'h\Y'`]b_'[fci d'hc'k \]W\']h'VY`cb[g"'=Z'h\Y'dUfYbh'`]b_'[fci d']g'bch'UXXYX'Xi f]b[g'a dcfhž'Xi Y'hc'ca]gg]cb'Zfca 'h\Y'7GJ'Z]'Y'cf'ch\Yf'fYZYfYbW]b['Yffcfgž'h\Y'`]b_']hYa 'k]``bch'VY'UXXYX'' \\ \end{tabular}$
- +"5```]b__']hYa 'cihdihg'aigh'fYZYfYbWY'h\Y']b__']hYa ']hVY`cb[g'hc"'=Z'h\Y'dUfYbh``]b__']hYa ']g'bch'UXXYX'Xif]b[']adcfhž

Xi Y`hc`ca]gg]cb`Zfca 'h\Y`7GJ`Z]`Y`cf`ch\Yf`fYZYfYbW[b[`Yffcfgž`h\Y``]b_`]h\Ya 'ci hdi h'k]```bch`VY`UXXYX"

- , "7ca a YbhgʻUfYʻU``ck YXʻUbX`a i ghʻVY[]b`k]h\`UʻgYa]Wc`cb`″/""6`Ub_``]bYgʻUfY`hc`YfUhYX`UbX`WbbʻVY`UXXYX Ubmk\YfY`]b`h\Y`7GJ`Z]`Y"
- " =hYa `]XYbh]Z]Yf`fYWtfXg`a Umbch`\Uj Y`Ubm'V`Ub_`Z]Y`Xgž`i b`Ygg`h\YmUfY`i gYX`hc`dUX`h\Y`YbX`cZ`h\Y`fYWtfX"`Gca Y Udd`]WUh]cbgž`gi W\`Ug`A]WfcgcZhʻ9I Wf`¦ ž`k]```UXX`UXX]h]cbU``Wta a Ug`Uh'h\Y`YbX`cZ`fck g"

 $CbWf'h Y'7GJ 'Z]Y' \ Ug'VYYb'YX]hYX'UbX'gUj YXž']h'WUb'VY']a \ dcfhYX'VUW_']bhc'@b_A \ UghYf'Vm'W]W_]b[' p' " I gYfg'k]```VY'dfca dhYX'hc'gUj Y'h\Y'W ffYbh'dfc'YWh']Z]h' \ Ug'bch'U`fYUXm'VYYb'XcbY"'@b_A \ UghYf'k]```h\ Yb'WfYUhY'U'bYk dfc'YWh'h\ Uh'WbhU]bg'U```cZ'h\Y'[fci dg'UbX']hYa g'XYZ]bYX']b'h\Y'7GJ 'Z]Y""$

 $= Z'Ub']hYa']XYbh]Z]Yf'fYWcfX']g'ZcibX'hc'VY']bj'U']X'Xif]b[']a'dcfhz'@]b_AUghYf'k]``bch'UhhYadh'hc'fYUX'UbmUXX]h]cbU``fYWcfXg''$

9ffcfg'c[[YX'Xi f]b['7GJ']a dcfh'WUb'VY'gYYb'k]h\'h\Y'9jYbh'J]YkYf'Udd`]WUh]cb"

 $\begin{tabular}{ll} $ K \begin{tabular}{ll} $ K \be$

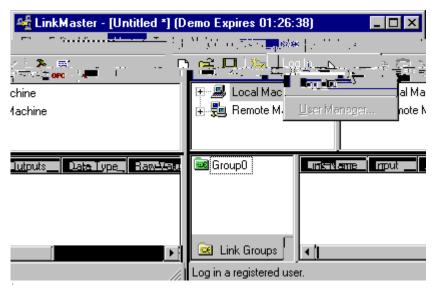
@]b_A UghYf^[]j Yg^i gYfg^h\Y`cdh]cb^cZ^fi bb]b[`hk c^@]b_A UghYf^a UW\]bYg^Ug^UfYXi bXUbhdU]f"`H\Y`FYXi bXUbWmZYUhi fY]bWfYUgYg^h\Y`@]b_A UghYf^WcbbYWf]cbgfifY`]UV]`]lm*UbX`h\Y`CD7`XUhU`VY]b[`hfUbgZYffYX"`K\Yb`FYXi bXUbWm]g`YbUV`YX.

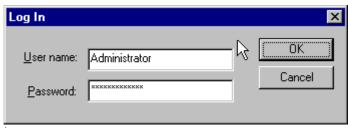
- ∉ CbY'@]b_A UghYf'a UVX]bY'cdYfUhYg'Ug'h\Y'
- 'UVM]j Y`m'dYfZcfa]b[``]b_'hfUbgZYfg"
- ∉ H\Y`ch\Yf`@]b_A UghYf`a UV\\]bY`cdYfUhYg`Ug`h\Y`

H\Y'df]a UfmbcXY']bZcfa g'h\Y'gYWbXUfmbcXY'h\Uh']h']g'i d'UbX'fi bb]b['VmdYf]cX]WJ`mgYbX]b['U' "'=Z'h\Y'gYWbXUfmbcXY'XcYg'bchfYWf]j Y'h\Y'df]b['Zfca 'h\Y'df]a UfmbcXY'Zcf'U'dfY! WbZ][i fYX'Ua ci bh'cZ'h]a Yż'h\Y'gYWbXUfmbcXY Ui rca Uh]WJ`mhJ_Yg'cj Yf'h\Y'fc`Y'cZ'h\Y'df]a UfmbcXY'UbX'dYfZcfa g'h\Y'`]b_'hfUbgZYfg"'K\Yb'h\Y'df]a UfmbcXY'Wta Yg VUW_'i d'U[U]bž'h\Y'gYWbXUfmbcXY'grcdg'dYfZcfa]b['']b_'hfUbgZYfg'UbX'h\Y'df]a UfmbcXY'fYgi a Yg']hg'cdYfUh]cbg"

: cf`U`a cfY`XYhJ]`YX`XYgWf]dh]cbž`]bWi X]b[`\ck 'hc`WbZ][i fY`UbX`YbUV`Y`@]b_A UghYf`fYXi bXUbWhž`fYZYf`hc

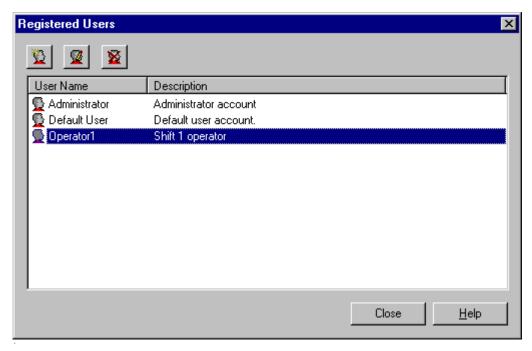
Hc'[U]b'UWWYgg'hc'h\Y'_____X]U'c['Vclž'W]W_' 'Zfca'h\Y'hUg_VUf'a Ybi'UbX'gY'YWh "





:: cf'a cfY']bZcfa Uh]cbž'fYZYf'hc'_____"

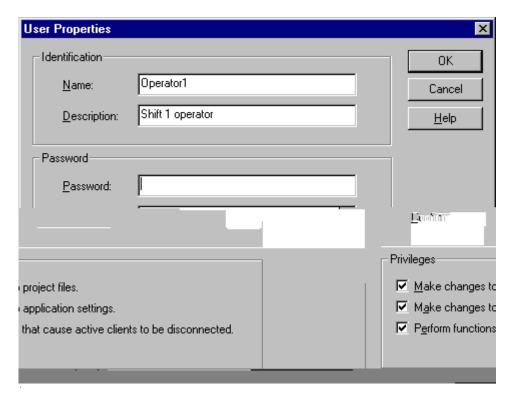
 $H Y T g Y F A UbU[YF]g i g Y X hc `Wtbhfc`h\ Y `UVM]cbg c d Y F Ubch `UWV g g]b `@b_A UghY f" `H\ Y `XYZUi `hi g Y F UWVt b hi [FUbhg Z ```UWV g g hc h\ Y `ZYUhi f Y g c Z @b_A UghY f" `=Z``]a]h Y X `UVWV g g hc h\ Y `dfc 'Y VM]g i bb Y W g g Ufm z h\ Y T g Y F A UbU[Yf g mghYa `Xc Y g b c h b Y Y X hc `V Y Y X]h Y X "$



H\YfY`UfY`UfX Umg`lk c`i gYf`UVWti bhg`Uj Uj`UV`Y`VmXYZJi`h`h\Y`
Cb`mh\Y`5Xa]b]ghfUhcf`UVWti bh'Wb`VY`i gYX`hc`UXX`UXX]h]cbU`i gYf`UVWti bhg'hc`h\Y`gmghYa `cf`hc`WXUb[Y`h\Y`gYh]b[g`cZYI]gh]b[`UVWti bhg''`6m`XYZJi`h'z`h\Y`dUggk cfX`Zcf`h\Y`5Xa]b]ghfUhcf`UVWti bhg''`6m`XYZJi`hz`h\Y`dUggk cfX`Zcf`h\Y`5Xa]b]ghfUhcf`UVWti bhg''`6m`XYZJi`hz`h\Y`dUggk cfX`Zcf`h\Y`5Xa]b]ghfUhcf`UVWti bhg''`6m`XYZJi`hz`h\Y`i gYf`a UbU[Ya YbhgmghYa `]g`hc`VY`i gYX"H\Y`5Xa]b]ghfUhcf`UVWti bh'Wbbch'VY`XY`YhYXž'Vi h`]lg`bUa YUbX`dUggk cfX`Wb`VY`WXUb[YX"H\Y`UXa]b]ghfUhcf`UVWti bh'Wb'U`gc`VY`i gYX`hc`UXX`UXX]h]cbU`i gYf`UW\ti bhg"`Hc`Xc`gcž\W]\W_cb`h\Y`bYk`i gYf`]Wtb`hc`X]gd`Umh\Y`_____X]U`c["'Hc`YX]h`Ub`YI]gh]b[`i gYf`UW\ti bhëgY`YV\h\N\Y`UV\ti bhUbX`dfYgg`h\Y`]\tb'b" \qquad \qquad \magY`YV\h\h\Y`UV\ti gYf`UW\ti bh`UbX`dfYgg`h\Y`]\tb'b"

H\Y' i gYf'UWti bh']g'i gYX'k \Yb'bc'ch\Yf'UWti bh']g'UWfj Y":H\]g']g'h\Y'bcfa U`WtbX]h]cb'cZ'h\Y'@b_A UghYf" 5`h\ci [\'h\Y'8YZUi `h'I gYf'UWti bh']g'g]a]`Uf'hc'h\Y'5Xa]b]ghfUhcf'UWti bh']b'h\Uh']h'Wbbch'VY'XY`YhYXž']hg'bUa Y'UbX dUggk cfX'UfY'Z]l YX"'H\Y'cb`mk Um'hc'X]gUV'Y'h\Y'8YZUi `h'UWti bh']g'hc'XYbm'U``df]j]`Y[Yg'hc']h''H\]g'Wb'cb`mVY Wta d`YhYX'k \Yb'`c[[YX']b'Ug'h\Y'5Xa]b]ghfUhcf"

@]b_A UghYffg` 'gmghYa 'Wtbhfc`g'k \Uh'UWh]cbg'U'i gYf'WUb'hU_Y'k]h\]b'U'dfc'YWh''H\Y' X]U'c[']g'i gYX'hc'WtbZ][i fY'h\Y'bUa Yž'dUggk cfX'UbX'df]j]'Y[Yg'Uj U]'UV'Y'Zcf'h\Y'UWhti bh''



8 YgWf]dh]cbg'UfY'Ug'Zc``ck g.

- ∉ H\Y` idUfUaYhYf]giigYXihcigdYWjZmiUibUaYiZcfih\YiigYf"H\YibUaYiWUbVYiidihci'% W\UfUWHYfgi]b``Yb[h\"
- # H\Y' 'dUfUa YhYf`]g'i gYX`hc`[]j Y`YUW\i gYf`UW\ti bh'U`Vf]YZ'XYg\f\]dh]cb"'H\]g'\Ub'VY'i gYX`hc`\Y`d`]bgi fY h\Uh'cdYfUhcfg'UfY'i g]b['h\Y'dfcdYf'U\V\ti bh'k\Yb'h\Ym`c[']b"
- # H\Y' 'dUfUa YhYf`]g`i gYX`hc`gdYVJZm`h\Y`dUggk cfX`h\Y`i gYf`a i gh`YbhYf`hc``c[`]b`hc`h\Y`gmghYa "`H\Y dUggk cfX`Wb`VY`i d`hc'%) 'VX\UfUWhYfg`]b``Yb[h\"': cf`h\Y`W\Ub[Y`hc`VY`UWWYdhYXž`h\Y`dUggk cfX`a i gh`VY`YbhYfYX WtffYWh`m`]b`Vch\`h\Y`DUggk cfX`UbX`7cbZ]fa 'Z]Y`Xg"'9UW\`h]a Y`U'i gYf`UWwti bh`]g`YX]h\Yž'h\Y`dUggk cfX`a i gh`VY`fY! YbhYfYX"'=Z'h\Y`dUggk cfX`Z]Y`X']g``YZh`V`Ub_ž`h\Y`dUggk cfX`k]``VY`fYa cj YX`Zfca 'h\Y`UWwti bh"

(\$\$`A\n'DYbh]i a *(`A6'cZFUa %\$`A6'cZ'<UfX'8]g_'GdUWY 5j U]`UV'Y'GYf]U``Dcfh'cf'9h\YfbYh'7UfX

I gYfg'a Um\Uj Y'hc`]bghU``A]WfcgcZh`=bhYfbYh`9I d`cfYf`j Yfg]cb'("\$'cf`VYhYf"'=b'h\Y'dUghž'A]WfcgcZh`\Ug'W\cgYb'hc gi dd`mgca Y'gmghYa 'dUhW\Yg'Ug'dUfh'cZ'h\Y'=bhYfbYh'9I d`cfYf`]bghU``"'A cgh'bchUV`nž'h\Y'Wta a cb'Wtbhfc`g'X]U`c['8@g\Uj Y'VYYb'dUhW\YX']b'h\]g'k Um''=Z'cXX'VY\Uj]cf']g'YI dYf]YbWYX'k\]Y'i g]b['h\Y'i gYf']bhYfZUW''cZ'@b_A UghYf'UbX'=bhYfbYh 9I d`cfYf']g'bch'W ffYbhm]bghU``YXž'i gYfg'a Um'VY'fYei]fYX'hc']bghU``']h']b'cfXYf'hc'fYa YXm'h\Y']ggi Y"

H\Y'cj YfU``'WcbWfdhcZ'h\Y'@b_A UghYf`]g'hc'W\ccgY`]bdi h']hYa g'Zfca 'cbY'CD7'gYfj Yf'UbX'`]b_'h\Ya 'hc'cbY'cf'a cfY ci hdi h']hYa g'Zfca 'Ubmch\Yf'CD7'gYfj Yfž'h\i g'WfYUh]b['k\Uh']g'W\`YX'U'______"'6YZcfY``]b_']hYa g'UfY'WfYUhYXž'U ______'a i gh'VY'gdYWJZJYX"'@b_'[fci dgž'`]b_g']hYa g'UbX'h\Y]f']bdi hg'UbX'ci hdi hg'UfY'h\Y'Wta dcbYbhg'h\Y'Udd`]WUh]cb dfcj]XYg'Xg'Zcf'WfYUh]b['U'dfc^YWf''H\Y'Udd`]WUh]cb'U'gc'dfcj]XYg'h\Y'UV]`]hm'hc'XYZ]bY'a i 'h]d'Y'dfc^YWfZJ'Ygž'gUj Y'UbX'`cUX h\Ya 'Ug'bYYXYX"

K\]'Y'a cgh'cZ'h\Y'WtbZ][i fUh]cb'XcbY'k]h\]b'@b_a UghYf']g'WtbhU]bYX'k]h\]b'U'dfc^YWfZJ'Yž'h\YfY'UfY'U'gc'U'bi a VYf'cZ WtbZ][i fUh]cb'cdh]cbg'h\Uh'UfY'['cVU'hc'@b_A UghYf'UbX'UfY'Udd']YX'hc'U'`dfc^YWfg''H\YgY'['cVU'cdh]cbg'UfY'WtbZ][i fYX']b

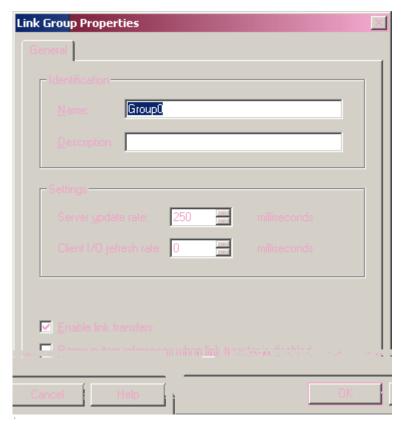
h\Y' p a Ybi "'H\Y'[`cVU`cdh]cbg`]bWi XY' \(\bar{z}\) \(\bar{z}\)

 $\label{lem:hamiliary} $$HY'Zc``ck]b['dfc'YWh'k]^*]^*ighfUhY'h\Y'cdYfUh]cb'cZ'@b_A UghYfž'k \]W\Wb'VY'igYX'hc'WcbbYWh'hc'a i `h]d`Y'CD7'gYfj Yfg cb'a i `h]d`Y'`cWU'`UbX`fYa chY'a UW\]bYg": cf'g]a d`]\\\\\\mathref{h}\ma$

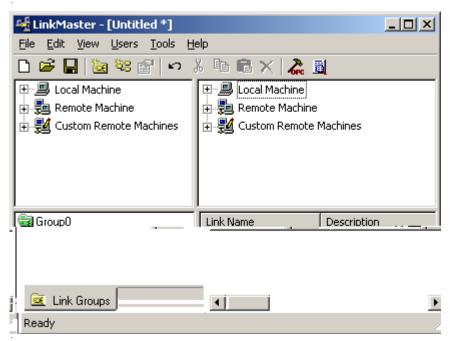
:: cf`a cfY`]bZcfa Uh]cbž`fYZYf`hc`	u
-------------------------------------	---







' "'7`]\<u>W</u> ' 'hc'\\cappa a d'Yh\Y'h\Y'UXX]h]cb'cZ'h\Y'`]b_'[fcid"



("'=Z'h\Y'[fci d'k Ug'UXXYX'WtffYWhmz'h\Y'[fci d']Wtb: g\ci `X'VY'j]g]V'Y']b'h\Y'`ck Yf'`YZh\UbX'k]bXck 'cZ'@]b_A UghYf"'=Zh\Y'[fci d']Wtb'hi fbg'[fUm@]: Uh'Ubmdc]bh'Xi f]b['h\Y'dfc'YWh'fi bz'h\YfY']g'a cgh'm`]_Y'm'Ub']h'a ']b'h\Y'[fci d'h\Uh']g']b
Yffcf"'=Z'gcz'Wtbgi `h'h\Y'Yj Ybh'`c["'=Z'h\Y'[fci d'Wt`cf']g'fYX'@z'h\Y'`]b_'hfUbgZYfg'Zcf'h\Uh'[fci d'\Uj Y'VYYb'X]gUV'YX"

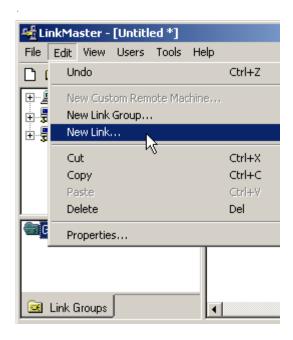
:: cf'a cfY']bZcfa Uh]cbž'fYZYf'hc'______"

