Selenian Boondocks
Random Musings from the Warped Minds of Jonathan Goff, Ken Murphy, John Hare, and Kirk Sorensen

Lunar Orbital Facility Location Options

Posted on April 16, 2016 by Jonathan Goff

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Lunar Orbital Facility Orbit Options

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kws=22vslulwdv1xwh{dv1hgx2(:Hilvr2whdhfrq2Z klwh|b70460492Z klwh|b70460491sqi

Wkh|#glvfxvv#p rvw#ri#wkh#frp p rqo|#Flwhg#rswlrqv#qfoxglqj#Orz #Oxqdu#Ruelw/#Ur}hq#Ruelw/#O5#K doc#Ruelw/# G lvwdqw#Jhwurjudgh#Ruelw/#dqg#d#p ruh#hfhqwo|#glvfryhuhg#rswlrq/#Q hdu#Jhfwdolqhdu#Ruelw1

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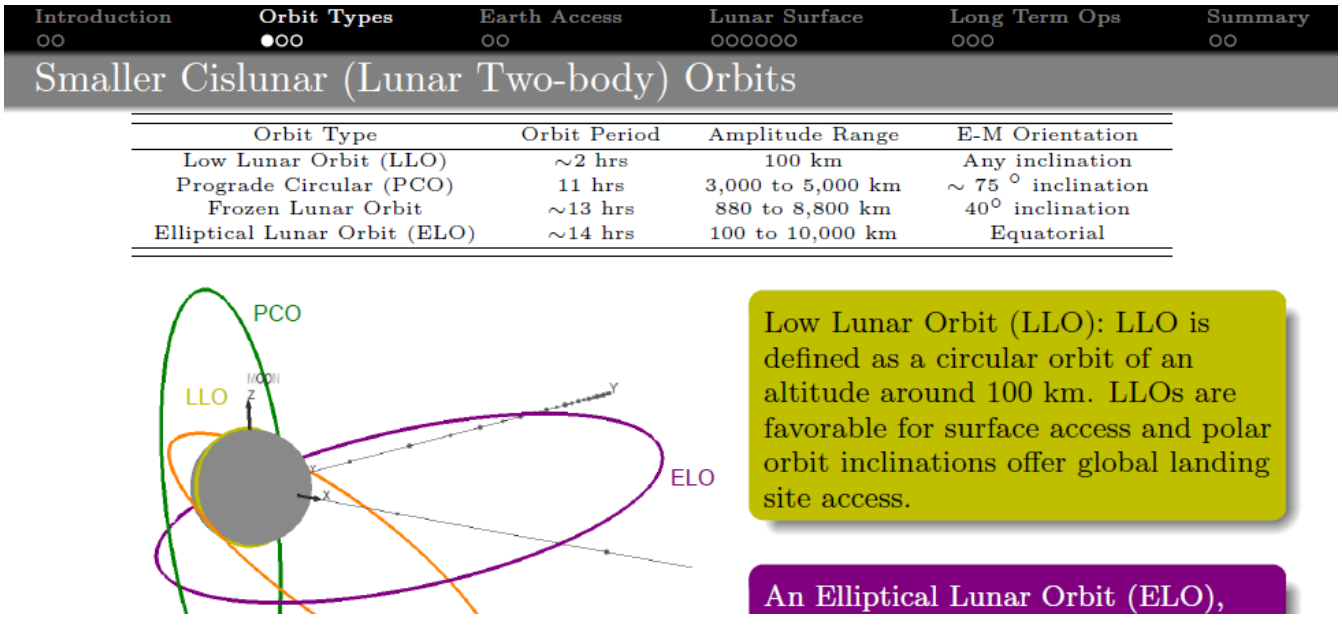

such as the 100 x 10,000 km shown, trades insertion costs with transfer cost to lunar surface.

Prograde Circular Orbits (PCOs) are defined as circular orbits of various sizes that rotate in the prograde direction and are highly stable, requiring few to zero corrections to be maintained.