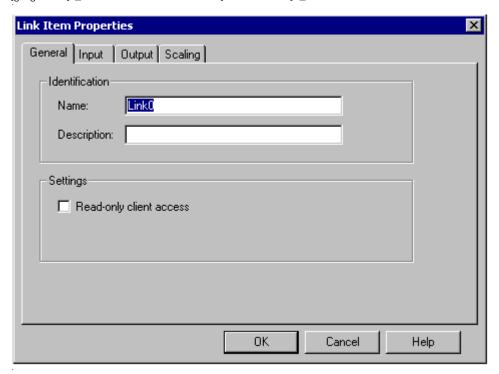
 $\label{eq:hamiltonian} $H\Y'Zc``ck\]b[\YI\ Ua\ d`Y'i\ gYg'h\Y'?\ 9DGYfj\ Yf9L\ C\ D7\ g]a\ i\ `Uhcf`Xf]j\ Yf'dfc\ YWh'WU``YX'g]a\ XYa\ c"cdZ'k\ \]bk\ YY'Zcib\ bX']bh\ YY'?\ 9DGYfj\ Yf9L\ 'VYZcfY'\UXX]b[\ 'U'`]b_\ HU[\ h'\Y'@]b_A\ UghYf'dfc\ YWh''$

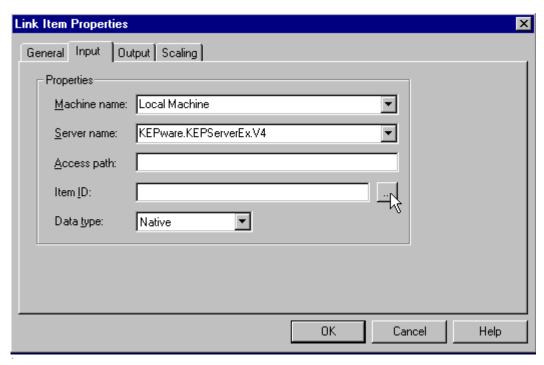


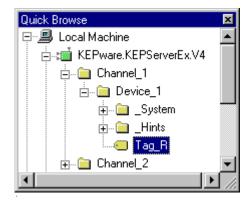
`]Wcb"`H\YfY`UfY`hk c`a Yh\cXg`Zcf

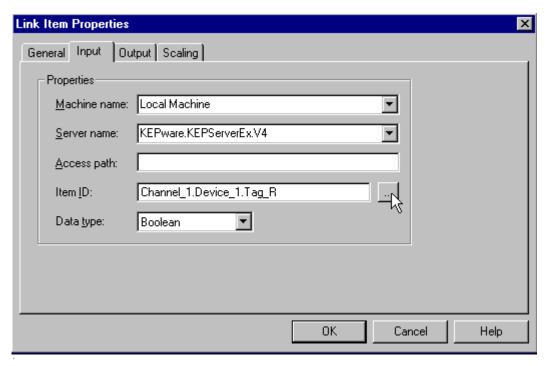






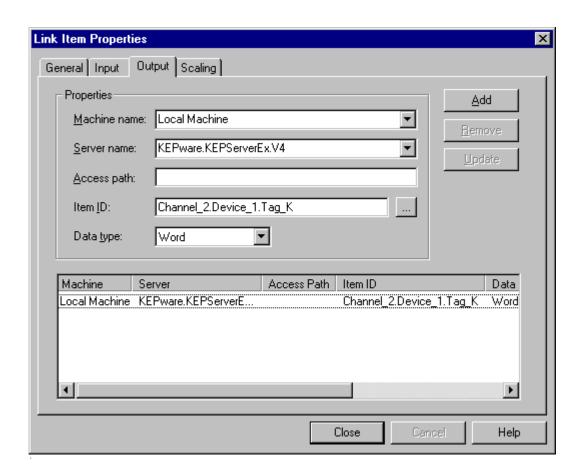






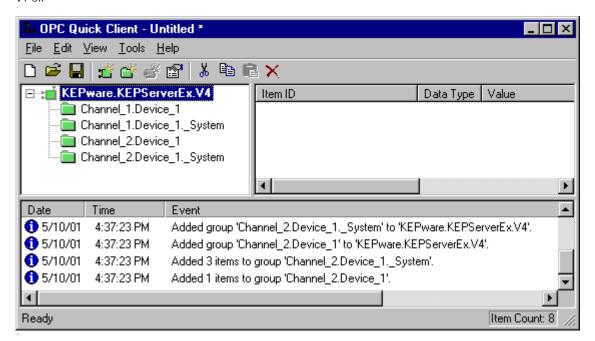
+""BYI hž gY`YVMrh\Y`_______'Vm'W]\W_]b[`cb'h\Y'ci hdi h'hUV""I gY`h\Y`E i]\W_`6fck gY`hc'ei]\W_`m`c\WUhY`h\Y`WcffYWh gYfj Yf""8ci V`Y! \W]\W_`cb'h\Y']h\a 'cb' \z`c\W\`a \UW\]bYz'hc \UXX`h\Y'ci hdi h']h\a ""H\]g_]\bghUbh`m\WfYUh\g`Ub`U\W]j Y``]b__'Zfca ']\bdi h' hc'ci hdi h "



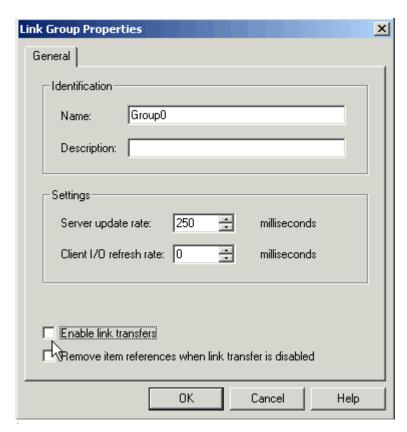


@b_`]hYa g`WUb`U`gc`VY`WYUhYX`VmXfU[[]b[`UbX`Xfcdd]b[``]b_`]bdi hg`UbX`ci hdi hg`Zfca `h\Y`@b_A UghYffg`a U]b`k]bXck "
: cf`a cfY`]bZcfa Uh]cbž`fYZYf`hc`_____"

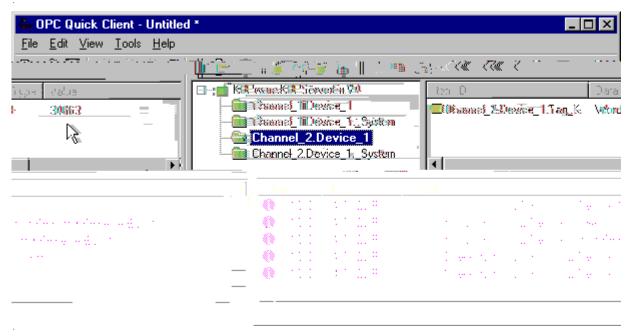
=Z'h\Y``]b_']hYa 'k Ug'WtffYWhm'UXXYXž'h\Y``]b_']Wtb ' g\ci `X'VY'j]g]V`Y']b'h\Y``ck Yf'k]bXck 'cZ@]b_A UghYf"'=Z'h\Y``]b_]Wtb'hi fbg'[fUm' ' 'Uh'Ubm'dc]bh'Xi f]b['h\Y'dfc'YWh'fi bž'h\YfY']g'a cgh']_Y`m'Ub']bWtffYWh']bdi h'cf'ci hdi h'Zcf'h\Uh']hYa "'=Z h\Y``]b_']hYa 'Wt`cf']g'fYX' $cdYfUh]cbg^{\circ}Uj^{\circ}UV^{\circ}Y^{\circ}]b^{\circ}Ubm^{\circ}CD7^{\circ}W]Ybh^{\circ}Udd^{\circ}WUh]cb^{\circ}H^{\circ}Y^{\circ}Ei^{\dagger}W^{\circ}7^{\circ}]Ybh^{\circ}]g^{\circ}i^{\circ}gYX^{\circ}h^{\circ}UWW^{\circ}gg^{\circ}U^{\circ}^{\circ}cZ^{\circ}h^{\circ}Y^{\circ}XUhU^{\circ}U^{\circ}Y^{\circ}]b^{\circ}h^{\circ}Y^{\circ}gYf^{\circ}Y^{\circ}H^{\circ}Y^{\circ}gYf^{\circ}gY^{\circ}H^{\circ}Y^{\circ}gYf^{\circ}gYf^{\circ}H^{\circ}Y^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}Y^{\circ}H^{\circ}Y^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}Y^{\circ}H^{\circ}Y^{\circ}gYf^{\circ}gYf^{\circ}Y^{\circ}H^{\circ}Y^{\circ}gYf^{\circ}gYf^{\circ}Y^{\circ}gYf^{\circ}Y^{\circ}gYf^{\circ}Y^{\circ}gYf^{\circ}gYf^{\circ}Y^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}gYf^{\circ}Y^{\circ}gYf^$



&"'8UHJ'g\ci`X'bck`VY'UV`Y`hc`VY'UWWggYX`Zfca`?9DGYfjYf9Lfg'dfc^YWh'″g]aXYac"cdZ'`k\]W\WbbHJbg'″HU[SF″'cb ″7\UbbY`S%"8Yj]WYS%"UbX`″HU[S?″'cb'″7\UbbY`S&"8Yj]WYS%""'6ch\`HJ[g'k]```UddYUf`fUad]b["'Hc'hYgh'h\Y``]b_ž'j]Yk 'h\Y `]b_fg'[fcid'dfcdYfh]Yg'UbX`X]gUV`Y'h\Y``]b_'hfUbgZYf"

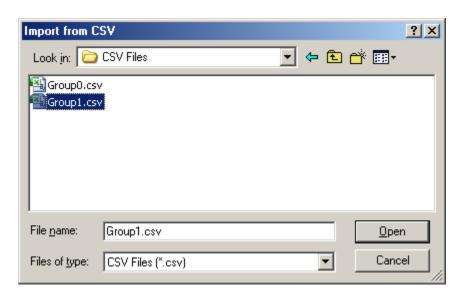


' "'5ZhYf`X]gUV`]b['@]b_\$ž'h\Y`ci hdi h`]hYa 'HU[S? 'k]```ghcd`fUa d]b["'GhUfh'h\Y'hfUbgZYf`VUW_'i d'Vm'YbUV`]b['h\Y`[fci dfig hfUbgZYf`gYh]b['UbX'h\Y'hU['k]``VY[]b`fUa d]b['U[U]b"



 $= Z'i g]b['J]gi U''6Ug]WYfYa Ya VYf'hc'Yl Ua]bY'h\Y'gi dd`]YX'Yl Ua d`Y'dfc^YWhg''H\YgY'hk c'dfc^YWhg'[]j Y'Vch\'U g]a d`Y'UbX'Wca d`Yl 'Yl Ua d`Y'cZ'\ck 'CD7'hYW\bc`c[m\Wb'VY'i gYX'X]fYWhm']b'J]gi U''6Ug]WUdd`]WUh]cbg''$

H\Y'Z]fgh'ghYd'fYei]fYX'k\Yb'XYZ]b]b['U'@b_A UghYf'dfc'YVM']g'hc'YghUV']g\'U'@b_'; fci dž'k\]W\'\c'Xg'U'```]b_']hYa g"'H\Y
`]b_'[fci d'a i gh'VY'UXXYX'VYZcfY'XYZ]b]b['h\Y'XUhU']hYa g 'h\Uhk]'`'VY'`]b_YX'hc[Yh\Yf"'H\Y'`]b_'[fci dfig'DfcdYfh]Yg'X]U'c[
]g'i gYX'hc'Wcbffc''UbX'cdYfUhY'h\Y']b_']hYa gz'UbX'WUb VY'i gYX'hc'UX'i gh'h\Y'fUhY'cZXUhU'hfUbgZYffYX'Zfca 'h\Y'@b_
]bdi hg'hc'h\Y'@b_'ci hdi hgz'Ug'k Y``'Ug'hc'YbUV'Y'UbX'X]gUV'Y'U``cZX]d `fl j VX'cD
`]'gYXd
]
]fci d@



`K\Yb`U`dfc^YWM`YjY``]adcfh`]g`]b]h]UhYXž`U```YI]gh]b[`@b_'; fcidg`UbX`h\Y]f`UggcW]UhYX`@b_'=hYag`k]``VY fYacjYX`Zfca`h\Y`W`ffYbh`UWh]jY`dfc^YWh`UbX`fYd`UWYX`k]h\`h\Y`@b_'; fcidg`UbX`@b_'=hYag`UggcW]UhYX`k]h\`h\Y`7GJ`Z]`Y"

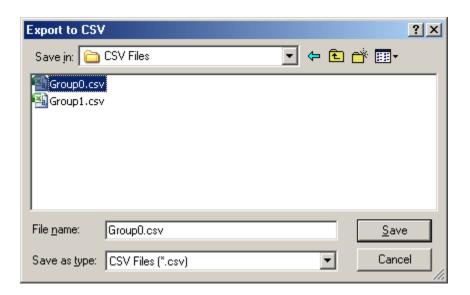
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I gYfg'WUb'YI dcfh'U'g]b['Y'@]b_'; fci d'7GJ'Zfca 'U'gY'YVWYX'@]b_'; fci d"'8c]b['gc'cb`mi h]`]nYg']hYa g'VY`cb[]b['hc'h\Uh gY`YVWYX'@]b_'; fci d'UbX']hg'UggcW]UhYX'@]b_'=hYa g"'H\YgY']hYa g'a UmVY'YI dcfhYX'k]h\ci h'X]gfi dh]b['h\Y'dfY!YI]gh]b[@]b_'; fci dg'UbX'@]b_'=hYa g"':cf'a cfY']bZcfa Uh]cbž'fYZYf'hc'h\Y']bghfi Wh]cbg'VY`ck"

%" Hc`gnUfhžf][\h\W]W_`cb`h\Y`gY`YWMYX`[fcid"`H\Ybž'gY`YWM` "5`hYfbUh]jY`mž'W]W_`hc gY`YWM`h\Y`XYg]fYX`[fcid"`H\Ybž'W]W_` p` "





 $K \ Yb \ XYZ[b]b[\ "U:@b_A \ UghYf'dfc \ "YW\"h.Y \ Z]fgh'ghYd']g'hc \ 'YghUV']g. \ "U'`]b_'[fci dz'k \]W. \ '\c'Xg'h\ Y'`]b_']hYa g'''H\ Y'']b_'[fci day' UXXYX' VYZcfY'h\ Y'XUhU']hYa g'h\ Uh'k]'``VY'`]b_YX'a Um'VY \ XYZ[bYX"'H\ Y'']b_'[fci day' DfcdYfh]Yg'X]U'c['a Um'VY'i gYX'hc \ Wbhfc`'UbX'cdYfUhY'h\ Y'']b_']hYa gz'UX'i gh'h\ Y'fUhY'cz'XUhU'hfUbgZYffYX'Zfca 'h\ Y'`]b_']bdi hg'hc 'h\ Y'`]b_'ci hdi hgz'YbUV'Y UbX'X]gUV'Y'U''`cz'h\ Y'hfUbgZYfg'WbhU]bYX']b'h\ Y'[fci d'UbX'fYa cj Y']hYa 'fYzYfYbWfg'k \ Yb'`]b_'hfUbgZYf']g'X]gUV'YX'' @]b_A UghYffay gmghYa 'hU[g'Wb'VY'i gYX'hc 'UWWgg'h\ Y'`]b_'[fci dg'Zfca 'Ub'C D7' W]Ybh'Udd']Wh]cb''$

5g'a Ybh]cbYX'UVcj Yž``]b_'[fci dg'a i gh'VY'UXXYX'hc'h\Y'dfc^YVW'VYZcfY'UXX]b['Ubm``]b_']hYa g"'@]b_'[fci dg'U``ck 'i gYfg'hc hU]'cf'h\Y'`Umci h'cZ``]b_']hYa g']bhc'`c[]\WD''[fci d]b[g']b'cfXYf'hc'Z]h'h\Y'Udd`]\WUh]cbfij bYYXg"': fca 'Ub'CD7'W]Ybh ghUbXdc]bhž``]b_'[fci dg'U``ck 'i gYfg'hc'gY[fY[UhY'CD7'XUhU']bhc'ga U``Yf']hYa '`]ghg"'H\]g'a U_Yg'gYUfW\]b['Zcf'U'gdYW[Z]W \]b_']hYa 'YUg]Yf'k\Yb'Vfck g]b['h\Y'@]b_A UghYf'j]U'Ub'CD7'W]Ybh'



9bhYf`h\Y`ghf]b[`h\Uh'k]```fYdfYgYbh'h\Y`XUhU`Uj U]`UV`Y`Zfca `h\]g`[fci d"`9UW\`]b_`[fci d`bUa Y`a i gh'VY`i b]ei Y`]b`U @b_A UghYf`Udd`]WUh]cb"`H\Y``]b_`[fci d`bUa Y`Wub`VY`i d`hc`, \$`W\UfUWhYfg``cb["'K\]`Y`i g]b[``cb[`XYgWf]dh]j Y`bUa Yg`]g [YbYfU``m'U`[ccX`]XYUž'gca Y`CD7`W]Ybh'Udd`]WUh]cbg`a Um\Uj Y`U``]a]hYX`X]gd`Um'k]bXck 'k\Yb`Vfck g]b['h\Y`hU['gdUWY`cZ Ub`CD7`gYfj Yf`gi W\`Ug`@b_A UghYf"`H\Y``]b_`[fci d`bUa Y`YbhYfYX`\YfY`k]```VY`dUfh'cZ'h\Y`CD7`Vfck gYf`]bZcfa Uh]cb"

5`Wa a YbhcZi d`m:*(`WXUfUWMYfg`WUb`VY`UhhUWXYX`m:h\Y``]b_[fci d`m:gYfj Y`Ug`U`XYgWf]dh]cb"

 $H \setminus [g'gdYW]Z/Yg'h \setminus Y'fUhY'Uh'k \setminus [W'@]b_A UghYf'k]^``W\YW_'h \setminus Y'`]b_fig']bdi h']h Ya fight Zcf'W\Ub[]b['j U'i Yg'UbX'i dXUhY'h \Y'`]b_fig ci hdi h']h Ya fight [Zcf'W\Ub[Y'\Ug'cWW'ffYX"']h \]g'gYh]b['XcYg'bch'fY[i `UhY'h \Y'W\Ub[]b[']bdi h'j U'i Yg'Zfca 'h \Y'gYfj Yf. `XUhU W\Ub[Y'Y]Ybhg'Zfca 'h \Y'gYfj Yf'k]``gh]```VY'k f]hh Yb 'hc 'h \Y'`]b_ci hdi hg'Ug'h \Ym'UfY'fYWY]j YX"': cf'h \cgY'ZUa]`]Uf'k]h \CD7 h Yfa]bc`c[mz'h \]g'j U'i Y'Yei UhYg'hc'h \Y'gYfj Yffig'[fci d'i dXUhY'fUhY'UbX'Wub'X]WhYh'\Y'fUhY'h \Uh'h \Y'CD7'gYfj Yf'k]``'dc``]hg'WbbYWYX'XYj]WYg''=Z'h Y'XUhU'h \Uh'k]``VY'hfUbgZYffYX'hc'h \Y'ci hdi hg'W\Ub[Yg'g`ck `mz'h \Y'gYh]b['g\ci 'X'VY'gYh'hc'U g'ck 'fUhY''h \Y'XYZUi 'h'gYh]b[']g'&) $`a]``]gYWbbXg''' H \Y'j U']X'fUb[Y']g'%$'hc'' z'* $$z$$$'a]``]gYWbbXg'''$

 $= ZigYfg``UjY`WcbZ][ifYX`h\Y`7`]Ybh'= \#C`FYZFYg\`FUhY`UbX`]h`]g`ZUghYf`h\Ub`h\Y`GYfjYf`IdXUhY`FUhYž`]h`k]```HU_YdfYWfXYbWf`cjYf`\ck`cZhYb`cihdihg`UfY`idXUhYX"$

H\]gʻgdYWJZJYgʻh\YʻfUhY`Uh`k\]W\``]b_`]bdi hj U`i Ygʻk]```VY`k f]HYbʻhc``]b_'ci hdi hgžʻfY[UfX`YggʻcZ'Ubm`W\Ub[Y`]b`]bdi h`XUhU"
H\Y`XYZUi `h`gYHd]b[']gʻnYfc`fCZZ!"=h`XcYgʻbch`i gi U``mbYYX`hc`VY`YbUV`YX`VYWUi gY`h\Y`GYfj Yf`I dXUhY`FUhY`]bhYfj U`
X]WhUhYgʻfYZFYg\`k f]hYgʻUVWcfX]b['hc`W\Ub[]b[']bdi hj U`i YgʻZfca 'h\Y`gYfj Yf"'I bbYWfggUfmk f]h]b['hc`h\Y`]bdi h`VWW\Y`k]h\
U'dcgg]V`mbcb! W\Ub[]b[']hYa 'WUb`VY`YI dYbg]j Y`]b`hYfa gʻcZ'7DI 'fYgci fWfg/\ck Yj Yfž']b`WYfhU]b'g]hi Uh]cbg`]h'a Um`VY
]a dcfhUbh'hc`''WcffYWh'`h\Y`]b_fajci hdi h`]Z'ch\Yf`gci fWfg`\Uj Y`k f]HhYb`hc`]h'`H\]gʻdUfUa YhYf`g\ci `X`cb`mVY`i gYX`k \Yb
Wcbh]bi ci gʻi dXUhYgʻhc`ci hdi hgʻUfY`fYei]fYX"

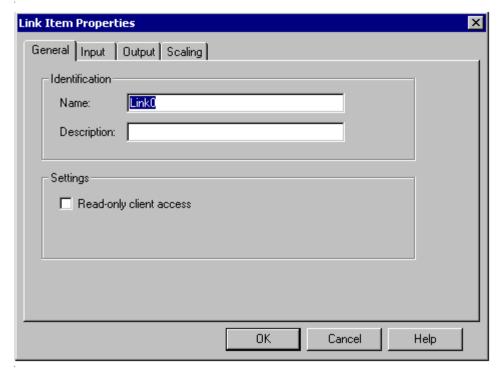
h\Y`_____`gYhh]b[g`XcbY`Vm@]b_A UghYf`hc`\Y`d`fYXi WY`h\Y`bi a VYf`cZk f]hYg`gYbh`hc`h\Y`CD7`gYfj Yf"

H\]g`gYhh]b[`U``ck g`i gYfg`hc`hi fb`Cb#CZZ``]b_`k f]hYg`k]h\]b`h\Uh`[fci d"`H\]g`gYhh]b[`WUb`U`gc`VY`gYhj]U`U`W]Ybh`Vm
UWWYgg]b[`h\Uh`[fci dfg`gmghYa `hU[`WU``YX`~S9bUV`YX~"``: cf`a cfY`]bZcfa Uh]cbž`fYZYf`hc`_____"

 $H\g gYfh]b[\k]^{\f Y} a \g Zfca \h\Y gci fW CD7 gYfj Yf h\Uh'UfY VY]b[\f YZYfYbWYX]b h\Y]b_[\f ci d"H\g gYhh]b[\g gYhh]b[\g gYYh]b V b h b h Y h b h Y h ch h Y h$

=Z'U'[fci d']g'WcffYWnmUXXYXž'h\Y'[fci d']Wcb' g\ci `X'VY'j]g]V'Y']b'h\Y'`ck Yf'`YZh\\UbX'k]bXck `cZ'@b_A UghYf"'=Z'h\Y [fci d']Wcb'h fbg'[fUm lubmdc]bh'Xi f]b['h\Y'dfc'YWnfi bž'h\YfY']g'a cgh`]_Y`mUb']hYa ']b'h\Y'[fci d'h\Uh']g']b'Yffcf"'=Z'gcž'Wcbgi `h'h\Y'Yj Ybh`c["'=Z'h\Y'[fci d'Wc'cf']g'fYX' lubz'h\Y']b_'hYbgzYfg'Zcf'h\Uh'[fci d'\Uj Y'VYYb'X]gUV'YX"

'H\YgY'dUfUa YhYfg'Wub'VY'W\Ub[YX'Uh'Ubmih]a Y'UbX'k]'``hU_Y'YZZYWh']a a YX]UhY`nd' =Z'h\Y'bUa Y'cZ'U`]b_'[fci d']g W\Ub[YX\text{x}\ck Yj Yf\text{x}'CD7'W]Ybhg'h\Uh'\Uj Y'U`fYUXmi gYX'h\Uh'`]b_'[fci d'Ug'dUfh'cZ'Ub'CD7']hYa 'fYei Ygh'k]'`bch'VY UZZYWhYX'i bh]`'h\YmfY`YUgY'h\Y']hYa 'UbX'UhhYa dh'hc'fYUW\i]fY']h''BYk ``]b_'[fci dg'UXXYX'hc'h\Y'dfc^YWh'Wub']a a YX]UhY`m VY'j]Yk YX'Zfca 'Ub'CD7'W]Ybh''Hc'dfYj Ybh'cdYfUhcfg'Zfca 'W\Ub[]b['h\YgY'dUfUa YhYfg\text{x}']a d`Ya Ybh'h\Y'________hc fYghf]Wh'UWWYgg'f][\hg'hc'h\YgY'UbX'ch\Yf'@]b_A UghYf'Z/Uhi fYg"



 $H\g''dUfUa\YhYf'\g'' gYX'hc'UhHUW\'U'Wa a Ybh'hc'h\g'' hU["'5'ghf]b['cZ'id'hc'*('W\UfUWhYfg'Wb'VY'YbhYfYX'Zcf'h\Y XYgWf]dh]cb''=Z'Ub'CD7'W]Ybh'h\Uh'gi ddcfhg'8UhU'5WWgg'&"$'HU['DfcdYfh]Yg']g'VY]b['i gYX<math>z'h$ \Y'XYgWf]dh]cb'dUfUa YhYf'k]'`VY'UWWgg]V'Y'Zfca'h\Y'=\Ya'8YgWf]dh]cb'dfcdYfhm'cZ'h\Y'HU["

 $H\g gYYWfcb \g i gYX hc gdYWZmk \Yh\Yf h\g \g YDbYXCb mcf FYUXK f]hY" 6mgYYVWfb \G FYUX Cb mc YBYUhlbby \G by YWhb \G gYYWfb \G hXYXUhl WcbhUbYX \g hY hY fh \g hY \G hXYXUhl WcbhUbYX \g hY hY \G hXYYW \g hX \g hY \g hY \g hY \g hY \G hXYYXYX" H\Y 7 \g hY fh \G gYYWfb \G b \G hXYYYX \G hX \g hY \G hXYYYX \G hXY \G$

=ZU``]b_']hYa']g'UXXYXž'h\Y``]b_']Wtb'****g\ci`X`VY'j]g]VY`]b'h\Y``ck Yf'k]bXck 'cZ'@]b_A UghYf"'=Zh\Y``]b_']Wtb'hi fbg'[fUm "B'Uh'Ubm'dc]bh'Xi f]b['h\Y'dfc'YWh'fi bž'h\Y']hYa 'a cgh``]_Y`m'WtbhU]bg'Ub']bWtffYWh']bdi h'cf'ci hdi h''=Z'h\Y``]b_']hYa 'Wt'cf]g'fYX'***z'h\Yb'h\Y``]b_'hfUbgZYfg'UbX']hg'[fci d'\Uj Y'VYYb'X]gUV'YX"

`5[U]bž'h\YgY'dUfUa YhYfg`Wub`VY`W\Ub[YX`Uh`Ubmh]a Y"`7\Ub[Yg`a UXY`hc``]b_`hU[`dfcdYfh]Yg`k]```hU_Y`YZZYWh
]a a YX]UhY`mž`\ck Yj Yf. `C D7`W]Ybhg`h\Uh`\Uj Y`U`fYUXm'WcbbYWhYX`hc`h\]g``]b_`]hYa `k]```bch`VY`UZZYWhYX`i bh]``h\Ym´fY`YUgY
UbX`fYUWei]fY`h\]g`hU["'Hc`dfYj Ybh`cdYfUhcfg`Zfca `W\Ub[]b[`h\YgY'dUfUa YhYfgž'i gY`h\Y`________hc`fYghf]Wh`UWWfgg
f][\hg`hc`@]b_A UghYf`ZYUhi fYg"

H\]g`]g`fYei]fYX`Vmgca Y`CD7`gYfj Yfg`hc`Wta d`YhY`Ub`]hYa `XYZJb]h]cb"`FYZYf`hc`h\Y`CD7`gYfj Yffig`XcWa YbhUh]cb`hc XYhYfa]bY`k\Yh\Yf`cf`bchi gYfg`bYYX`hc`gdYWJZm`Ub`UWMYgg`dUh\"

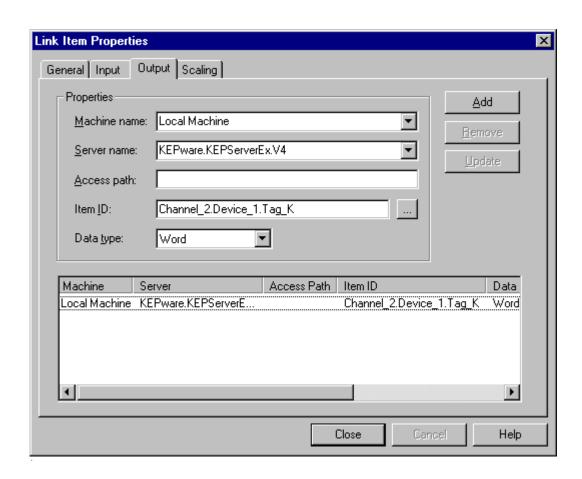
H\Y'CD7'gYfjYf']hYa 'i gYX'hc'fYZYfYbW'h\Y'XUHU"'FYZYf'hc'h\Y'CD7'gYfjYffgiXcWa YbHUh]cb'hc'XYhYfa]bY'j U']X']hYa bUa Yg'Zcf'h\Y'cWuh]cb']b'ei Ygh]cb"'=Z'h\Y'gYfj Yf'gi ddcfhg'hU['Vfck g]b['z'h\Yb'Ub']hYa 'Wub'VY'gY`YWhYX'Vmi g]b['h\Y 6fck gY'ZYUhi fY"

H\]g`]g`h\Y`fYei YghYX`XUhU`hmdY`h\Uh`g\ci `X`VY`i gYX`k \Yb`Wta a i b]\Wbh|b['VYhk YYb`h\Y`CD7 'gYfj Yf`UbX`h\Y`CD7 @b_A UghYf"`H\]g`g\ci `X`VY`gdYV\\Z]YX`hc`U[fYY`k]h\ 'h\Y`g]nY`UbX`hmdY`cZ`h\Y`fY[]ghYf`cf`a Ya cfm`c\\\h\Uh`]g`VY]b[UXXfYggYX"`Gi ddcfhYX`XUhU`hmdYg`UfY`XYZ]bYX`Ug`Zc``ck g"

BUhjj Y	8YZUi `h'Ug'XYhYfa]bYX'Vm'h\Y'CD7'gYfj Yf
6cc`YUb	G]b[`Y'V]h
7\Uf	G][bYX', !V]h'j U'i Y
6nthY	I bg][bYX ⁻ , !V]h ⁻ j U ⁻ i Y
G\cfh'	G][bYX '%* 'V]h'j U'i Y
K cfX'	I bg][bYX˙%* ˙V]h˙j U˙i Y
@cb[G][bYX'' &'V]h'j U'i Y
8K cfX	I bg][bYX'' &'V]h'j U'i Y
FYU'	G]b[`Y`dfYW]g]cb`ZcUh]b[`dc]bh'j U`i Y"`fl & V]h'gŁ
8ci V'Y	8ci V`Y`dfYVljg]cb`ZcUhjb[`dc]bh'j U`i Y`fl* (! V]hgk
Ght]p[NYfc'hYfa]bUhYX'W\UfUV\Yf'UffUm

5```cZ'h\Y'UVcjY'XUhU'hmdYg'UfY'UjU]`UV`Y'Ug'

'YI WYdh'Zcf'6cc`YUb'UbX'Ghf]b["



 $7 \cdot ccgY \cdot Y]h \cdot Yf \cdot h \cdot Y \cdot cWU \cdot a \cdot UW \cdot]bY \cdot cf \cdot U \cdot a \cdot UW \cdot]bY \cdot cWU h \cdot Y \cdot cb \cdot h \cdot Y \cdot 9 h \cdot Yf b \cdot Y h \cdot b \cdot h \cdot Y \cdot gU b m \cdot Uf \cdot Uj \cdot Uj \cdot UV \cdot Y \cdot L' = Z \cdot h \cdot Y \cdot gY f j \cdot Y \cdot f \cdot []g \cdot cWU h \cdot Y \cdot Cb \cdot h \cdot Y \cdot gU a \cdot Y \cdot a \cdot UW \cdot]bY \cdot Ug \cdot @]b _ A \cdot Ug h \cdot f \cdot Z' \cdot Y \cdot J \cdot Y \cdot h \cdot Y \cdot gY h \cdot J \cdot [Ug \cdot Ug \cdot Y \cdot h \cdot Y \cdot gY h \cdot J \cdot J \cdot Y \cdot J \cdot Y$

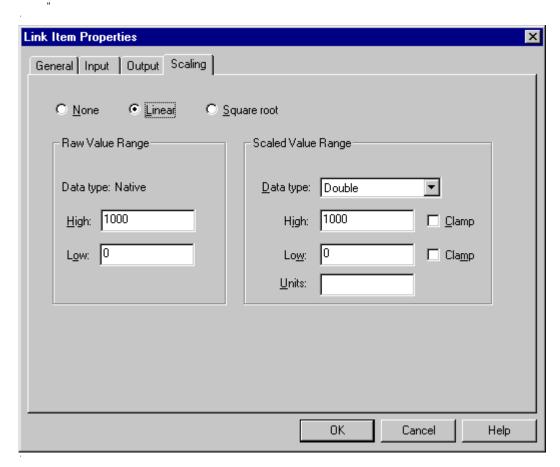
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H\Y'CD7'gYfjYff']hYa 'i gYX'hc'fYZYfYbWr'h\Y'XUhU"'FYZYf'hc'h\Y'CD7'gYfjYffgiXcWa YbhUh]cb'hc'XYhYfa]bY'j U']X']hYa bUa Yg'Zcf'h\Y'cWUh]cb']b'ei Ygh]cb"'=Z'h\Y'gYfjYf'gi ddcfhg'hU['Vfck g]b[ž'h\Yb'i gYfg'WUb'gY'YWh'Ub']hYa 'Vmi g]b['h\Y Vfck gY'ZYUhi fY"

BUh]j Y	8YZUi `h'Ug'XYhYfa]bYX'Vm'h\Y'CD7'gYfj Yf
6cc`YUb	G]b[`Y'V]h
7\Uf	G][bYX´, !V]h'j U`i Y
6mhY	I bg][bYX ⁻ , !V]h ⁻ j U ⁻ i Y
G\cfh'	G][bYX '%* 'V]h'j U`i Y

K cfX	I bg][bYX [·] %* [·] V]h [·] j U [·] i Y			
@cb[G][bYX'' &'V]h'j U'i Y			
8K cfX	l bg][bYX'' &'V]h'j U'i Y			
F YU`	G]b[`Y`dfYW]g]cb`ZcUh]b[`dc]bh'j U`i Y"`fi & V]h'gŁ			
8ci V [·] Y	8ciV`Y`dfYV][g]cb`ZcUh][b[`dc][bh'j U`iY`ff*(! V]hgL			
Ghf]b[NYfc'hYfa]bUhYX'VXUfUVWYf'UffUm			
5```cZ`h\Y`UVcjY`XUhJ`hmdYg`UfY`UjU]`U\	/`Y`Ua` 'YI WYdh'Zcf' 'UbX			

@b_A UghYf`gi ddcfhg` ž`k \]W\`U``ck g`fUk`]bdi h`XUhU`Zfca `h\Y`gYfj Yf`hc`VY`gWU`YX`hc`U`a cfY Uddfcdf]UhY`fUb[Y`Zcf`h\Y`______]hYa `cf`W]Ybh`Udd`]WUh]cb"`H\YfY`UfY`hk c`hmdYg`cZ`gWU`]b[.` `UbX



GY`YVMjb[`Y]h\Yf`@|bYUf`cf`GeiUfY`Fcch`gWU`]b[`k]``YbUV`Y`gWU`]b[`cdYfUh]cbg`Zcf`h\Y`@|b_`⊨HYa"

H\Y`fUk `XUhU`fUb[Y`]g`i gYX`hc`gdYW]Zmh\Y`fUb[Y`cZ`fUk `XUhU`Zfca `h\Y`gYfjYf"`H\Y`j U`]X`fUb[Y`XYdYbXg`cb`h\Y`XUhU`hmdY cZ`h\Y`@]b_`=hYa ftg`fUk `j U`i Y"`=Zz`Zcf`Yl Ua d`Yz`h\Y`fUk `j U`i Y`k Ug`gYh`hc`G\cfhz`h\Y`j U`]X`fUb[Y`cZ`h\Y`fUk `j U`i Y`k ci `X`VY!' &+*, `hc`' &+*+"`H\Y`fUk `\][\`fUb[Y`a i gh`VY`[fVUhYf`h\Ub`h\Y`fUk ``ck `fUb[Y"

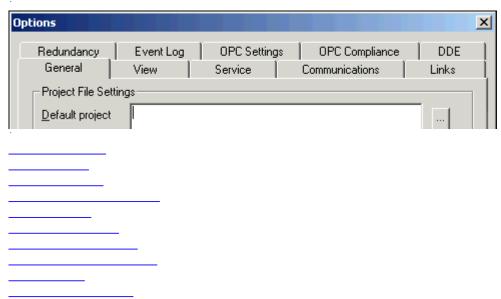
=b`a Ubm\WugYg`h\Y`fUk `XUHU`Zfca `h\Y`XYj]WY`YI WYYXg`h\Y`fUb[Y`h\Uh\\Ug`VYYb`gdY\\]Z]YX`Zcf`h\Y`fUk `XUHU``K \Yb`h\]g c\W\fgž`h\Y`g\W`YX'j U`i Y`]g`U`gc`Zcf\WX`ci hg]XY`cZ`h\Y`YgHUV`]g\YX`fUb[Y"`Hc`dfYj Ybh'h\]gž`i gY`h\Y` 'UbX` hc`\\bghfU]b`h\Y`g\W`YX`j U`i Y`hc`h\Y`fUb[Y`gdY\\]Z]YX"

@lb_A UghYf`U`gc`U``ck g`U`i b]hfg`ghf]b[`hc`VY`Ugg][bYX`hc`U`gWU`YX`@lb_`]hYa "`H\Y`i b]hfg`ghf]b[`WUb`VY`i d`hc`' &`W\UfUWHYfg `cb["