Frozen orbits are similar but need not be circular and have orbital parameters that oscillate around fixed values.

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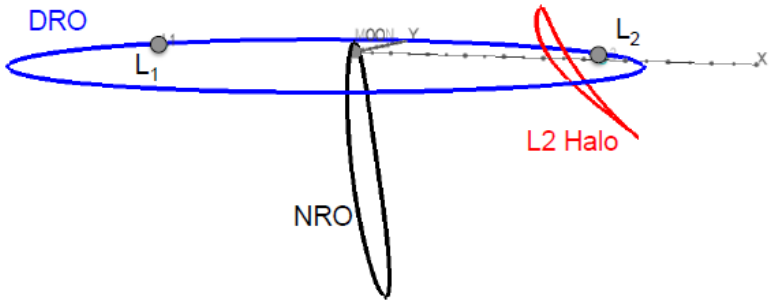
Larger Cislunar (Three-body) Orbits

Orbit Type	Orbit Period	Amplitude Range	E-M Orientation
Near Rectilinear Orbit (NRO)	6-8 days	2,000 to 75,000 km	Roughly polar
Earth-Moon L2 Halo	8-14 days	0 to 60,000 km (L2)	Dependent on size
Distant Retrograde Orbit (DRO)	~14 days	70,000 km	Equatorial



Near-rectilinear halo orbits (NROs) were discovered as a bridge between L1 and L2 halos. NROs are halo orbits with large amplitudes over either the North or South poles that are fixed in the Earth-moon plane.

Halo orbits are a subset of orbits around the collinear libration points that are purely periodic but slightly unstable in the full ephemeris model.

Distant Retrograde Orbits (DROs) are relatively periodic three-body orbits that can be extremely stable, requiring zero corrective maneuvers.

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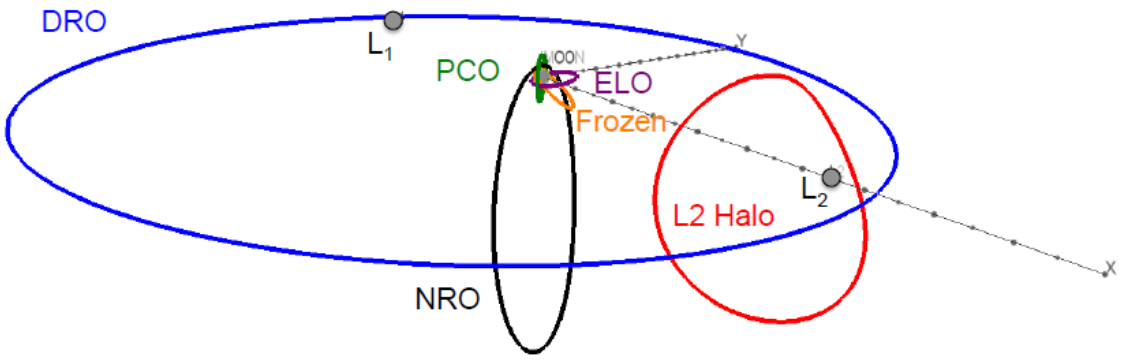
All Cislunar Orbits for Consideration Summarized

Orbit Type	Orbit Period	Amplitude Range	E-M Orientation
Low Lunar Orbit (LLO)	~2 hrs	100 km	Any inclination
Prograde Circular (PCO)	11 hrs	3,000 to 5,000 km	~ 75 ° inclination
Frozen Lunar Orbit	~13 hrs	880 to 8,800 km	40° inclination
Elliptical Lunar Orbit (ELO)	~14 hrs	100 to 10,000 km	Equatorial

Near Rectilinear Orbit (NRO)	6-8 days	2,000 to 75,000 km	Roughly polar
Earth-Moon L2 Halo	8-14 days	0 to 60,000 km (L2)	Dependent on size
Distant Retrograde Orbit (DRO)	~14 days	70,000 km	Equatorial



In total, 7 types of orbits were considered, relying on both previous studies from literature and new analysis, primarily for the NRO. While the analysis presented is not comprehensive for all orbits, trends and characteristics are computed to permit generalized conclusions.

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Comparison of Options

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- K rz #iuhtxhqwo|#gr#|rx#kdyh#rssruwxqlwlhv#wr#wudyho#iurp #d#OHR #idflow|#wr#wkh#xqdu#idflow|/#dqg#krz #iuhtxhqwo|# |rx#fdq#wudyho#wkh#rwkhu#gluhfwlrqB
- K rz #p xfk#ghowd0Y #grhv#lw#wdnh#wr#jr#ehwz hhq#wkh#idflow|#dqg#OHR #dqg#wkh#idflow|#dqg#wkh#xqdu#vxuidfhB
- K rz #orqj#lv#wkh#wudqvlw#ehwz hhq#wkh#orfdwlrq#dqg#wkh#xqdu#vxuidfhB
- K rz #xvhixo#lv#wkh#ruelw#iru#vxssruwlqj#ghhs#vsdfh#p lvvlrqvB
- K rz #kdug#lv#lw#wr#uhdfk#ydulrxv#xqdu#vxuidfh#ghvwlqdwlrqv#iurp #wkh#xqdu#ruelwdo#idflow|#orfdwlrqB
- Z kdw#lv#wkh#wkhup do#hqylurqp hqw#dnh#lq#wkh#ruelwB
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Pros and Cons of EML-2 Halo Orbits

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- R qh#ri#wkh#orz hvw#ghowd0Y #wrsslqj#srlqw#lq#wkh#xqdu#ylflqlw|/#uhtxlulqj#rqo|#£6176np 2v#ri#ghowd0Y #iurp #OHR 1
- Hdv|#dffhvv#wr2iurp #d#OHR #idflow|#rq#hyhu|#OHR 0xqdu#ru#xqdu0OHR #z lqgrz 1

- Dq|0wp h#dffhvv#wr2iurp #dq|zkhuh#rq#wkh#xqdu#xuidfh1
- Orz #wdwlrqnhhslqj#ghowd0Y.
- Ehqljq#dqg#frog#wkhup dd#hqylurqp hqw.
- Frqwlqxrxv#frp p xqlfdwlrqv#z lwk#Hduwk/#dqg#p rvw#ri#wkh#iduvlgh#ri#wkh#P rrq1
- Jrrg#wdjlqj#srlqw#ru#erwk#ghhs0vsdfh#dqg#xqdu#p lvvlrqv1
- Frxog#ehfrp h#d#wduwlqj#brfdwlrq#ru#d#xqdu#vsdfh#hdnydwru1

Exw#HP O05#grhv#kdyh#d#hz #gudz edfnv=

- Orqj#DHR#HP O5#dqg#HP O50OHR#wudqvlw#p hv.#ru#wkh#rz #ghowd0Y#srzhuhg0vz lqje|#rswlrq1
- Orqj#HP O5#wr#xqdu#xuidfh#dqg#ylfh#yhuvd,#wudyhd#p hv.
- Iw#z dvqÑ#fdnu#wkdw#d#surshoolqwdnvv#xqdu#dxqfk#rswlrq#rfdwhg#dw#lwkhu#srn#frxog#dxqfk#hdvlo|#wr#HP O51#Dq# hoolswlfdd#ruelw#urp #xfk#d#dxqfkhu#z rxog#kdyh#w#dqh#ri#dsvlghv#sdvv#kurxjk#wkh#dxqfk#rfdwrq/#z klfk# z rxog#eh#ruwkrjrqdd#wr#wkh#P rrq0HP O5#dqh1#\rx#frxog#dxqfk#qwr#d#sroo#DOR/#dqg#wkhq#gr#p xowsdn#exuqv# iurp #wkhuh#wr#HP O5/#ex#wkh#surshoolqwdnvv#dxqfk#rswlrq#z rxog#rqo|#surylgh#wkh#luvw#hj#ri#wkh#wuls#vxuidfh#wr# OOR,1