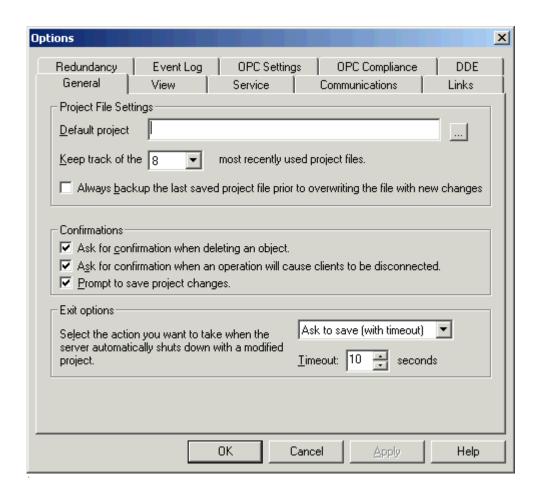
@jb_A UghYf`gi ddcfhg`h\Y`CD7`hU[`dfcdYfh]Yg`Uj U]`UV`Y`]b`h\Y` gdYV]Z]WUh]cbg"`=Z`h\Y`CD7`W]Ybh`VY]b[i gYX`gi ddcfhg`h\YgY`dfcdYfh]Ygž']h`WUb`Ui hca Uh]WU``m'WbbZ][i fY`h\Y`fUb[Y`cZ`cV^YWhgž``]_Y`i gYf`]bdi h`cV^YVhg`cf`X]gd`Umgži g]b[`h\Y`XUhU`YbhYfYX`\YfY"

'H\YgY'dUfUa YhYfg'WUb'VY'W\Ub[YX'Uh'Ubm'h]a Y"'7\Ub[Yg'a UXY'bc'@b_A UghYf'dfcdYfh]Ygz'gi W\'Ug'gWU']b[z'k]\``H_Y YZZYWh']a a YX]UhY`nd'CD7'W]Ybhg'h\Uh'\Uj Y'U'fYUXm'WbbYWhYX'bc'h\]g'@b_']hYa 'HU['k]\``bch'VY'UZZYWhYX'i bh]\`h\YmfY'YUgY UbX'fYUWei]fY'h\]g'hU["'Hc'dfYj Ybh'cdYfUbcfg'Zfca 'W\Ub[]b['h\YgY'dUfUa YhYfgz'i gY'h\Y'_______ bc'fYghf]Wh'UWWYgg f][\hg'bc'@b_A UghYf'ZYUhi fYg"

: cf'a cgh'dfc^YWngz'@b_A UghYffg'XYZUi`h'gYHn]b[g'UfY'UXYei UhY"`=Z'`cc_]b['Zcf'a cfY'Udd']WUh]cb'WcbHfc'`cdh]cbgz'fYZYf'hc h\Y'Zc'`ck]b['\Y'd'hcd]Wg'h\Uh'XYgWf]VY'j Uf]ci g'@b_A UghYf'cdh]cbg"'Hc'UWWYgg'h\Y'Cdh]cbg'X]U'c[z'W]W_' p'H\Y'X]U'c['g\ci'X'UddYUf'Ug'g\ck b'VY`ck "'7`]W_'cb'U'`]b_'Zcf'U'XYgWf]dh]cb'cZ'h\Y'HUV"



 $\label{eq:hamiltonian} Hc `UWW'gg `h Y ; YbYfU` `cdh]cbgž `W] \underline{W} `cb' \qquad \quad \text{`p'} \qquad \qquad \text{`"H} Y X] U `c[`k] `` VY `X] gd `UmY X `Ug `g \ ck \ b `VY `ck " \quad \text{"} \quad \quad \text{"} \quad \quad \text{"} \quad \text{"} \quad \text{"} \quad \quad \text{"} \quad \quad \text{"} \quad \$



- # H\Y' 'Z]Y`X`ghcfYg`h\Y`dUh\`UbX`bUa Y`cZ`h\Y`dfc^YWh`h\Uh`k]``VY`cdYbYX`k\Yb`@b_A UghYf`]g ghUfhYX"'7`]W_`h\Y 'Vi hhcb`hc`h\Y`f][\h`]b`cfXYf`hc`Vfck gY`Zcf`h\Y`dfc^YWh`hc`h\Uh`]g`hc`VY`XYg][\bUhYX`Ug`h\Y XYZUi`h"`=Z'h\Y`Z]Y`X`]g``YZh`V`Ub_ž`h\Y`a cgh`fYWYbh`dfc^YWh`fbf`h\Y``Ugh`dfc^YWh`gUj YXŁ`k]```VY`cdYbYX`k\Yb @]b_A UghYf`]g`ghUfhYX"
- gYhh]b['WUb'VY'i gYX'hc'gdYW]Zm\ck 'a Ubmdfc^YWhZhY'cb'h\Y' 'Zci bX'cb'h\Y':]'Ya Ybi "'H\Y'j U']X'fUb[Y']g'%'hc'%* "
- gYMjb['Wb'VY i gYX'hc'U'k Umg'\Uj Y'h\Y'`Ugh'gUj YX'@b_A UghYf'dfc^YWhffl "`a Zb'Ui hca Uhj\Wb'`m\Vu\V_YX'i d'VYZcfY'@b_A UghYf cj Yfk fjhYg'h\Uh'ZjY'k jh\'U'bYk 'cbY"'H\Y'VU\V_i d'ZjY'k j``VY'bUa YX'dfc^Y\WbUa Y'``a Z'VU_'UbX'ghcfYX']b'h\Y'
 'Zc'XYf"

Hc'dfYj Ybh'i bk UbhYX'W\Ub[Yg'Zfca 'VY]b[']a d'Ya YbhYXž'@]b_A UghYf'WUb'X]gd`Umk Ufb]b['a YggU[Yg'k \YbYj Yf'U'W\Ub[Yg]g'a UXY'h\Uh'k]``'UZZYWh'UVMjj Y'WtbbYVMjcbg"

- # 7`]\w_hc 'WkY\w_' hc 'WkY\w_' hc 'WkY\w_' hc 'NkY \w_h' cf' \w h'cdYfUh]cb ']g'YbhYfYX"'H\Y'cdYfUhcf'k ci `X`\Uj Y'hc 'WcbZ]fa 'VYZcfY'h\Y'XY`YhY'cf' \w h cdYfUh]cb ']g'Wca d`YhYX"
- 'fc '\\Y\\\Y\' '\O' k \Ufb]b[
 a YggU[Y'X]gd`Um\X']Z'Ub`cd\YfUhcf`]bj c_\Yg`Ub`cd\YfUh]cb`h\Uh`k ci `X'X]g\\\b\Y\\f\]h\Zfca 'h\Y'CD7'g\Yfj \Yf"'H\Y
 cd\YfUhcf`k ci `X'\Uj \Y`hc`\\\b\Zffa 'V\Zcf\Yh\Y'X]g\\\\b\Y\\\f\g\Yei \Yb\\Y\`k \Ug`]b]h]Uh\X"
- £ 7\YW_` hc`\Uj Y`U`a YggU[Y`X]gd`UmYX`]Z'@]b_A UghYf`]g`VY]b[`g\i h`Xck b`k]h\
 ci hghUbX]b[`W\Ub[Yg`]b`h\Y`dfc^YWf"

 $\begin{tabular}{ll} \begin{tabular}{ll} \be$

Y'dW

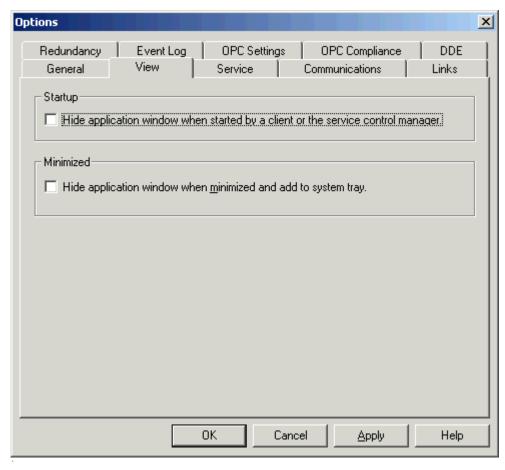
X]gWcbbYWrh\Y]f`CD7`fYgci fWrg"`CD7`W]Ybhg`h\Uh`Xc`bch`gi ddcfh`h\Y`gYfj Yf`g\i hXck b`Yj Ybh'a Um\Uj Y`]ggi Yg`cbWr @b_A UghYf`g\i hg`Xck b"` ______"

 $K \ Yb @b_A \ UghYf]g']bj \ c_YX \ Zfca \ U'W]Ybh Udd]WWhcbz']h'Ui \ hca \ Uh]WW'm `cUXg']hgY Z'UbX `VY[]bg'fi \ bb]b['h\ Y'`Ugh'dfc YWh i gYX"' @b_A \ UghYf a \ UmU'gc 'Ui \ hca \ Uh]WW'm `cUX' Ubm C D7 'gYfj Yf 'h\ Uh' k \ Ug'Uggc WJUhYX 'UbX 'WcbbYWhYX 'hc 'h\ Y' dfc YWh' k \ Yb']h k \ Ug'`Ugh'gUj YX"' Bcfa \ U'`mz' k \ Yb'Ub' C D7 'W]Ybh']g' Z[b]g\ YX'' g]b['@b_A \ UghYf 'UbX 'X]gWcbbYWhgz' @b_A \ UghYf 'k]``h\ Yb'Yl]h\ \ck Yj Yfz' h\ YfY a \ Um'VY'g]hi \ Uh]cbg' k \ Yb'h\ Y' cdYf Uhcf' a \ Um'\ Uj Y' a \ UXY' \ W\ Ub[Yg'hc'h\ Y' dfc YWh' k \]'Y']h' k \ Ug']bj \ c_YX' Vm' U \ W]Ybh' Udd`]WUh]cb"'=Z'@b_A \ UghYf 'k \ YfY'hc'g\ i h\ Xck b'k]h\ ci h'k \ Ufb]b[z'h\ cgY' \ W\ Ub[Yg'Wc' X' VY'`cgh'' Hc'dfYj Ybh'h\]g'Zfca \ \ UddYb]b[z'@b_A \ UghYf \ \ Ug'dfcj]XYX'Yl]h' cdh]cbg"' H\ Y' \ gYH]b[g'UfY'i gYX'hc' \ WcbZ][i fY'@b_A \ UghYffg'Yl]h \ ghfUhY[m'$

Y'VWfUfig m' d _ g5d U ž c bg

WXY d

,,,È\^],æ¦^È&[{



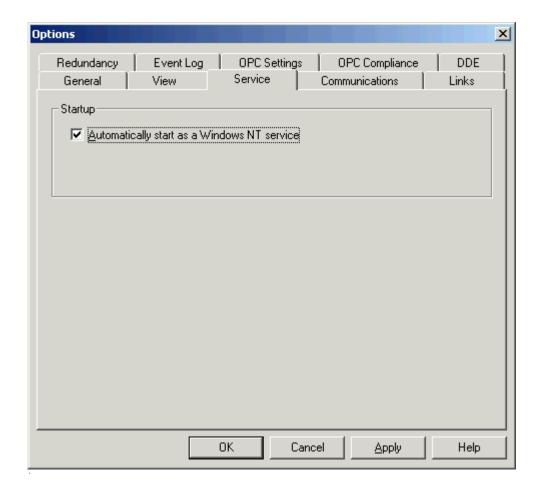
 $\label{eq:hamiltonian} $$HY' $$ $$ $ \cdh]cb'WbZ[i fYg'\ck'@]b_A UghYf'k]$$ $$ fygdcbX'k Yb'VY]b[``Ui bWXYX'Ui hca Uh]\W'`m'Vm'Ub'CD7'W]Ybh'cf h\fci [\'h\Y'BH'gYfj]\W'a UbU[Yf'k \Yb'WbZ][i fYX'hc'fi b'Ug'U'gYfj]\W'''=Z' $$$

`]g`W.YW_YXž`@b_A UghYf`k]```bch`UddYUf`cb`h\Y`bcfa U``K]bXck g`hJg_VUf" =bghYUXž`]h`k]```UddYUf`cb`h\Y`gmghYa `hfUmUg`U`gYfj Yf`]Wb'K]h\`h\Y`@b_A UghYf`]Wb`]b`h\Y`gmghYa `hfUmž`g]a d`m'W]W_`h\Y]Wb'hc`ghUfh`i d`@b_A UghYf"

Webhjbi YinciUddYUficbin\Yik]bXck figihUg_VUfik\Ybia]b]a]nYX"=Zh\]gigYYWhjcbi]giWkYW_YXži@jb_AUghYfik]``cbimVY X]gd`UmYX`UgiUbi]Webicbin\YigmghYaihfUmk\Ybi@jb_AUghYfi]gia]b]a]nYX":H\]giWbifYacjYWihYfiZfcaih\YiK]bXckg Ybj]fcbaYbhiUbX`\YididfYjYbhin\YigYfiZfcaiibbYWfggUf]`m]bhYfUWhjb[ik]h\in\Yi@jb_AUghYfidfc^YWh"

@b_A UghYf`gi ddcfhg`fi bb]b['Ug`U`gYfj]Wf`i bXYf`K]bXck g`BH#&\$\$\$"'H\Y`UV]`]mm'c`fi b`Ug`Ub`BH`gYfj]Wf`]g`Wfi WJU``Zcf a Ubm'Udd`]Wuh]cbg'k \YfY`@b_A UghYf`a i gh'dfcj]XY`XUHU'nc`CD7`W]Ybhg'j]U`87CA ":: cf`h\YgY`Udd`]Wuh]cbg'z`h\Y``cgg`cZ'U 87CA 'WtbbYWf]cb`WUbbch'VY`nc`YfUhYX"'Bcfa U`mz'Ub`CD7`gYfj Yf`h\Uh'cb`mgi ddcfhg`ghUbX`U`cbY`dfc[fUa 'cdYfUh]cbg`]g ZcfWfX`nc`g\i h`Xck b`k\Yb`]hg`\cgh'a UW\]bY`YI dYf]YbWfg'U`i gYf``c[`]b`cf``c[ci h''K\]Yfi bb]b['Ug`U`gYfj]Wfz'@b_A UghYf WUb`Wtbh]bi Y`nc`gi dd`mCD7`XUhU`UWfcgg`i gYf``c[`]b`gYgg]cbg": i fh\Yfa cfYz'@b_A UghYf`WUb`VY`WtbZ[[i fYX`nc`fi b`k]h\`bc j]g]V`Y`dfYgYbWf`UbX`U`gc`nc`]bhYfUWfk]h\`h\Y`XYg_ncd`fk\]Wx`]g`i gYX`nc`a U_Y`W\Ub[Yg`nc`h\Y`gYfj Yf`dfc^Y\WhL"

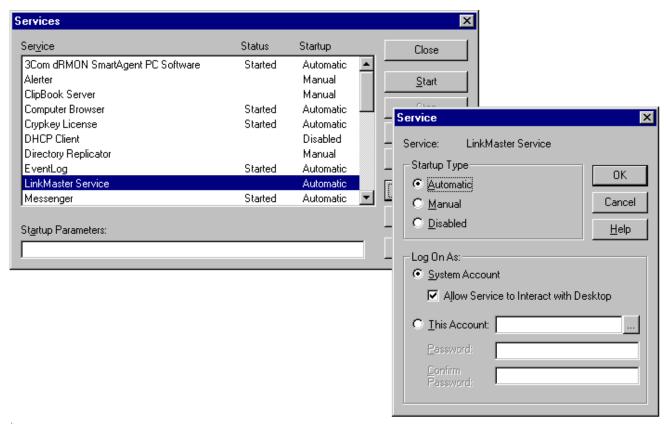
HcUWWggh\YGYfj]WYcdh]cbgžW]W_cb p žh\YbgY`YWh\Y`GYfj]WYhUV"



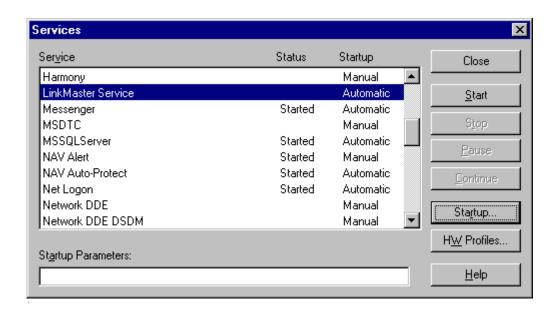
 $H \setminus [g'cdh]cb'Wb'VY'i gYX'hc'WcbZ][i fY'@b_A UghYf'Zcf'cdYfUh]cb'Ug'U'gYfj]W''i bXYf'BH'UbX'K]bXck g'&$$$"'6mXYZUi `hz'h\]g cdh]cb']g'X]gUV`YX'fi bW\Y\W_YX\L'''K \Yb'YbUV']b['h\Y'gYfj]W''cdh]cbz'U'k Ufb]b['a YggU[Y'X]U'c['Vcl'k]'``UddYUf'hc']bZcfa i gYfg'h\Uh'h\]g'W\Ub[Y'k]'``bch'hU_Y'YZYWh'i bh]``h\Y'bYl h'h]a Y'@b_A UghYf']g'fi b"'H\i gz'Zcf']h'hc']a a YX]UhY`m'VY\can Y'U gYfj]\W''h\Y'dfc[fUa'a i gh'VY'Yl]\h\X'''5ZhYfk UfXgz']h'a Um'VY'fYghUfhYX'Zfca'h\Y'K]bXck g'BH'GYfj]\W''A UbU[Yf'Zci bX'cb h\Y'' 'cf'Vm'U``ck]b['h\Y'CD7'\W]Ybh'hc']bj c_Y'@b_A UghYf'k \Yb']h'\cbyV\fg''$

 $\label{eq:condition} $$ 'HY' $$ 'cdh]cb'cZ'@b_A UghYf'WUb'cb'mVY'UVWY'ggYX'k Yb'i gYfg'UfY'`c[[YX']bhc'K]bXck g'BH#&$$$'Ug'UbUXa]b]ghfUhcf'''K Yb'`c[[YX']b'Ug'U'bcfa U'`i gYfZ'h\Y' $$ 'cdh]cb'k]``VY'X]gUV'YX''$

 $52 hYf'h Y'@b_A UghYf'gYfj]WY'cdh]cb' WcbZ[[ifYXž'h Y'gdYW]Z]WUdd']WUh]cb'a UmfYei]fY'h UhiigYfg'a cX]Zmh Y'BHgYfj]WY'cdh]cbg'Zcf'h Y'@b_A UghYfffg'XYZUih GYfh]Yg'k][ifYXž'h Y'gdYW]Z]WUdd']WUh]cb'a UmfYei]fYg'h UhiigYffg'XYZUih GYfh]Yg'k DfcdYfh]Yg'X]U'c[iZcf'@b_A UghYfffg'XYZUih GYfh]Yg'k]`UddYUf'Ug'g ck b'VY'ck "$



`=Zfibb]b[`@b_AUghYf`]b`U`XYac`cf`YjU`iUh]cb`acXYž`kY`ghfcb[`mfYWtaaYbX`h\Uh`@b_AUghYf`]g`U``ckYX`hc
"`H\]g`k]```g\ck`UbmYffcf`aYggU[Yg`h\Uh`@b_AUghYf`aUm[YbYfUhYž`giW\`Ug`
"`=Z'h\]g`cWWfgž`ghcd`h\Y`@b_AUghYf`gYfj]WY`ig]b[`h\Y`GYfj]WY`aUbU[Yf`Ug`g\ckb`VY`ck"



Hc fYhi fb @b_A UghYf hc bcfa U ghUbX! U cbY dfc[fUa cdYfUh]cbz'i gYfg a i ghZfghVY UV Y hc]bhYfUWh k]h\ h\ Y @b_A UghYf dfc YWh'' H\]g fYei]fYg h\ Uh @b_A UghYf VY UV Y hc]bhYfUWh k]h\ h\ Y XYg_hcd" = Z @b_A UghYf]g bch WtbZ[[i fYX hc]bhYfUWh k]h\ h\ Y XYg_hcd]bhYfUWh]cb \ UbX ghcd h\ Y @b_A UghYf gYfj]W''' CbW h\ Y Udd]Wh]cb \ Ug ghcdd Y Z fYghUfh]hi g]b[h\ Y GhUfh Vi hhcb Ug g\ ck b UVcj Y'' @b_A UghYf g\ ci X bck UddYUf cb h\ Y gmghYa hUg_VUf'' CbW @b_A UghYf Wb VY gYYb cb h\ Y XYg_hcd X W Ub[Yg Wb VY a UXY hc h\ Y dfc YWh' hc fYhi fb hc bcfa U dfc[fUa a cXY h\ h\ Y Udd]Wh]cb i g]b[h\ Y Ghcd Vi hhcb cZ h\ Y GYfj]W' a UbU[Yf'' Bck Z @b_A UghYf Wb f' Wbb fi b Zfca h\ Y bcfa U `XYg_hcd] Wcb cf ghUfh a Ybi gYYWh]cb''



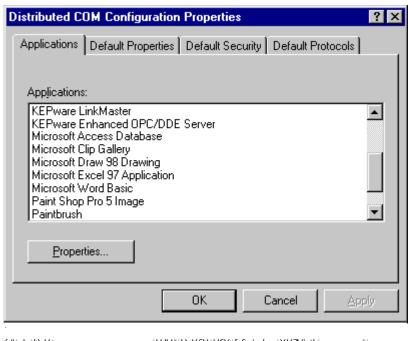
 $= b \cdot cfXYf \cdot hc \cdot a \cdot U_Y \cdot @ b_A \cdot UghYf \cdot fi \cdot b \cdot Ug \cdot U \cdot bcfa \cdot U \cdot dfc [fUa \cdot \check{z} \cdot fYj \cdot]Yk \cdot h \cdot Y \cdot ghY \cdot dg \cdot]b \cdot UVcj \cdot Y''$

 $\label{thm:converse} I \ bXYf'a \ cgh'WfW a \ ghUbWfg'i \ gYfg'g\ci `X`VY`UV`Y`hc `gYUa `Ygg`mgk]hW.`VYhk YYb`GYfj]Wf'a \ cXY`UbX`GhUbX`5`cbY`a \ cXY'' H\YfY`]g'h\Y'dcgg]V]]hmcZ'U` gYW f]hm]ggi Y`h\Uh'a \UmdfYj Ybh'h\Y`CD7 W]Ybh'Zfca `VY]b[`UV`Y`hc `WbbYWh'hc '@]b_A \UghYf'k \Yb']h']g'fi \bb]b[`Ug'U'gYfj]Wf'''$

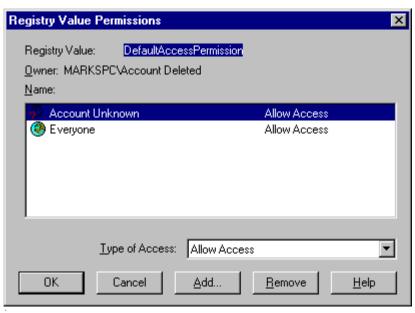
=Zi gYfg`Yl dYf]YbWY`Ub`]ggi Y`WcbbYWh]b[h\Y`CD7`W]Ybh'hc`@b_A UghYf`k \Yb`]h`]g`fi bb]b[`Ug`gYfj]WYžk Y`gi [[Ygh'h\Uh @]b_A UghYf`VY`hU_Yb`ci h`cZ`gYfj]WY`a cXY`UbX`h\Y`CD7`WcbbYWh]cb`VY`WcbZ]fa YX`]b` "`CbWY`h\Y`CD7 W]Ybh'WcbYWh]cb`\Ug`VYYb`WcbZ]fa YX`i bXYf`bcfa U``W]fW a ghUbWrgži gYfg`WUb``cc_`Uh'h\Y`87CA`gYhh]b[g`i g]b[h\Y Zc``ck]b[`ghYdg.

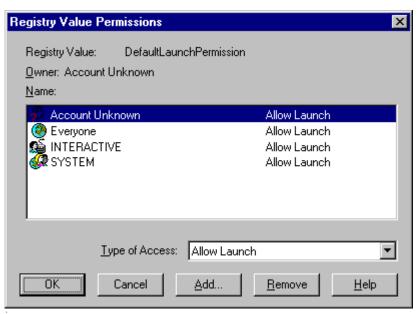
%" D`UW @b_A UghYf VUW_]bhc "

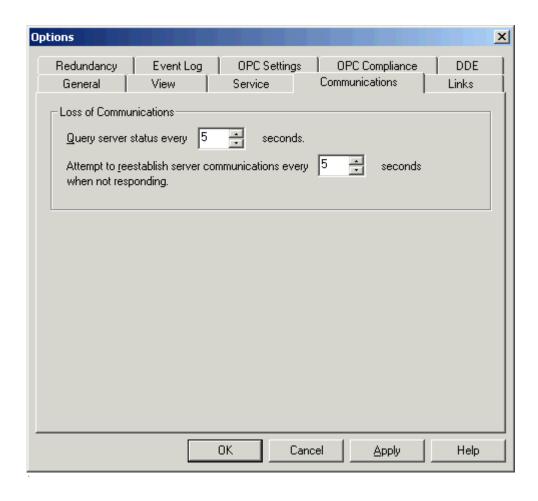
&"'Fib' "'H\]g'WUb'VY'XcbY'Zfca 'h\Y'K]bXck g'ghUfh'a Ybi 'i g]b['h\Y' 'Wca a UbX"'HmdY'″87CA7B:; ""
' "'CbWY'87CA7B:; ']g'fi bb]b[ž'h\Y'a U]b'X]U'c['k]``'UddYUf'Ug'g\ck b'VY'ck "



("'=b'h\Y' 'h\YfY'UfY'[fci dg. 'XYZUi `h' ž' 'UbX' ' ' "'=b' ž'W]W_' "'H\Y'X]U'c['g\ci `X'UddYUf'Ug'g\ck b'VY`ck "







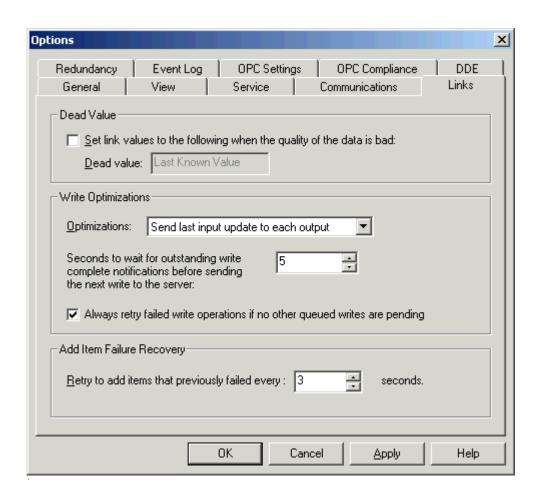
p.

 $H\g gYYWf \c Wub VY i gYX hc gdYWfZm\c cZhYb @b_A UghYf k]``WXYW hc a U_Y gi fY h\Y WcbbYWfYX CD7 gYfj YffgL \Uj Y bchVYYb X]gWcbbYWfYX" H\Y XYZUi `h']g') gYWcbXg" H\Y j U]X fUb [Y]g') hc '' $ gYWcbXg"$

Hc'UVWYgg'h\Y'@]b_g'cdh]cbgž'W]W_'cb'

"'H\Ybž'gY`YWh'h\Y'

'HJV"



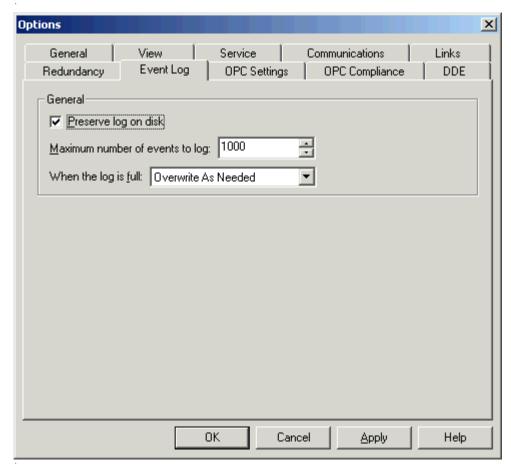
``6cc`YUb``]b_`]hYa g`WUb`cb`m`\Uj Y`Uʻj Uʻi Y`f%ffHFI 9Ł'cf`f\$fft 5@G9Ł"'GYhh]b['h\Y`XYUX'j Uʻi Y`hc`U'bcb! nYfc j Uʻi Y`k]```gYh'h\Y``]b_`]hYa `hc`f%ffHFI 9Ł'k \Yb`h\Y'j Uʻi Y`VYWta Yg`VUX"'`G]a]`Uf`mž'gYhh]b['h\Y`XYUX'j Uʻi Y`hc`nYfc'k]```gYh h\Y``]b_`]hYa `hc`f\$fft 5@G9Ł"

 $: cf'h\ Y'Cdh]a\]nUh]cbg'gYh]b[\ z'h\ Y'fYwca\ a\ YbXYX'W.c]wY']g' \\ x' A cgh'fYwYbh']bdi\ hi dXUhY'hc'h\ Y'wcffYgdcbX]b['ci hdi h']hYa "'H\]g'cdh]cb'Wb'a]b]a]nY'h\ Y'`cUX'cb'h\ Y'CD7'gYfj Yffg k f]hY'ei Yi Y'''H\ Y'ch\ Yf'cdh]a]nUh]cbg'cdh]cb']g' \\ z' k \]w'' gYbXg'U'''k f]hY'fYei Yghg hc'h\ Y'WcffYgdcbX]b['ci hdi hfg\color="1" b' YwcffYgdcbX]b['ci hdi hfg\c$

GY`YVM]b[c i `NeUb``PPUX`hc`qYfj Yf`cj Yf`cUX`]Z'h\Y`

gYfj Yfg h\Un'U``ck ']bWta]b['W]Ybh'WtbbYWf]cbg'df]cf hc Zi ``m']b]h]U']n]b[']hg'Uj UJ'UV'Y']hYa '`]gh''

Hc`UWWYgg`h\Y`9j Ybh`@c[`cdh]cbgž`W]_`cb` 'p` 'UbX`h\Yb`gY`Y\\h`h\Y` 'h\Y`Zc``ck]b[`X]U`c[`k]`` VY`X]gd`Um\X"



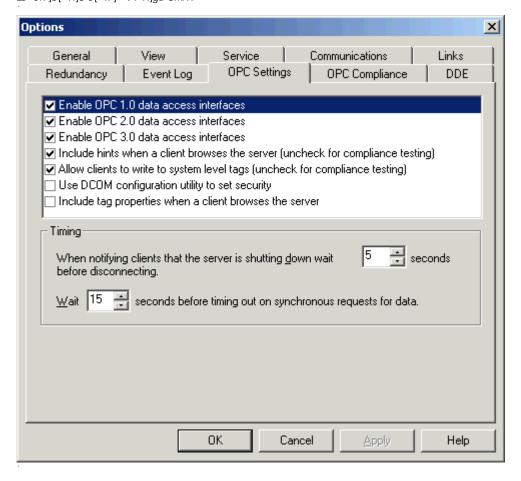
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H\]g'gYHn]b['YbUV`Yg'h\Y'i gY'cZ'U`X]g_'VUgYX``c['Z]'Y"'K\Yb`YbUV`YXž'U```Yj Ybhg']b'@b_A UghYf'k]```VY'a U]bHJ]bYX`cb`X]g_/Zfca 'cbY'fi b'hc'h\Y'bYl h''H\Y``c['Z]'Yž'WU``YX'``]b_a UghYf"`c['`]g'Zci bX']b'@b_A UghYffig'a U]b'K]bXck fig'Zc`XYf"'=Z'h\]g
gYHn]b[']g'X]gUV`YXž'h\Yb'h\Y'Yj Ybh``c[']b['gmghYa'k]```VY'ghcfYX'cb`m]b']bHYfbU``a Ya cfm'UbX'bch'cb'X]g_"'K\Yb'
']g'X]gUV`YXž'h\Y'Yj Ybh``c['WbhYbhg'k]```VY'Ya dhmYUW\'h]a Y'h\Y'gYfj Yf']g'fi b"

Yj Ybh'cbWY'h\Y'`c[']g'Zi``"'K\Yb'gYh'hc ž'h\Y'Yj Ybh`c['k]``ghcd'UWWYdh]b['bYk'Yj Ybhg'UbX'a U]bhU]b'h\Y'W ffYbh`]ghcZ'Yj Ybhg'i bh]``Ub'cdYfUhcf'a Ubi U``mfYgYhg'h\Y'Yj Ybh'`c["'H\]g'Wub'VY'i gYZi``k\Yb'hfm]b['hc'WuhW\Y'i g]j Y'YffcfWcbX]h]cbg"

H\Y'WcbhYbg'cZ'h\Y'Yj Ybh'c['Wb'VY'hJ]cfYX'hc'a YYh'h\Y'Udd`]Wbl]cbfg'fYdcfh]b['fYei]fYa Ybhg"'7i ffYbh'mz'h\YfY'UfY h\fYY'hmdYg'cZ'a YggU[Yg'h\Uh'Wb'VY'd'UWYX']bhc'h\Y'Yj Ybh'c[/'; YbYfU'`a YggU[Yg'fgi W\'Ug'gYfj Yf'ghUfhi d'UbX g\i h\Ck b\text{b\text{E}'K Ufb]b['a YggU[Yg'fgi W\'Ug'XYj]W'bch'fYgdcbX]b['t'UbX'9ffcf'a YggU[Yg'fgi W\'Ug'h\Y'fY'VM]cb'cz'VUX'CD7]hYa 'fYei Yghgt"'Hc'dfchYWh'h\Y'`c['Z]Yfg'WcbhYbhgž'i gY'h\Y'______'hc'XYZ]bY'dYfa]gg]cbg'UbX'`]a]h'k \Uh'Z bWh]cbg cdYfUhcfg'Wbb'UWWgg"

@b_A UghYf`gi ddcffg`Vch\`j`Yfg]cbg`cZ'h\Y`CD7`: ci bXUh]cbfg`8 UhU`5WWfgg`GdYWJZ]WUh]cb`%*\$`UbX`&"\$ž`UbX`Vch\`j Yfg]cbg`UfY gi ddcfhYX`g]a i `hUbYci g`m'`K \]Y`h\]g`dfcj]XYg`h\Y`i ha cgh``Yj Y``cZ'Wta dUh]V]`]lmž'h\YfY`a Um'VY`h]a Yg`k \Yb`ZcfW]b[`h\Y @b_A UghYf`hc`i gY`cbY`a Yh\cX`cj Yf`Ubch\Yf`a Um'VY`bYWfggUfm"`H\Y`CD7`Cdh]cbg`X]U`c[`]g`i gYX`hc`a U_Y`h\YgY gY`YWh]cbg"`Hc`UWWfgg`h\Y`CD7`GYhh]b[g`cdh]cbgž`W]\W_`cb` p` ž`h\Yb`gY`YWh`h\Y`CD7`GYhh]b[g`HUV"`H\Y Zc``ck]b[`X]U`c[`k]``VY`X]gd`UmYX"



 $\label{eq:hamiltonian} $$H^{g'}H^b[\ k]^{\ U}ck \ h\ Y^ab_A Ugh f hc \ UW \ dh CD7 \ W]Ybh \ Wcbb Y Mg cbg \ Zf ca \ CD7 \ W]Ybhg h \ Uh gi \ ddcfh h Y \& "$ gd Y MZ] Wuh]cbg \ Gm X Y ZUi \ hz \& "$ cd Y f Uh]cbg \ Uf Y Y b UV Y X "$

H\]g`gYHn]b[`k]``U``ck 'h\Y'@]b_A UghYf`hc`UWWdhCD7`W]Ybh`WbbbYWn]cbg`Zfca 'CD7`W]Ybhg`h\Un`gi ddcfh'h\Y'` "\$

qdYWZJWUhjcb"6mxYZUi h' "\$ cdYfUhjcb jg YbUV YX"

H\]g'gYH]b['k]``U`ck 'CD7'W]Ybh'Udd`]WUh]cbg'bc'Vfck gY'@b_A UghYffig'@b_']hYa 'ghUh' g'hU[gz'k\Yb'YbUV`YX"'H\YgY']hYa g WUb'VY'i gYZ\``k\Yb']h']g'bYWYggUfm'bc'a cb]hcf'`]b_'WbbX]h]cbg'Zfca 'h\Y'CD7'W]Ybh''6mXYZUi `hz'h\]g'gYHh]b[']g'YbUV`YX fCbł''

K\Yb`fi bb]b['h\Y`CD7'7ca d`]UbWYhYghž'h\]g'cdh]cb'g\ci `X'VY'hi fbYX'fiCZZL"

H\]gʻcdh]cbʻWcbhfc`gʻk f]hYʻUWWYggʻhcʻgmghYaʻhU[gž``]_Y`h\Y` 'hU['Zcf`U' "'=b`gca Y`WUgYgž`i gYfgʻa Umbch k`Ubh'U'W]Ybh'Udd`]WUh]cbʻhc`\Uj Y`h\Y`UV]`]hmhcʻhi fb`U'@]b_'; fci d`cb`cf`cZZ]b`h\Y`dfc^YWf'`H\]gʻgYhh]b[`'Udd`]Ygʻhc`U`` gmghYa``Yj Y``hU[g"

`K \Yb`fi bb]b[`fh\Y`CD7`7ca d`]UbWY`hYghz`h\]g`cdh]cb`g\ci`X`VY`hi fbYX`flCZZ±" H\Y`XYZUi `h`WbX]h]cb`]g`flCb±"

 $H\g`cdh]cb`Wcbhfc`g`\ck`@b_A\ UghYf`k\]``fYgdcbX'hc`87CA`gYWf]hmfYei\ Yghg''.K\ \Yb'YbUV`YXž'h\Y`87CA`WcbZ][ifUh]cbih\]ghmWb`VY`igYX`hc`YghUV`]g\`ghfcb[`gYWf]hmcb`k\c`Wb`UWWfgg'h\Y`gYfJ\f''.K\Yb'h\]g'cdh]cb']g`X]gUV`YXž'@b_A\ UghYfkk\]``Uihca Uh]WU``mfYXi\W'`h\Y``Yj\Y``cZ'87CA`gYWf]hmž'a\U_]b[`]h'ai\W`YUg]Yf'Zcf'Udd`]\Wh]cbg'hc`WcbbYWh'hc`@b_A\UghYf''$

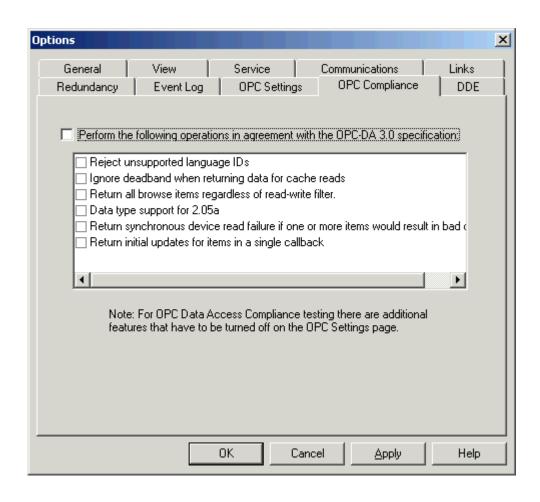
 $= ZYI dYf]YbV]b[~87CA~gYW~f]hm]ggi~Ygž~hfmX]gUV~]b[~h\]g~cdh]cb"~:~cf~bYk~Udd~]WUh]cbgz~h\]g~cdh]cb~XYZUi~hg~hc~h\Y~fC~ZZ#X]gUV~YXL~ghUhY"$