Wkh#rqj#wuls#wlp hv#p hdq#wkdw#wkh#yhklfdnv#wdnlqj#shrsdn#ehwz hhq#DHR#dqg#HP O5#dqg#ehwz hhq#HP O5#dqg#wkh# P rrq#z lo#ehtxluh#p xfk#p ruh#n{whqvlyh#dlh#vxssruw#dqg#dffrp p rgdwlrqv#wkdq#z rxog#eh#qhhghg#i#wkh#wuls#z huh# vkruwhu1#Wkdw#z lo#gulyh#ks#wkh#gu|#p dvv#ri#wkrvh#v|vwhp v/#dqg#e|#n{whqvlrq#wkh#surshoolqw#dqg#ryhudo#frvw#ri# p rylqj#shrsdn#wr#dqg#urp #HP O51

Pros, Cons, and Questions Regarding Near Rectilinear Orbits

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- Rqo|#vdljkwo|#kljkhu#ghowd0Y#wr2iurp #DHR#wr#Q URv#frp sduhg#wr#DHR#wr#HP O5.1
- Ehfdxvh#wkh#Q URv#ruelwÑ#shuloxqh#v#rqo|#5333np #urp #wkh#P rrqÑ#vxuidfh/#rqfh#shu#90;#gd|#ruelw/#wkh#ruelw# dqhv#ks#vr#wkdw#wkh#wudyhd#p h#ehwz hhq#Q URv#dqg#wkh#xqdu#xuidfh#gursv#wr#318#gd|v1
- Srzhuhg#vz lqje|#wudnfwruhv#ehwz hhq#DHR#dqg#Q URv#wdnh#dssur{lp dwho|#8#gd|v#dffk#gluhfwlrq/#lqvwdg#ri# <044#ru#HP O51
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- Olnhz lvh/#ghsduwxuhv#urp #wkh#LUR#p d|#qrw#eh#lq#wkh#rswp dd#sduw#ri#wkh#ruelw#ru#wkh#Hduwk#hwxuq#p dqhxyhu# z khq#wkh#wp lqj#v#uljkw#r#hwxuq#r#wkh#sodqh#ri#wkh#OHR#idflw|1#Wklv#vqÑW#sureduhp #i#|rxÑh#grlqj#d#guhfw# uhwxuq/#exw#rqfh#djdlq#v#d#elj#sdlq#q#wkh#qhfn#ru#hxvh#ri#vsdfh#kdugz duh1#Rqfh#djdlq#wklv#v#rp hwklqj#Ñg# z dqw#r#dqdo|}h#p ruh#ehiruh#vhwoqj#rq#dq#LUR#ruelw1
- Dgglwrqdoo|/#wkh#LUR#idflw|#kdv#DRV#z lwk#rqh#oxqdu#srd#berxw#9(#ri#wkh#wp h#z kldh#khdglqj#rxw#dqg# frp lqj#edfn#urp #dlsroxqh,/#exw#rqo|#vhv#wkh#rwkhu#idflw|#ru#d#eulh#shulrg#qhdu#shuoxqh1#Li#|rxÑh#sodqqlqj# rq#kvlqj#surshoolqwdnvv#doxqfk#p hwkrgv#r#vhqg#wxii#urp #d#srodu#oxqdu#vhwwdhp hqw#r#wkh#LUR#idflw|/#Ñ#W# jrlqj#r#eh#lq#dq#LUR#z lwk#dsloxqh#rq#wkh#rssrvlwh#vlgh#ri#wkh#p rrq#urp #|rxu#oxqdu#vhwwdhp hqw/#p hdqlqj# |rxÑo#rqo|#eh#lq#frqwdfw#ulhio|#ru#p d|eh#4#gd|#rxw#ri#d#z hhn1
- Ehfdxvh#wkh#shuoxqh#v#rqo|#5333np /#wkh#khdwlqj#hqylurqp hqw#v#jrlqj#r#eh#z dup hu#wkdq#HP O05/#z lwk#vdjkwo|# kljkhu#erlorii/#exw#wklv#v#suredeo|#rqo|#d#p lqru#gliihuhqfhu.lw#krxog#wloo#eh#vrqv#dvlhu#r#hhhs#fu|r#erlorii#brz # lq#dq#LUR#wkdq#lq#OHR1

Conclusions?