 $\label{eq:hamiltonian} $$H\g^cdh_c^YbuV^Yg^CD7^W]Ybh^Udd^]Wh_cbg^hc^Vfck gY^h_Y^HU[^dfcdYfh]Yg^U[U]^UV^Y^Zcf^YUW^hU[^]b^h_Y^UUXXfYgg^gdUWY''^6m XYZUi^h_h_]g^gYhh]b[^]g^X]gUV^YX''^7\\Ub[^b[^Ubm^cZ'h_YgY^cdh]cbg^Wb^VY^i gYZi^-]Z'h_Y^CD7^W]Ybh^Udd^]Wh]cb^\Ug^dfcV^Ya g k]h_UdUfh]W^Uf^j Yfg]cb^cZ'h_Y^gdYW]Z]WUh]cb''$

 $H\g`h]a\ Yci\ h`gYhh]b[\ ']g`i\ gYX'hc'WcbZ][i\ fY'\ck\ ``cb[\ '@b_A\ UghYf'k\]```k\ U]h'Zcf'Ub'CD7'W]Ybh'hc'fYhi\ fb'Zfca'h\Y'gYfj\Yf'g\i\ hXck\ b'Yj\Ybh''=Z'h\Y'W]Ybh'Udd`]\Wlh]cb'XcYg'bch'fYhi\ fb'k\]h\\]b'h\\Y'h]a\ Yci\ h'dYf]cXZ'@b_A\ UghYf'k\]```Wca\ d'YhY']hg'g\i\ hXck\ b\ UbX'YI\]h''\H\Y'j\ U']X'fUb[\Y'Zcf'h\]g'h]a\ Yci\ h']g'%\ hc''\ $'gYWcbXg'''H\Y'XYZUi\ h']g')\ 'gYWcbXg'''$

 $H\g gYHhlb[']g'i gYX'hc'WcbZ[[ifY'\ck']cb['@b_A UghYf'k]'''k U]h'Zcf'U'gmbWkfcbci g'fYUX'cf'k f]hY'cdYfUhlcb'hc'Wca d'YhY'''=ZU'gmbWkfcbci g'cdYfUhlcb']g']b'dfc[fYgg'UbX'h\Y'h]a Yci h']g'YI WYYXYXž'@b_A UghYf'k]'''ZcfW'h\Y'cdYfUhlcb'hc'Wca d'YhYkk]h\'U'ZU]'ifY'hc'h\Y'CD7'W]YbH''H\]g'dfYj Ybhg'CD7'W]Ybhg'Zfca 'UddYUf]b['hc'VYWca Y''cW_YX'id'k\Yb'ig]b['gmbWkfcbcig cdYfUhlcbg'''H\Y'jU']X'fUb[Y']g')'hc'*$'gYWcbXgz'k]h\'\%) 'gYWcbXg'Ug'U'XYZUi'h'$

@b_A UghYf`\UgʻVYYbʻXYg][bYX`hc`dfcj]XY`h\Y`\][\Ygh`Yj Y``cZ'Wta dUh]V]`]hmik]h\`h\Y`CD7: ci bXUh]cbfij gdYWJZJWUh]cbg":=bhYgh]b[ž\\ck Yj Yfž]h`\UgʻVYYbʻZci bX`h\Uh`VY]b['Zi ``mWta dUh]V`Y`k]h\`h\Y`gdYWJZJWUh]cb'UbX`k cf_]b['k]h\`U```CD7'W]Ybh Udd`]WUh]cbg']g'U'X]ZZYfYbh'a UhhYf"'H\Y'CD7'7ca d`]UbWY'cdh]cb']g'i gYX`hc`hU]`cf`h\Y`cdYfUh]cb'cZ'@b_A UghYf`hc`VYhHYf a YYh'h\Y'bYYXg'cZ'fUfY'CD7'W]Ybhg"'Bcfa U``m'h\YgY'cdh]cbg'k]```bch'bYYX`hc`VY'UX'i ghYX`Zcf'h\Y'a U'cf]hmcZ'CD7'W]Ybh Udd`]WUh]cbg'h\Uhi gYfg'k]``YbWti bHYf"

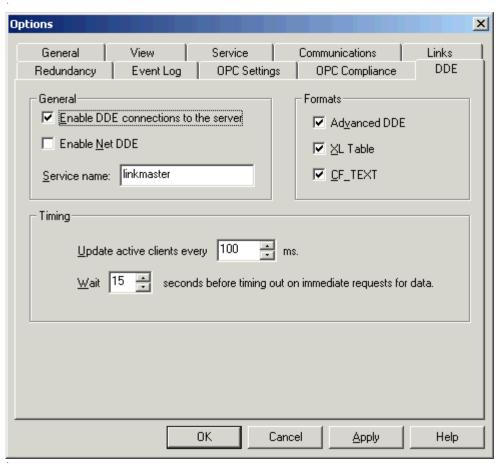


 $\label{eq:continuity} K \ Yb \ gY'YWYXZ' \ k \]^``WJi gY'h\ Y'@]b_A \ UghYf'hc 'fYhi fb 'U``'hJ[g'hc 'Ub'C D7 'W]Ybh'Udd`]WJh]cb 'k \ Yb \ U'Vfck gY'fYei Ygh']g'a \ UXY'fY[UfX'Ygg'cZ'h\ Y'UWWYgg'Z]'hYf'Udd`]YX'hc 'h\ Y'C D7 'W]Ybhg'hJ['Vfck gYf'' \ Yb' Ybhg'hJ['Vfck gYf'' \ Ybhg'hJ['Vfck gYf'' \ Yb' Ybhg'hJ['Vfck gYf'' \ Ybhg'hJ[$

K\Yb`gY`YWnYXž' k]``WUi gY`h\Y`gYfj Yf`hc`fYhi fb`U`ZU]`i fY`]Z`cbY`cf`a cfY`]hYa g Zcf`U`gmbW\fcbci g`XYj]\Wr`fYUX`fYgi `hg`]b`U`VUX`ei U`]hm`fYUX"`7ca d`]Ub\Wr`fYei]fYg`h\Y`gYfj Yf`hc`fYhi fb`gi \WWrgg`]bX]\Wuh]b[h\Uh'h\Y`gYfjYf`Wti`X`Wta d`YhY`h\Y`fYeiYghž'YjYb`h\ci[\`h\Y`XUhU`Zcf`cbY`cf`a cfY`]hYa g`a Um`]bWiXY`U`VUX`UbX#cf i bWffhU]b`ei U`]hm"

 $K \ Yb \ gY \ @b_A \ UghYf \ fc \ fYhi \ fb \ U``ci \ hghUbX]b[\ b]h]U'']hYa \ 'i \ dXUhYg']b \ 'U \ 'g]b[\ 'Y \ 'WU``VUW_" \ 'K \ Yb \ bch \ gY \ YWhYXž' @b_A \ UghYf \ k \]``fYhi \ fb \]b]h]U''i \ dXUhYg' \ Ug \ h\ Ym UfY \ Uj \ U]`UV \ Y \ k \]W \ 'Wti \ 'X' fYgi \ 'h']b \ a \ i \ 'h]d'Y \ 'WU''VUW_g'''$

 $\label{eq:continuity} \mbox{Hc $^{\prime}$UWW gg'h$\ Y$'889$'cdh]cbg$$\check{z}$'W]$$\underline{W}$'$ p' "'H\ Yb$\check{z}"gY`YWh'h\ Y" "hUV"$



H\Y`889`Cdh]cb`X]U`c[`U``ck g`U`[fYUh`XYU``cZ`Wbhfc``]b`XYhYfa]b]b[`\ck '@b_A UghYf`dfcj]XYg`889`XUhU"

H\]g'dUfUa_YhYf'U`ck_g'h\Y`i_gY`cZ`A]WfcgcZhfig'BYh'889`gYfj]Wfg'hc`VY`X]gUV`YX"`=Z']bhYbX]b['hc'i_gY`@|b_A_UghYf'k]h\'cb`m `cWU``889`W]Ybh'Udd`]WUh]cbgz`BYh'889`g\ci_`X`VY``YZh`X]gUV`YX`fh\Y`XYZUi_`h`gYhh]b['£"`GhUfh]b['h\Y`BYh'889`gYfj]]Wfg'WUb`VY

Uʻhja YʻWoʻbgi a]b[ʻdfcWfggʻh\UhʻWubʻgʻck ʻh\YʻghUfhi dʻcZʻh\Yʻ@b_A UghYf"ʻ9bUV`]b[ʻBYh'889ʻk\Ybʻ]hʻXcYgʻbchʻbYYXʻhcʻVY i gYX`k]``'Wu gY`@b_A UghYfʻhcʻUi hca UhjWu`mfY[]ghYfʻ]hgʻ″g\UfYʻbUa Yg″ʻUbXʻghUfhih\YʻBYh'889ʻgYfj]Wfʻa UbU[Yf"'889 g\UfYgʻk]``'UʻgcʻVYʻfYa cj YX`k\Ybʻh\YʻgYfj Yfʻg\i hgʻXckb"
:: cf`a cfY`]bZcfa Uh]cbž'fYZYf`hc`"
I gYfg`Wub`U`gc`XYhYfa]bY`\ck `@jb_A UghYffg`gYfj]WY`bUa Y`UddYUfg`Ug`Ub`Udd`]WUh]cb`bUa Y`hc`889`M]Ybhg"`6mXYZUi `hz`h\Y gYfj]WY`bUa Y`]g`^`]b_a UghYf^"`=Z`i gYfg`bYYX`hc`fYd`UWY`Ub`YI]gh]b[`889`gYfj Yf`k]h\`@jb_A UghYfz`h\YmWub`W\Ub[Y`h\Y gYfj]WY`bUa Y`cZ@jb_A UghYf`hc`a UhW\`h\Y`889`gYfj Yf`VY]b[`fYd`UWYX"`H\Y`gYfj]WY`bUa Y`U``ck g`U`ghf]b[`cZ%`hc`' & W\UfUVMYfg`hc`VY`YbhYfYX"
@]b_AUghYf'U`gc`U``ckg'igYfg`hc`WcbZ][ifY`k\Uh`ZcfaUh`cZ889`h\Y`W]Ybh`Udd`]WUh]cbg`k]```VY`dfcj]XYX"'5`h\ci[\`U```h\fYY ZcfaUhg`UfY`YbUV`YX`VmXYZUi`hž`YUVW`cZh\Y`889`ZcfaUhg`WUb`VY`X]gUV`YX`hc`U`ck`hYgh]b[`cZU`gdYW]Z]WZcfaUh`]b]gc`Uh]cb"`9jYfm889`UkUfY`Udd`]WUh]cb`aighž`Uh`U`a]b]aiaž`giddcfh`7:SHYIh'
H\]g`h]a Yf`]g`i gYX`hc`U``ck `889`XUhU`hc`VY`Vi bX`YX`i d`Zcf`hfUbgZYf`hc`W]Ybh`Udd`]\WUh]cbg"`K\Yb`i g]b[`U`889`Zcfa Uhz``]_Y 5Xj Ub\WfX`889`z'dYfZcfa Ubw'`[U]bg`cb`m`Wta Y`k\Yb``Uf[Y`V`c\W_g`cZ`gYfj Yf`XUhU`WUb`VY`gYbh`]b`U`g]b[`Y`889`fYgdcbgY" Hc`]a dfcj Y`h\Y`UV]]mm`cZ`h\Y`gYfj Yf`hc`[Uh\Yf`U``Uf[Y`V`c\W_cZ`XUhUz`h\Y`i dXUhY`h]a Yf`\Wb`VY`gYh`hc`U``ck `U`dcc``cZ`bYk XUhU`hc`U\WVa i `Uh\z`cYYZcfY`VY]b[`gYbh`hc`U`\W]Ybh`Udd`]\WUh]cb"`H\Y`j U`]X`fUb[Y`cZ`h\Y`i dXUhY`h]a Yf`]g`&\$!*\$\$\$\$ a]``]gY\WtbXg"`H\Y`XYZUi`h`]g`%\$\$`a]``]gY\WtbXg"
H\]gʻh]a YfʻUʻck gʻUʻh]a Yci h'mʻVYʻWcbZ[[i fYXʻZcfʻh\YʻWca dʻYh]cbʻcZʻUʻ889ʻfYei Yghlʻ=ZUʻ889ʻW]YbhʻfYei YghgʻY]h\YfʻUʻfYUX cfʻk f]hYʻcdYfUh]cbʻcbʻ@b_A UghYfžʻUbXʻh\UhʻfYei YghʻWubʻbchʻVYʻWca dʻYhYX`k]h\]bʻh\YʻgdYWJZJYXʻh]a Yci hzʻUbʻYffcfʻk]``VY fYhi fbYXʻncʻh\Yʻ889ʻ7`]Ybhʻ'H\Yʻj Uʻ]XʻfUb[Y`]gʻ%lʻ\$ʻgYWcbXg"'H\YʻXYZUiʻh`]gʻ%) ʻgYWcbXg"
7\Ub[Yg`a UXY`hc`h\Y`889`cdh]cbg`k]```cb`m`hU_Y`YZZYVMri dcb`h\Y`bYl h`fYghUfh`cZ`@]b_A UghYf"
@ b_AUghYf`giddcfhg`h\Y`cdYfUh]cb`cZ`hkc`@ b_AUghYf!YbUV`YX`aUVW\]bYg`fibb]b[`Ug`U`fYXibXUbh`dU]f"`K\Yb`h\Y FYXibXUbWh`cdh]cb`]g`hifbYX`cbž`h\Y`Zc``ck]b[`dfcWrgg`cWWYfg. %"CbY`@ b_AUghYf`aUW\]bY`cdYfUhYg`Ug`h\Y` "`=h`UWN]jY`m'dYfZcfag``]b_`hfUbgZYfg"
&" H\Y`ch\Yf`@b_A UghYf`a UW\]bY`cdYfUhYg`Ug`h\Y` "`H\fYY`hmdYg`cZ`gYWcbXUfmbcXYg`UfY`dcgg]V`Y. GYWcbXUfm! < chz`GYWcbXUfm! K Ufa z`UbX`GYWcbXUfm! 7c`X" ""
' "H\Y`df]a UfmbcXY`]bZcfa gʻh\Y`gYWtbXUfmbcXY`h\Uh`]h`]gʻi dʻUbX`fi bb]b[`VmdYf]cX]WU``mgYbX]b[`U` 'bc`h\Y gYWtbXUfmbcXY"

- ("=Z'h\Y`gYWcbXUfmbcXY`XcYg`bch`fYWf]jY`h\Y`d]b[`Zfca 'h\Y`df]a UfmbcXY`Zcf`U`dfY!WcbZ][i fYX`Ua ci bh`cZ'h]a Yž`h\Y gYWcbXUfmbcXY`Uggi a Yg`h\Y`df]a UfmbcXY`hc`VY`bc``cb[Yf`Z] bWf]cbU``UbX`hJ_Yg`cj Yf`h\Y`fc`Y`cZ'h\Y`df]a UfmbcXY f]"Y"ž'h\Y`gYWcbXUfmbcXY`dYfZcfa g`h\Y``]b_`hfUbgZYfg`Ug`h\ci [\`]h`k YfY`h\Y`df]a UfmbcXYŁ"
-) " K \Yb'h\Y'df]a UfmbcXY'Wta Yg'VUW_i d'U[U]bž'h\Y'gYWtbXUfmbcXY'ghcdg'dYfZcfa]b[``]b_'hfUbgZYfg'UbX'h\Y df]a UfmbcXY'fYgi a Yg']hg'cdYfUh]cbg"

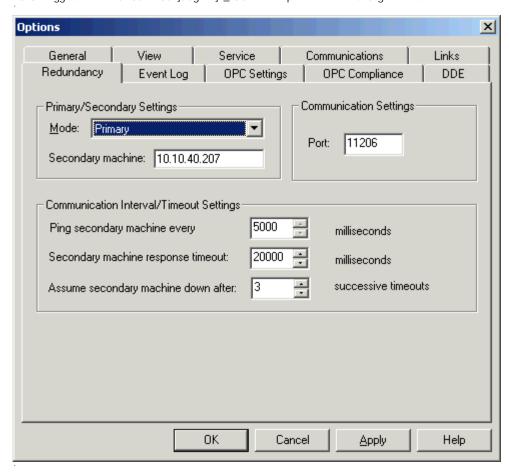
 $\label{eq:continuous} $$ = Z'h YfY']g'U'ZU]'i fY']b'h Y'WbbYWf]cb'VYhk YYb'h Y'df]a UfmUbX'gYWbXUfmbcXYgZ'h Yb'h Y'gYWbXUfmbcXY'k]'`Uggi a Y'h Uh'h Y'df]a UfmbcXY']g'bch'Z bWf]cbU'`UbX'h Y'gYWbXUfmbcXY'k]'``VY[]b'dYfZcfa]b[``]b_'hfUbgZYfgZ'h Yb'Vch 'h Y'df]a UfmUbX'gYWbXUfmbcXYg'k]'``VY hfUbgZYff]b['XUhU'VYhk YYb']bdi hg'UbX'ci hdi hg''$

Hc 'UWWYgg'h\Y'FYXi bXUbWmcdh]cbgž'W]W_cb'

.