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Jonathan Goff

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51 Oxqdu#Vdqjv/#P dvv#Sulyhuv/#Ddxqfk#Drrsv/#nwf1#Dodwkh#wxii#z dv#xssrvhg#wr#zulwh#berxw#q#p |#Wkh#Vdqjv# dqg#Duurz v#ri#Rxwdjhrxv#Oxqdu#Wudqvsruwdwlrq#Vfkhp hvŠ#vhulhv#wkdw#l#wloo#ghhg#wr#lqlvk ç

61 ?43p 2v2|u ç

71 Derxw#3{#orz hu#OR [2OK 5#erlorii#tdwh#wkdq#DHR 1#q#idfw#z lwk#sdvvlyh#qvxodwlrq#|rx#fdq#frp sdnho|#xusuhvv# OR [#erlorii#bqg#nyhq#uhh}h#r{|jhq#lw#HP 005 ç

81 <044#gd|v ç

91 608#gd|v ç

:1 618;np 2v#½v#5176np 2v ç

;1 Z klfk#|rxÑg#lovr#z dqw#r#eh#wkh#exuq#wkdw#eulqjv#|rx#r#lhqgh}yrxv#z lwk#wkh#QUR#idflow| ç

This entry was posted in Lunar Exploration and Development, Propellant Depots, Space Development, Space Transportation. Bookmark the permalink.

17 Responses to *Lunar Orbital Facility Location Options*

Andrew_W *says:*
April 17, 2016 at 4:05 am

IÑo#eh#kqlp djlqdwlyh#bqg#xvw#jr#ru#wkh#qhdu#sro#ur}hq#ruelw/#l#wklqn#sro#ruelw#z lo#eh#p sruwdqw#ehfdxvh#wkh#sro#v#duh# jrlqj#r#eh#z khuh#lo#wkh#dlwrq#v/#l#wklqn#wkh#rz hvw#sudfwlfdo#ghwhuplqlqj#urp #wkh#xqdu#xuidfh#lv#p ruh#p sruwdqw#wkdq#rz #ghwhu# Y#urp #DHR/#bqg#l#wklqn#wkh#wdeolw|#ri#wkh#ruelw#z lo#eh#l#idfwru1

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gbaikie *says:*
April 17, 2016 at 10:16 am

Z kdw#v#Oxqdu#Ruelwdo#Idflow|B
I#p hdq#l#frxog#eh#hyhu|wklqj/#vl|#kxe#ehwz hhq#DHR/#P rrq/#P duv#bqg#hovhz khuh1
Dqg#l#frxog#eh#QDVD#w|sh#vsdfh#wdwlrq1
Dv#QDVD#vsdfh#wdwlrq#l#frxog#hodwhg#r#Oxqdu#{sorudwlrq#bqg#hvhdufk#ri#ghhs#vsdfh#qylurqp hqw#soxv#kvhg#lv#wdjlqj# duhd#ru#P duv#{sorudwlrq1#Vxfk#lv#P dqqhg#p lvvlrq#r#P duv#ehjlq#khuh#bqg#hwxuq#urp #P duv#r#l1
Dqg#lv#QDVD#wdwlrq#l#frxog#eh#frqqhfwhg#r#LVV1
L#eholhyh#wkdw#QDVD#vkrxog#qrw#gh0ruelw#LVV/#bqg#LVV#frxog#eh#Ñuhvfxhg Š#urp #DHR1
Exw#l#vxssrvh#LVV#frxog#lovr#eh#n{wqghg#q#whup v#ri#lwÑ#rshudwlrq#q#DHR#bqg#kdyh#vrp h#rshudwlrqdd#holdwlrqvkls#z lwk#wkh# Oxqdu#Ruelwdo#Idflow|1#Ru#rqh#grhv#gh0ruelw#LVV1#Ru#LVV#frxog#ehfrp h#wkh#Oxqdu#Ruelwdo#Idflow|1