ž'h\Yb'gY`YWh'h\Y

'HUV"



H\Y` 'gYhh]b[`WUb`VY`i gYX`hc`gYh`h\Y`fYXi bXUbWh`ia cXY"`Dcgg]V`Y`a cXYg`UfY`X]gd`UmYX`]b`h\Y`HUV`Y`VY`ck "

8]gUV`YX	H\]g`gYhh]b[`X]gUV`Yg`fYXi bXUbWhf'`K \Yb h\]g`gYhh]b[`]g`gY`YWhYXž`h\Y`W`ffYbh a UW\]bY`]g`h\Y`cb`mUWh]j Y`@]b_A UghYf a UW\]bY"
Df]a Ufm	H\]g'gYhh]b['WtbZ][i fYg'h\Y'W ffYbh @]b_A UghYf'a UW\]bY'bc'cdYfUhY'Ug'h\Y UWh]j Y'Vf]X[Y'cZ'h\Y'fYXi bXUbh'dU]f"'=h dYfZcfa g'h\Y']b_'hfUbgZYfgž'UbX']h dYf]cX]WU'`m'gYbXg'U'd]b['bc'h\Y'gYWtbXUfm bcXY'bc']bZcfa ']h'h\Uh']h']g'fi bb]b["
GYWtbXUfmfkchŁ	H\]g'gYhh]b['WtbZ][i fYg'h\Y'W ffYbh @]b_A UghYf'a UW\]bY'hc'cdYfUhY'Ug'h\Y VUW_i d'Vf]X[Y'cZh\Y'fYXi bXUbh'dU]f"=b h\]g'a cXYž'U``'h\Y']bdi h']hYa g'UfY'UWn]j Y Vi h'`]b_'hfUbgZYfg'UfY'X]gUV'YX"'5ZhYf'U 'cgg'cZ'Wta a i b]WUh]cb'k]h\'h\Y'df]a Ufm a UW\]bYž'h\]g'bcXY'k]``'Uggi a Y'h\Y'fc`Y'cZ h\Y'UWn]j Y'Vf]X[Y'VmYbUV`]b['`]b_ hfUbgZYfg"
GYWcbXUfmfK Ufa Ł	H\]grgYhh]b['WebZ][i fYgrh\Y'W ffYbh @b_A UghYfra UW]bYrbccdYfUhYrUgrh\Y VUWi drbcXYrcZh\YrfYXi bXUbhdU]f"'=brh\]g a cXYž'U``h\Yr]bdi h]hYa grUfYr]bUWh]j YrUbX

	`]b_'hfUbgZYfg'UfY'X]gUV'YX"'5ZhYf'U'`cgg'cZ Wtaaib]WUh]cb'k]h\'h\Y'df]aUfmaUW\]bYž h\]g'bcXY'k]'`'UggiaY'h\Y'fc'Y'cZh\Y UWh]jY'Vf]X[Y'VmgYhh]b['U'`]hYag'hc'UWh]jY UbX'YbUV']b['']b_'hfUbgZYfg"
GYW¢bXUfmff7c`XŁ	H\]g gYhh]b['WbZ][i fYg h\Y'W ffYbh @b_A UghYf a UW]bY hc cdYfUhY 'Ug h\Y VUW_i d bcXY cZh\Y'fYXi bXUbhdU]f" =b h\]g a cXYZ]bdi h]hYa g 'UfY bch UXXYX" 5ZhYf 'U 'cgg cZ Wa a i b]Wh]cb k]h\ h\Y'df]a Ufm a UW]bYZ h\]g bcXY k] "Uggi a Y h\Y'fc Y cZ h\Y'UWn] Y Yf]X[Y'VmUXX]b[']hYa g ']b 'Ub UWn] Y 'ghUhY 'UbX'YbUV']b['`]b_ 'hfUbgZYfg"

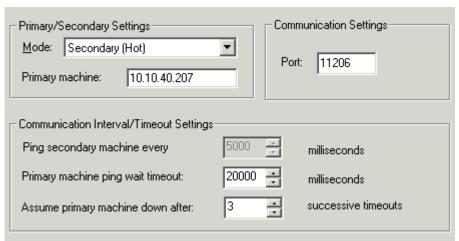
 $=b.'h\ Y \\ = \frac{2}{Y}XZYDhYf'h\ Y'dcfh'bi \ a \ VYf'Zcf'Wca \ a \ i \ b]WUh]cbg'''H\]g']g'h\ Y'dcfh'bc'k \]WW'fYgdcbgYg'k]```VY'gYbh'Vm'h\ Y gYWcbXUfm'bcXY'''H\ Y'XYZUi 'h'dcfh'bi \ a \ VYf']g'\%&$*"'H\ Y'j U']X'fUb[Y'Zcf'h\ Y'Dcfh'Z]Y'X']g'\%'bc'*))')''$

 $"H\Y"Dcfh'bi\ a\ VYf'a\ i\ gh'VY'h\Y'gUa\ Y'Zcf'h\Y'df] a\ Ufm'UbX'gYWcbXUfm'@]b_A\ UghYf'a\ UWX]bYg"'H\]g']g'fYei\]fYX'Zcf\ fYXi\ bXUbWh''$

- "XYhYfa]bYg`\ck `cZhYb`h\Y`df]a UfmbcXY`k]```gYbX`U`d]b[`hc`h\Y`gYWbXUfm bcXY`hc`WbZ]fa `h\Uh`h\Y`df]a UfmbcXY`]g`fi bb]b["`H\Y`XYZUi `h`]g`) \$\$\$`a]``]gYWbXg"`H\Y`j U`]X`fUb[Y`]g`%\$\$`hc %&\$\$\$\$ a]``]gYWbXg"`H\]g`Z]Y`X`]g`YbUV`YX`cb`mk\Yb`A cXY1 Df]a Ufm'
- "XYhYfa]bYg`\ck 'a UbmfYgdcbgY`h]a Yci hg`h\Y`df]a UfmbcXY`k]`` U``ck `VYZcfY`Uggi a]b[`h\Y`gYWcbXUfmbcXY`hc`VY`bch`Zi bWh]cbU`"`H\Y`XYZJi `h`]g'' `fYhf]Yg"`H\Y`j U`]X`fUb[Y`]g'%`hc %\$\$`fYhf]Yg"

 $H\Y`Zc``ck]b[g`UfY`UjU]`UV`Y`k\Yb`GYWcbXUfmfl$

Ł']g'gY`YWYX']b'h\Y' 'Z]Y`X"



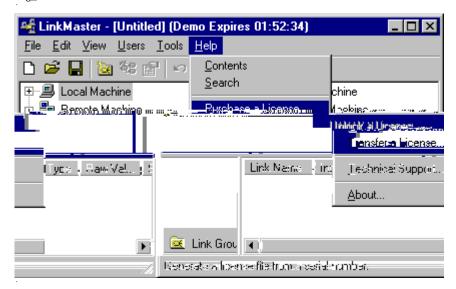
- %" H\Y` ZJY`X`WUb`VY`i gYX`hc`gdYWJZmih\Y`df]a Ufma UW\]bY"`I gYfg`WUb`YbhYf`Y]h\Yf`h\Y`=D`UXXfYgg`cf h\Y`a UW\]bY`bUa Y`fk]h\ci h`h\Y`"PP`Ł`cZ`h\Y`df]a Ufma UW\]bY"
- &" `]g`h\Y`dcfh'bi a VYf`Zcf`Wta a i b]WWh]cbg"`FYXi bXUbWhfYei]fYg`h\Uh'h\Y`dcfh'bi a VYf`]g`h\Y`gUa Y`Zcf`h\Y df]a Ufm'UbX`gYWtbXUfm@]b_A UghYf`a UW\]bYg"
 - `]g`[fUmYX`ci h`VYVWi gY`h\]g`gYhh]b[`]g`cb`m`YbUV`YX`k \Yb`A cXY1 Df]a Ufm'

) " XYhYfa]bYg`\ck 'a Ubmd]b['h]a Yci hg`h\Y`gYWbbXUfmbcXY`k]```U``ck VYZcfY`Uggi a]b['h\Y`df]a UfmbcXY`hc`VY`bch`Zi bWh]cbU``UbX`HU_]b['cj Yf`h\Y`fc`Y`cZ'h\Y`df]a Ufm''H\Y`XYZUi `h`]g'' fYhf]Yg"'H\Y`j U`]X`fUb[Y`]g'%hc`%\$\$`fYhf]Yg"

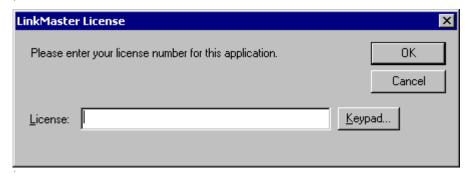
Hc'di fWkUgY'U'@ b_A UghYfž'g]a d'm'gY'YVh' hUg_VUf"

'Zfca 'h\Y'

'Xfcd'Xck b'a Ybi 'cb'@b_A UghYffg'a U]b



 $5^{X}U^{c}[^{k}]^{U}ddYUf^{U}g^{c} ck b^{V}Y^{c}k$



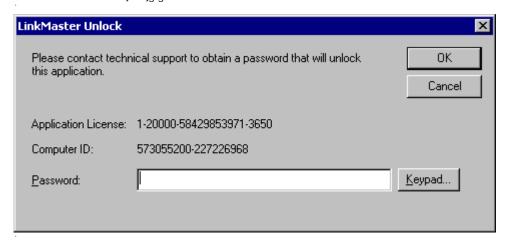
5`dfcXi Wh``]WYbgY`fY[]ghfUh]cb`WcXY`WUb`VY`cVhU]bYX`Vm`WcbhUWh]b[`?Ydk UfY`cf`Ub`Ui h\cf]nYX`X]ghf]Vi hcf"`CbWY`U`dfcXi WhfY[]ghfUh]cb`WcXY`\Ug`VYYb`cVhU]bYXž`]h`a Um`VY`YbhYfYX`\YfY"`=Z`U`_YmVcUfX`]g`i bUj U]`UV`Yž`i gY`h\Y`cb!gWfYYb`_YmdUX`hc YbhYf`h\Y`WcXY"

 $K \ \ Vb \ @b_A \ UghYf \ \ Ug \ VYYb \ gi \ \ WW \ ggZ \ \ \ m'di \ fWL \ UgYX \ \ UbX \ \ dfY! \ fY[\]ghYfYXž \ h \ Y \ \ Zc \ \ ck \]b[\ \ X]U \ c[\ \ k\] \ \ VY \ g \ ck \ b"$



``C bWr'h\Y`dfcXi Wh'fY[]ghfUh]cb`WcXY`\Ug`VYYb`YbhYfYXž'h\Y``]WrbgY`k]```cb`m'Wcbh]bi Y`hc`fi b`Zcf`U`%\$!XUm]bghU``Uh]cb'[fUWr'dYf]cX"`I gYfg`k]```gh]```bYYX`hc`dYfZcfa `h\Y'_________'ghYd`hc`Wca d`YhY`h\Y`]Wrbg]b[`gYei YbWr"`I gYfg`\Uj Y`i d`hc'%\$`XUmg`hc`WcbhUWh'?Ydk UfY`cf`Ub`Ui h\cf]nYX`X]ghf]Vi hcf`hc`Zi ``mi b`c_'h\Y @]b_A UghYf`Zcf`i bfYghf]WhYX`i gY"

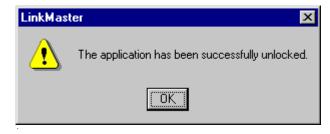
CbWr'U``]WrbgY`\Ug`VYYb'di fW\UgYX'UbX`]bgHU``YXž'h\Y'@]b_A UghYf`WUb'h\Yb'VY'i b`cW_YX'Zcf'Zl ``!i b`]a]hYX'i gY'cb'h\Y HUf[Yh'D7"'H\Y' p 'A Ybi 'cdh]cb'k]```cb`m'VY'YbUV`YX`]Z'U``]WrbgY`]g`XYhYWhYXž'Vi h\\Ug'bch'mYh VYYb'Zl ``mi b`cW_YX"'=Z'h\Y'@]b_A UghYf`\Ug'bch'VYYb'i b`cW_YXž'h\Y'Zc``ck]b['X]U'c['k]```UddYUf'k \Yb'h\Y' 'a Ybi 'cdh]cb']g`gY`YWhYX"



5h'h\]g'dc]bhži gYfg'Wb'WcbhUWf?Ydk UfY'Vm'Ya U]`ž'ZUI `cf'd\cbY"`H\Y`XUHU'dfYgYbhYX'cb'h\]g'X]U'c['a i gh'VY'dfcj]XYX'hc?Ydk UfY'hc'fYWf]j Y'U'dUggk cfX"'H\Y' 'UbX' 'a i gh'VY'fYhi fbYX'UWW fUhY'mž'hc'U'`ck?Ydk UfY'hc'[YbYfUhY'h\Y'Uddfcdf]UhY'dUggk cfX"'CbW'h\Y'dUggk cfX'\Ug'VYYb'cVhU]bYX'Zfca '?Ydk UfYž']h'Wb'VY'YbhYfYX]b'h\]g'X]U'c['hc'Z ``mi b`cW_'h\Y'@]b_A UghYf"'=Z'U'_YmVcUfX']g'i bUj U]'UV'Yž'i gY'h\Y'cb! gWfYYb'_YmdUX'hc'YbhYf'h\Y'WtXY"

=Zi gYfg`WUbbch`WcbHuWh`?Ydk UfY`]a a YX]UhY`mž'@b_A UghYf`WUb`VY`fi b`]b`]hj]U``%\$!XUm`]WfbgYX`fi b`a cXY'"H\Y`%\$!XUm]bghU``Uh]cb'a cXY`]g`XYg][bYX`hc'U``ck i gYfg`hc'WcbHuWh`?Ydk UfY`k\Yb`]h`]g`Wcbj Yb]Ybh"'=Zi gYfg`WUbbch`WcbHuWh`?Ydk UfY`a YYbu]la a YX]UhY`mž\]h`h\Y`WUbWf``Vi hhcb'hc'ghUfh`h\Y`%\$!XUm]bghU``Uh]cb'[fUWf'dYf]cX"\\Yb'h\]g`cWWffgz`U'a YggU[Y'k]``VYd'UWfX`]b`@b_A UghYffg`Yj Ybh`c[[Yfz'9j Ybh]Yk Yfz'k\]W\'ghUh\Yg`h\Uh'h\Y`%\$!XUm]bghU``Uh]cb'[fUWf'dYf]cX'\Ug'VY[i b"

 $\label{eq:continuous} $$K \Yb'@]b_A UghYf'\Ug'VYYb'gi WW'ggZ' ``m'i b`c\W_YXž'h\Y'Zc``ck]b['X]U'c['k]```VY'g\ck b'' $$$

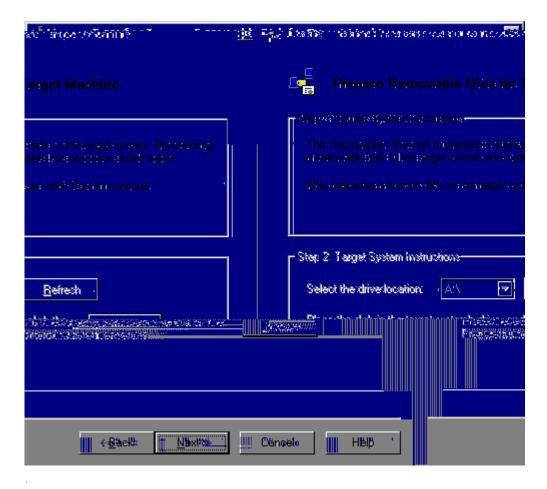


H\Y'Zc``ck]b[`ghYdg'a i gh'VY'dYfZcfa YX`]b`cfXYf`hc`hfUbgZYf`Ub`YI]gh]b[``]WYbgY'Zfca `cbY`gmghYa `hc`Ubch\Yf" ``FYUX`UbX`UWWdh'n\Y`]WYbgY`U[fYYa Ybh' ``DfYdUfY`U`]WYbgY`X]g_ 'Zcf'n\Y`hUf[Yh`gmghYa " ``HfUbgZYf`Ub`YI]gh]b[``]WYbgY`Zfca `h\Y`gci fWY`gmghYa `hc`h\Y``]WYbgY`X]g_"`H\]g`k]``fYa cj Y`h\Y``]WYbgY`Zfca `h\Y gci fWY`gmghYa " ``HfUbgZYf`Ub`YI]gh]b[``]WYbgY`Zfca `h\Y``]WYbgY`X]g_ 'hc`h\Y`HUf[Yh`gmghYa "`H\]g`k]```a cj Y`h\Y``]WYbgY`hc`h\Y`hUf[Yh gmghYa " H\Y`Zc``ck]b[``]g`fYei]fYX`hc`hfUbgZYf`U``]WYbgY. € 5\WW\gg`hc`Vch\`gci fWY`fMcbhU]bg`U'j U`]X``]WYbgYŁ`UbX`hUf[Yh`gmghYa g" € 9\UW\`gmghYa `g\ci `X`VY`Yei]ddYX`k]h\`U'\wca dUh]V`Y`fYa cj UV'Y`a YX]U`Xf]j Y" € : cfa UhhYX`fYa cj UV'Y`a YX]U`fY''["z̄': `cddmX]g_z̄'I G6`_Ymt'''

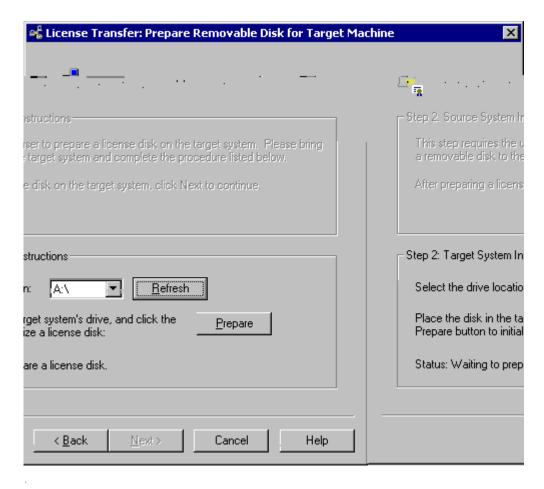
Hc'a cj Y'U'@b_A UghYf'`]WYbgY'Zcfa 'cbY'D7'hc'Ubch\Yfž'gY'YWf	'Zfca 'h\Y'@b_AUghYf'a Ybi 'UbX'gY'YVh'
K\Yb'acj]b['U'@]b_AUghYf``]WYbgY'Zfca'cbY'aUW\]bY'bc'Ubch\Yf U[fYYaYbh''=Z'W\ccg]b['bc'UWWYdh'h\Y'U[fYYaYbhz'gY`YWh'h\Y'fUX] ""'H\]g'k]``h\Yb'U``ck'UWWYgg'bc'cZ'h\Y'hfUbgZ	c'Vi http://byl.hihte'//
K Y`gi [[Ygh`h\.Uh`i gYfg`i gY`U`WYUbž`bYk`m'Zcfa UHhYX`X]g_YthY`VYZcfY`VY[]bb]b[`th\Y``]WYbgY`hfUbgZYf`dfcWYgg"

K Y gi [[Ygh N Uh i gYfg i gY U WYUbz bYk 'm Æfa Uhfy X Xjg_Yhfy VYÆfY VY[]bb]b['N Y "]WYbgY 'hTUbgZYf dfcWYgg"
H\Y'dfcWYgg cZhfUbgZYff]b['U"]WYbgY 'Zfca 'cbY'a UW]bY''bc'Ubch\Yf'a i ghVY'Wa d'YhYX'cbWY'h\Y']WYbgY'\Ug'VYYb
fYa cj YX'Zfca 'h\Y'gci fWY'a UW\]bY"'=Zh\Y']WYbgY'hfUbgZYf'dfcWYgg']g'WUbWY"\YX'UZhYf'h\Y']WYbgY'\Ug'VYYb'fYa cj YXž']h'k]"
VYWaa Y'Waffi dh'UbX'WUbbchVY']bghU`YX'cb'Y]h\Yf'h\Y'gci fWY'cf'hUf[YhD7"

 $IgYfg'k]^{"VY'dfYgYbhYX'k]h("cbY'cZ'h(Y'Zc'"ck]b["X]U'c[g'XYdYbX]b["cb'k(Yh(Yf'h(Y'HUf[Yh'cf'GcifWf'D7']g'VY]b["igYX"]}$

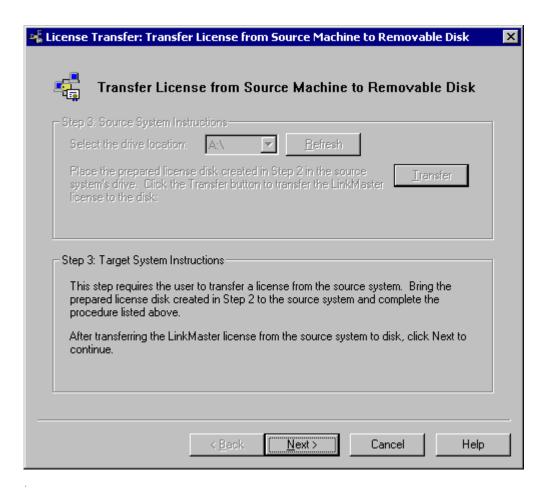


 $= b \cdot h \cdot]g \cdot g h \cdot d z \cdot i \cdot g \cdot y \cdot f \cdot g \cdot y \cdot f \cdot y \cdot h \cdot y \cdot h$

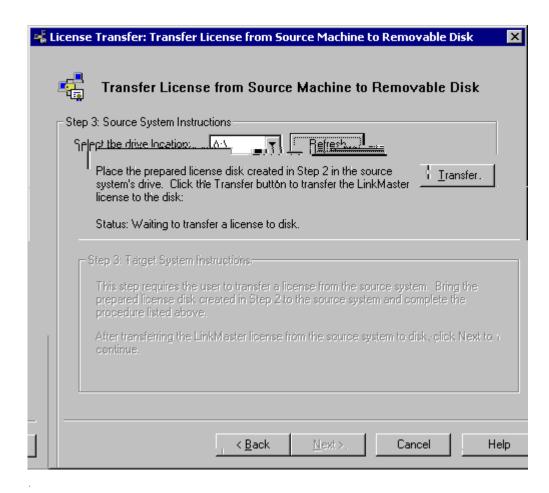


5h'h\]g'dc]bhž'h\Y'X]g_YhhY'dfYdUfUh]cb'XcbY'cb'h\Y'HUf[Yh'D7'dfcXiWfg'h\Y'a YX]U'fYei]fYX'hc'a cj Y'h\Y'\]WfbgY'Zfca 'h\Y gci fW'a UW\]bY"'=b'ch\Yf'k cfXgž'h\Y'hUf[Yh'gmghYa']g'fYei]fYX'hc'dfcXiWf'h\Y'X]g_YhhY'bYYXYX'hc'a cj Y'h\Y'@]b_A UghYf \]WfbgY'Zfca 'h\Y'gci fWf'a UW\]bY"'=Z'h\Y'X]g_YhhY'dfYdUfUh]cb']g']bhYffi dhYXž'h\Y'\]WfbgY'k]\`ZU]'hc'hfUbgZYf'Zfca 'h\Y qci fWf'a UW\]bY"