Z rxog#Oxqdu#Ruelwdo#Idflow|#eh#berxw#jhwwlqj#l#p dr#vsdfh#urfn0#edp dÑ#hyroyhg#qwr#dvwhurlg#p lvvlrq1#Dqg2ru#berxw# udgldwlrq#wklhoglqj0#vsdfh#urfnv#bqg#jhwwlqj#ghdg#JHR#dwholdwhv1#Dqg#surylglqj#kdgh#ru#fu|r#wrudjh1

Ru#grhv#l#w#wdu#dv#l#p rwo|#frp p hufldo#wklqj1#Vr#holdwhg#wr#kvh#Oxqdu#wrxulvp #bqg#xqdu#p lqlqj1#Dqg#zrp hsolfh#wr#eulqj# vsdfh#urfnv#bqg2ru#ghdg#wdwholdwhv#bqg2ru#vxsso|qj#QDVD#P duv#surjudp 0#xqdu#z dwu#bqg#DR [#^dqg2ru#dgldwlrq#wklhoglqj‘1

Vr#z d|#orrn#dw#w#QDVD#wkrxog#{soruh#wkh#P rrq#wr#ghwhup lqh#li#bqg#z khuh#wkuh#v#frp p hufldo|#p lqdeh#xqdu#z dwu1
Dqg#nh|#dvshfw#ri#wklv#QDVD#surjudp /#v#wkruw#xudwlrq#ri#surjudp #bqg#wkuhe|#orz #frvw#q#whup v#ri#wd{#sd|hu#p rqh|#bqg# wlp h0#3#eloolrq#bqg#hnvv#wkdq#43#|hduv#r#frp sdnwh#QDVD#xqdu#{sorudwlrq#z klfk#wkhq#roorz hg#e|#P duv#{sorudwlrq# surjudp #z klfk#kdv#xusrvh#r#ghwhup lqh#li#bqg#z khuh#rq#P duv#z rxog#eh#ehvw#rfdwlrqv#ru#xp dq#hwwdnp hqw1
Dqg#QDVD#wduw#Oxqdu#{sorudwlrq#surjudp #e|#nvwdoolqj#l#ghsrw#q#DHR1#Dqg#wklv#ghsrw#z lo#uhixhq#urerwlf#{sorudwlrq#

p lvvlrqv#wr#wkh#P rrq/#z klfk#lv#ireorz hg#e|#uhixhdqj#fuhz hg#h{scrudwlrq#ri#wkh#P rrq1#Wkh#fuhz hg#p lvvlrq#wr#P rrq#duh#wr# frqilup #dqg#frp sdnwh#rerwlf#bxqduh{scrudwlrq#dqg#uhwuq#bxqdu#vdp sdnv1
Z klh#Oxqduh{scrudwlrq#lv#grqh/#LVV#wkrxog#eh#uhvroyhg#q#wrp h#dvklrq#dqg#wkh#luvw#rswlrq#wkrxog#qrw#eh#wr#gh0ruelw#w1
Vr#z khq#bxqduh{scrudwlrq#dqg#LVV#lv#lqlvkhg/#Q DVD#{scruhv#P duv1
Dqg#ehiruh#Q DVD#ehjlqv#vhqglqj#fuhz #wr#P duv/#survshfw#ri#frp p hufldo|#p lqlqj#z dwu#rq#wkh#P rrq#z lo#kdyh#uhvxow#z klfk# fdq#kvhg#wr#ghwhup lqh#z khwkhu#vxfk#dlfwylw|#lv#ylsdeoh1#Exw#frp p hufldo#xqdu#p lqlqj#lv#qrw#rq#fuwlfdo#sdwk#ri#P duv#{scrudwlrq# dqg#Oxqduh{scrudwlrq#frxog#qglfdwh#wkdw#p lqlqj#wkh#P rrq#lv#qrw#ylsdeoh#q#qhdu#wup 1#Wkrxjk#Q DVD#P duv#{scrudwlrq# surjudp #p d|#sod|#sduw#q#p dnlqjŠ#frp p hufldo#xqdu#p lqlqj#ylsdeoh1

Dq|z d|v/#wklv#Q DVD#xqduh{scrudwlrq#qfoxghv#OHR#ghsrw/#p dq|#rerwlf#xqduh#p lvvlrqv#dqg#hz #fuhz hg#p lvvlrqv#wr#wkh# P rrq1#Dqg#grhvqÑ#qfoxgh#xqdu#edvhv/#xqduh#p lqlqj#ru#xqduh#ruelwqj#edvhv1

Dv#idu#dv#Q DVD#p duv#{scrudwlrq#surjudp /#l#wklqn#w#wkrxog#qfoxgh#wdjlqj#P duv#fuhz hg#p lvvlrqv#vrp hz khuh#q#K ljk#lduwk1# Dovr#wdjlqj#q#P duv#kljk#ruelw1
Vr#P duv#{scrudwlrq#frxog#qfoxgh#vrp hwklqj#dnh#wklv#Oxqduh#Ruelwd#Idfldw|#ru#eh#frqqhfwhg#wr#w#ru#li#wkh#Oxqduh#Ruelwd# Idfldw|#v#frp p hufldoˆdqg#kdylqj#vrp hwklqj#wr#gr#z lwk#frp p hufldo#xqduh#p lqlqj#dqg#Q DVD#P duv#{scrudwlrq‘

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ken anthony *says:*
April 17, 2016 at 10:21 am

Wklv#lv#wkh#suredp #z lwk#wklqnlqj#wdwlrqv#yv1#wklsv1#Ohw#wklsv#eh#rxu#ghsrw#z lwk#qrxjk#ghowd0Y#wr#p ryh#wkhp #z khuh#rx# z dq#wkhp #dqg#rx#fdq#p dnh#bgmxvwp hqw#wr#z kdw#v#ehvw#D#wdwlrq2ghsrw#z lwk#rr#bwdh#ghowd0Y#ihp ryhv#wkdw#rswlrq1

Dqdo|vlv#lv#juhdw#exw#ich{leolw|#lv#ehwwhu#Wklqn#orw#ri#fkhds#wklsv#lqfuhp hqwdo|#p suryhg#ryhu#wp h1

Iurqlf#wkqj#v/#lv#li#dghsrw#kdv#hqrxjk#ixho#wr#eh#kvhixd#w#wkrxog#eh#ded#wr#kvh#wkdw#xho#dv#ghowd0Y1#Exw#z h#hhhs#ihshdwlqj#wkh# vdp h#p lwdnhv#dnh#gliihuhqw#fr5#fdqlvwhuv#q#wkh#OHP #dqg#Frp p dqg#p rgxdnv1,#Dqdo|vlv#bz d|v#frp hv#ks#wkruwl

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Chris Stelter *says:*
April 17, 2016 at 10:45 am

J lyhq#wkh#dqqxdo#herrvw#ghowd0y#ghhghg#ru#LVV/#|rx#frxog#wudyho#ehwz hhq#dq|#ri#wkhvh#kljk#ruelw#rswlrqv1

Wkh#ihdoo|#juhdw#klqj#derxw#ehlqj#q#d#yhu|#kljk#ruelw#v#wkdw#|rxÑh#YHU\#forvh#hqhuj|#dqg#ghowd0y0z lvh,#wr#dq|#rwkhu#yhu|# kljk#ruelw#q#wkh#Hduwk0P rrq#v|vwhp 1

D#vsdfh#wdwlrq#z lwk#rqo|#dv#p xfk#p dqhxyhudeolw|#dv#LVV#z rxog#eh#fdsded#ri#p rylqj#q#ehwz hhq#wkhvh#gliihuhqw#ruelw1