CbWY:h\Y:X]g_YhhY:]g:dfYdUfYX:Vmh\Y:HUf[Yh:D7ž:i gYfg:a UmdfcWYYX:hc:______"



 $5h'h\]g'dc]bh''i\ gYfg'bYYX'hc'hU_Y'h\ Y'X]g_YhhY'h\ Uh'k\ Ug'dfYdUfYX']b'GhYd'\&'cj\ Yf'hc'h\ Y'gci\ fWf'a\ UW\]bY'''H\ Y'X]U'c[\ 'cb'h\ Y'gci\ fWf'a\ UW\]bY'g\ ci' X'UddYUf'Ug'Zc'`ck\ g.$



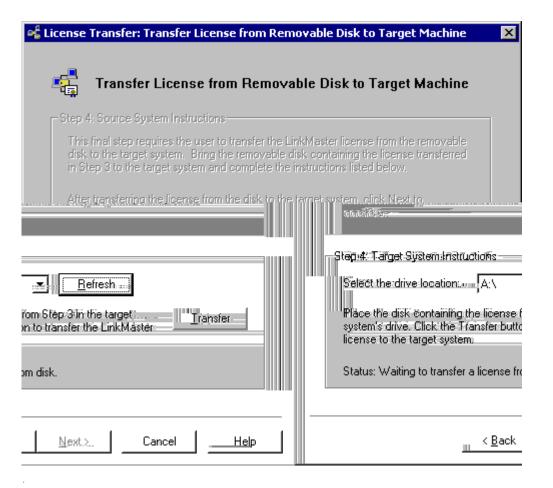
 $Bck 'd'UW'h Y'X]g_YhhY'dfYdUfYX'Vmh\Y'hUf[Yh'D7']bhc'h\Y'Zcddm'Xf]j Y'cZ'h\Y'gci fW'a UW\]bY'UbX'dfYgg'hfUbgZYf'i h]`]hmk]``bck 'hfUbgZYf'h\Y'@]b_A UghYf``]W'bgY'hc'h\Y'Zcddm'X]g_YhhY''Bck 'dfcWYYX'hc'______"$

"'H\Y

 $FYa\ cj\]b[\ 'h\ Y'X]g_YhhY'Zfca\ 'h\ Y'Zcddm'Xf]j\ Y'VYZcfY'h\ Y'X]g_^`][\ h'\ Ug'VYYb'hi\ fbYX'cZZ'a\ Um'fYgi\ 'h']b'h\ Y'`cgg\ cZ'cZ'`]W'bgY']bZcfa\ Uh]cb'''5``ck 'U``X]g_'cdYfUh]cbg'hc'Wta\ d'YhY'VYZcfY'UhhYa\ dh]b['hc'fYa\ cj\ Y'Ubm'X]g_YhhYg'Zfca\ 'h\ Y'D7''' \leftarrow \lefta$

CbWY'h\Y``]WYbqY'\Ug'VYYb'hfUbqZYffYX'hc'h\Y'ZcddmX]q_YhhY'Zfca 'h\Y'Gci fWY'D7ž'i gYfq'g\ci `X'gYY'h\Y'Zc``ck]b['X]U'c["





CbWI'h\Y'hfUbgZYf`cZ`]WIbgY`]bZcfa Uh]cb`]g`Wta d`YhYz`gY`YWih\Y' Vi hhcb`hc`dfcWYX`hc`h\Y' ____"=ZU``k Ug`Wta d`YhYX`WtffYWinz`U`@b_A UghYf``]WIbgY`\Ug`VYYb`gi WWYgqZi ``m'hfUbgZYffYX`hc`h\Y'hUf[Yh`a UW\]bY"

H\Y'a cgh'Wta a cb'Yffcf'h\Uh'a Um'VY'YbWti bhYfYX'k]``VY'fY`UhYX'hc'h\Y'ZcddmX]g_YhhY'''K\]'Y`]h'a Um'VY'Wta a cb'bUhi fY hc'[fUV'h\Y'bYUfYgh'X]g_YhhYž'V`ck 'h\Y'X]fh'cZZž'UbX'gh]\\'_'[h']bhc'h\Y'ZcddmXf]j Yž'k Y'gi [[Ygh'h\Uh'U'WYUbž'bYk `m Zcfa UhhYX'X]g_YhhY`VY'i gYX'VYZcfY'VY[]bb]b['h\Y'@]\\'fUbgZYf'dfcWfgg"'5g'\Ug'U`fYUXmVYYb'a Ybh]cbYXž'fYa cj]b[h\Y'X]g_YhhY`Zfca 'h\Y'ZcddmXf]j Y'Xi f]b['Y]h\Yf'h\Y'hUf[YhX]g_'dfYdUfUh]cb'cf'UWf U``]\\'bY'a Um'V\'bgY'hfUbgZYf'dcfh]cb'cb'h\Y gci fW'a UW\]bY'a Um'V\'g'Ub'Yffcf'h\Uh'k]`'`fYgi 'h']b'h\Y'`cgg'cZ`]\\'bgY']bZcfa Uh]cb

H\Y`ch\Yf`dcgg]V`Y`Yffcf`h\Uh`a Um`VY`YbWci bHYfYX`]Z`i gYfg`ZU]``hc`UWfi U``m`hfUbgZYf`h\Y`]WfbgY`]bZcfa Uh]cb`Zfca `h\Y gci fWr`a UW\]bY`hc`h\Y`dfYdUfYX`X]g_YHHY"`=Z`h\]g`cWWfgž`h\Y`Zc``ck]b[`X]U`c[`k]``VY`]bj c_YX.



H\Y`dfcWfgg`cZ`hfUbgZYff]b[`U``]WfbgY`Zfca `cbY`a UW\]bY`hc`Ubch\Yf`a i gh`VY`Wca d`YhYX`cbWf`h\Y``]WfbgY`\Ug VYYb`fYa cj`YX`Zfca `h\Y`gci fWf`a UW\]bY"`=Z'h\Y``]WfbgY`hfUbgZYf`dfcWfgg`]g`WUbWf``YX`UZhYf`h\Y``]WfbgY`\Ug`VYYb`fYa cj`YXž $]h'k]```VYW&a Y'W&ffi dh'UbX'WUbbch'VY']bghU``YX'cb'Y]h\Yf'th\Y'gci fWf'cf'hUf[Yh'D7'''K]h\'th\]g']b'a]bXž']bgi fY'th\Uh'th\Y'ghYdg XYg\W]VYX'UVcj Y'\Wb'VY'\W&a d`YhYX'VYZcfY'th\Y'`]\WfbgY'tfUbgZYf'dfc\Wfgg'VY[]bg''$

 $= ZU @[b_A UghYf^*] WYbgY^* Ug^*VYYb^*hfUbgZYffYX^gi WWggZ ``mž'h\Y`gWYYb^g\ci `X`UddYUf^Ug^g\ck b^*VY`ck "$



···Zc``ck]b[··`]gh'WcbHJ]bg'U'	gUa d`Y [*] cZ*W¢a a	cb ei Ygh]cbg	c Z hYb dcgYX Vmii	gYfg"	
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ÔØ´V^¢cÁÁÁÁHÉÁÍÍ

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&[]c![]•ÁÁÁÁÁÏ

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ÖæcæÁŒ&&^••ÁÁÁÁI€ ÖæcæÁŒ&&^•ÁGÈ€ÁÁÁÁ Šā}\Tæ•c^¦Á•~]][¦c•ÁÁÁÁÁI€ ÖÖÒÁÁÁÁHÉÁF€ÉÁ Í Í ÖÖÒÁÔJã^}cÁÁÁÁÁHÉÁÍÍ ÖÖÒÁØ`}åæ{^}cæ|•ÁÁÁÁH ÖÖÒÁU]cã[}•ÁÁÁÁÁÍÍ ÖÖÒÙPŒÜÒÈÒÝÒÁÁÁÁF€ Ö^æå\Xæ|~^\\\\IJ Ö^|^cã} *ÁÁÁÁÍ [€ Ö^•ã*}ÁæÁÚ¦[b^&cÁËÁŒååã}*ÁŒÁÕ¦[~]ÁÁÁÁÁGF Ö^•ā*}ÁæÁÚ¦[b^&cÁËÁŒååä}*ÁŒÁŠā}\ÁQc^{ÁÁÁÁGI Ö^•ā*}ÁæÁÚ¦[b^&cÁËÁÙæçā}*Áæ}åÁV^•cā}*Ác@^ÁÚ¦[b^&cÁÁ Ö^•ã*}ÁæÁÚ¦[b^&cÁËÁÙcæ¦cã}*ÁŒÁÚ¦[b^&cÁÁÁÁÁGF Öã•&æ¦åÁÁÁÁI€ åã•&[}}^&cÁÁÁÁÁÏÊÁI€ÊÁIÌ Ö¦æ*ÁÁÁÁÁFGÉÁGI Ö¦æ*Áæ}åÁÖ¦[]Áāc^ { ●ÁÁÁÁÁFG ÖY[¦åÁÁÁÁHÎ Ö^}æ { i&ÁÖæcæÁÒ¢&@æ} * ^ÁÁÁÁÁ Í Í

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Òç^}cXi^_^!AAAAATF

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Õ^}^¦æ|ÁÁÁÁHÍ

Õ^}^¦æ|ÁU]æ[}•ÁÁÁÁÁÏÊÁI€ *¦[ˇ]ÁÁÁÁÁÏÊÁFGÊÁGFÊAHÍÊÁÍH

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Pæ|cÁÁÁÁÁÍF P^|]ÁÁÁÁÁÍJ P[,ÁÖ[ÁCÉÉÉÑÁÁÁÁÁÎÌ

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SÒÚÙ^¦ç^¦ÒÝÁÁÁÁGI

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Šå&^}•^ÁÁÁÁ

Ú '|&@æ•^ÁÁÁÁÍJ

Šå&^}•^ÁV¦æ}•-^¦ÁÁÁÁÍF

Šå}\ÁÕ;[`]ÁÚ![]^!cá^•ÁÁÁÁHH

Šå}\ÁQ; [`]ÁÚ![]^!cá^•ÁÁÁÁHH

Šå}\ÁQc^{ÁÕ,}^!æ|ÁÁÁÁHÍ

Šå}\ÁQc^{ÁQ}] `cÁÁÁÁHÍ

Šå}\ÁQc^{ÁQ}] `cÁÁÁÁHÍ

Šå}\ÁU`c] `cÁÁÁÁHÏ

Šå}\ÁU`c] `cÁÁÁÁHÏ

Šå}\ÁU`c] `cÁÁÁÁHÏ

Šå}\ÁU`c] `cÁÁÁÁHÏ

Šå}\ÁUÙCD `cÁÁÁÁHÏ

Šå}\ÁC!æ}•-^!•ÁÁÁÁGF

ŠQÞSÖÒTUÈUÚØÁÁÁÁGI

Šå}\Tæ•c^!AÔ[}~ā*~!æcā[}AAAAAF€ Šå}\Tæ•c^!Aåå^AAAAAF€ Šå}\Tæ•c^!AÜ^*ā•c!æcā[}AAAAA΀ Šå}\{æ•c^!EQÞQAAAAAGF ŠTÖÖÒÖŒVŒAAAAAF€ Š[&æ|ATæ&@à}^AAAAAGI Š[,AAAAHJ

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Tæ&@ā}^ÁÞæ {^ÁÁÁÁHÎ

Tæ\ā}*ÁÁÁ

Þ^cÖÖÒÁÁÁÁF€

{^}*ÁÁÁÁÏÊÁGFÉÁI€ÊÁÍJ

Tā&¦[•[~cÁÁÁÁÁÍÍ

Tā&¦[•[~cÁ•ÁÞ^cÁÁÁÁÁÍÍ

Tā}ā { ~ {ÁÙ^•c^{ ÁÜ^~~ā!^{^}c•ÁÁÁÁGÈ}

T[•cÁÜ^&^]cÎAW•^åÁ-ā]^ÁJā•cÁÁÁÁÁGÌ

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Þæ { ^ÁÁÁÁHÍ
 Þ^CÁÁÁÁ
 ÙCæ¦Cå} * ÁÁÁÁÁÍ Í
 Þ^CÁÖÖÒÁÁÁÁÁ Í
 ÞÒVÖÖÒÁÁÁÁ
 ^•Cæà|i•@ÁÁÁÁF€
 *Cæ¦CÁÁÁÁF€
 Þ^CÖÖÒÁ•^!Çå&^•ÁÁÁÁF€
 ÞÒVÖÖÒÈÒÝÒÁÁÁÁF€
 Þ^ ÁŠå} \ÁÁÁÁGI

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U~ÁÁÁÁÁÍÍ
U}ÐU~Áͪ}\ÁÁÁÁÁHH
UÚÔÁÁÁÁÁHÉÁÏÉÁGFÉÁIÌÉÁÍÍ
UÚÔÁÔ[a^}cÁÁÁÁÁGÌ
UÚÔÁÔ[{}]!æ}&^ÁU]cá[}•ÁÁÁÁÁÍH
UÚÔÁÞ[c^ÁÁÁÁÁI€
UÚÔÁU]cá[}•ÁÁÁÁÁÍG
UÚÔÁU]cá[}•ÁÁÁÁÁÍG
UÚÔÁÙ]^&æ-å&æcá[}ÁÁÁÁH
[]cá[]•ÁÁÁÁÄÏÉÁGFÉÁI€ÉÁIÌÉÁIJÉÁÍGÉÁÍHÉÁÍÍ
U`c]~CÁÁÁÁÁHÏ

U`c]`chāc^{AAAAGI [ç^!çā^, AAAAHEAÏ Uç^!, lāc^AŒ•AÞ^^å^åAAAAAAF

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Ú¦[&^••å}*ÁŒ¦!æ^ÁÖæcæAQ}ÁŒÁÖÖÒÁÔ|ā^}cÁÁÁÁÁJ Ú![b^&cÁÁÁÁ Ö^•ã*}ÁÁÁÁAGÌ V^•cã}*ÁÁÁÁAGÌ Ú![{]cÁÁÁÁI€ Ú*¦&@æ•^ÁÁÁÁ Šã&^}•^ÁÁÁÁÁ∫J Šã}\Tæ•c^¦ÁŠã&^}•^ÁÁÁÁÁ∫J Ú*¦&@æ•^ÁÆÁŠã}\Tæ•c^¦ÁŠã&^}•^ÁÁÁÁÁ∫J

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Û`ā&\AÓ¦[,•^AAAAAGI Û`ā&\AÓ¦[,•^A,ā}å[,AAAAAGI

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ÙĐÞÁÁÁÁÁÍ€ Ùæ{]|^ÁÁÁÁ &[];cæi}•ÁÁÁÁÁÍÌ Ù&æ|^åÁXæ|~^ÁÁÁÁHJ Ù&æ|i}*ÁÁÁÁÍÏÉÁHJ Ù^|^&ci}*ÁÁÁÁ Ü^æåÁU}|^ÁÁÁÁHÍ Ù^lc^lÁÁÁ Ò¢&^|ÁÁÁÁF€ Ù^\c^\AÞæ { ^AAAAAHÎÊAHÏ Ù^¦ç^¦ÁW]åæc^ÁÜæc^ÁÁÁÁGF ^ccã } *ÁÁÁÁÁHH •^¦çã&^ÁÁÁÁÁÏÊÁÍÍ Ù^\cã&^ÁÞæ { ^ÁÁÁÁÁ Í Í Ù^¦çã&^ÁU]cã[}•ÁÁÁÁÁIH Ù^ccã} * ÁÁÁÁ Ù^¦ç^¦ÁW]åæc^ÁÜæc^ÁÁÁÁHH •@æ¦^•ÁÁÁÁÁF€ÉÁÍÍ Ùā*}^åÁFÎËàācÁÁÁÁHÎĒÁHÏ Ùā*}^åÁHGËàācÁÁÁÁHÎĒÁHÏ Ùā*}^åÁÌËàācÁÁÁÁHÎĒÁHÏ Ùã { ~ |æc [¦ÁÁÁÁFJ Ù~~ÁÜ[[cÁÁÁÁÁÏĒÁHJ Ùcæ¦cã} *ÁÁÁÁ Þ^cÁÁÁÁÁÍÍ Þ^cÖÖÒÁÁÁÁF€ •cæc • Áàæ¦ÁÁÁÁÏ Ùc¦ã} *ÁÁÁÁÁHÎ Ù I I I I I CÁÁÁÁÁ Í G Ù ˇ]] [¦c•ÁÔU TÁÁÁÁÁ Ï Ù^•c^ { ÁVæ*•ÁÁÁÁFFÉÁHH

I.H.I

Væ*ÁÓ¦[, •ã}*ÁÁÁÁÏ
Væ•\àæ¦ÁÁÁÁÍJ
V^¦{•ÁÁÁÁ
ÔÚWÁÁÁÁÁHH
Vã{^[`cÁÁÁÁÁI€ÉÁÍGÉÁÍÍ
c[[]•ÁÁÁÁÏ
V[[]•@U]cã[]}•®ÖÖÒÁÁÁÁ
•^|^&cÁÁÁÁF€
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W}|[&\ÁÁÁÁ
Šã&^}•^ÁÁÁÁÁ΀

W}•ā*}^åÁFÎËàācÁÁÁÁÁHÎĒÁHÏ

W}•ā*}^åÁHGËàācÁÁÁÁÁHÎĒÁHÏ

W}•ā*}^åÁÌËàācÁÁÁÁÁHÎĒÁHÏ

W]åæc^Áà`cc[}ÁÁÁÁ
]!^••ā}*ÁÁÁÁÁHÏ

Čaæc^Áá}c^!çæ|ÁÁÁÁÁÏĒÁHH

W•^ÁÁÁÁ
ÖÔUTÁÁÁÁÁÍG
W•^ÁÖÔUTÁÁÁÁÁÍG
W•^¦ÁTæ}æ*^{^}cÁÁÁÁÁÏÉÁFÏ
W•^¦ÁTæ}æ*^¦ÁÁÁÁÁÏÉÁFÏ
W•^¦ÁÚ¦[]^¦cá^•ÁÁÁÁÁFÌ
W•^¦•ÁÁÁÁÁÎÌ
W•å}*ÁÞÒVÖÖÒÁÁÁÁF€
W•å}*ÁV@^ÁW•^¦ÁTæ}æ*^¦ÁÁÁÁFÎ

!'J'!

çã^¸ÁÁÁÁÁÏ Xã•~æ|ÁÓæ•ã&ÁÁÁÁÁGÌ

!'K'!

YæācÁÁÁÁÍJ Y¦āc^ÁU]cā {ā:æcā[}•ÁÁÁÁÁÏÊÁIJ

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ÝŠ´Væà|^ÁÁÁÁHÊÁÍÍ

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Ÿ[ˇ¦ÁÚ¦[b^&cÁÁÁÁ V^•câ}*ÁÁÁÁÁGÌ