Marcel Williams *says:*
April 17, 2016 at 11:23 am

I#suhihu#wkh#fodvvlf#O4#Tdwhz d|1#

41#Wu|lqj#wr#wdnh#dgydqwdjh#ri#wkh#rz hu#ghowd0y#ihtxluhp hqw#6176#hp 2v,#urp #OHR#wr#HP O5#z rxog#ihtxluh#dssur{lp dwho|# hljkw#gd|v#ri#wudyho#dqg#frqwlqxrxv#frvp lf#d|#n{srvxuh1#D#idvwhu#7#gd|#HP O5#wuls#z rxog#ihtxluh#d#vdjkwo|#dujhu#ghowd0y#wkdq# d#irxu#gd|#wuls#urp #OHR#wr#HP O41#D#ghowd0y#ri#7174#frxog#wudqvsruw#dvwurqdxw#wr#HP O4#q#xvw#z r#gd|v1#Wxfk#dl#kljk#ghowd0y# frxog#hdvlo|#eh#dffrp sdvkhg#e|#ihxvdedn#yhklfdnv#xfk#dv#wkh#xwuh#DFHV074#z lwk#dq#Rulrq#fdsvxdn1#

Dq#HP O5#kdelwdw#dqg#grfnlqj#vsdfhfudiw#frxog#srwhqwdoo|#qvhuihuh#z lwk#dglr#dvwurqrp |#rq#wkh#idu#vlgh#ri#wkh#P rrq1# Hxursh#kdv#bouhdg|#wkrz q#d#juhdw#ghdd#ri#qvhuhvw#q#hvwdedvklqj#dq#rxwsrvw#wkhuh1#

61#Dhvwkhwlfdoo/#wrxulvw#lw#IP O4#z rxog#eh#ledv#wr#ylhz #lq#Iduk#dujhu#kdq#frxog#eh#ylhz hg#lw#IP O5#lqg#nyhq#dujhu#kdq# vhhq#urp #wkh#xuidfh#ri#wkh#P rrq1#

71#Wdwlrq#hhhslqj#l#kdelwdw#lw#IP O4#ru#IP O5#z rxog#rqo|#lhtxluh#l#hz #wrqqhv#ri#surshoolqw#lqqxdoo|Ù #nyhq#i#wkh#kdelwdw# kdg#l#hz #wkrxvdqgv#wrqqhv#ri#khdy|#rdgldwlrq#wklhoglqj#

P dufho

Jonathan Goff *says:*
April 17, 2016 at 4:38 pm

Dqguhz/
Wkh#ur}hq#ruelw#wkh|#lqdo|}hg#lq#wklv#sdshu#ihtxluhg#lqp rvw#wkh#vdp h#,33p 2v#wr#jhw#wr#l#srodu#DOR#lv#frp lqj#urp #IP O5# ru#QUR#gxh#wr#wkh#qhhg#ru#l#elj#soolqh#fkdqjh1#Wkhuh#p ljkw#eh#qhdu#srodu#ur}hq#ruelw#z lwk#dnvv#ghowd0Y#ihtxluhg/#exw#p rvw# dnho|#wkrvh#z rxog#eh#kdug#wr#dffhvv#uhtxhqwo|#urp #Iduk1#L#jxhvv#dxw#grqÑ#vhh#wkh#ehqhilw#ri#rxu#lssurdfk1

Jedlnlh/
L#z dv#ehlqj#qwhqwlrqdoo|#ydjxh#derxw#z kdw#l#Oxqdu#Ruelw#Idfldw|#v1#w#frxog#eh#l#ghsrw/#ru#l#vsdfh#wdwlrq/#ru#lq|wklqj#hovh# |rx#qhhg#wr#lhqgh}yrxv#z lwk1#Exw#p rvw#dnho|#l#p doo#vsdfhfudiw2ghsrw#wkdw#|rx#fdq#vz lwfk#ehwz hhq#/vhlfdnv/#wudqvihu# surshoolqw#lqg#srvvleo|#wd|#ru#wkruw#gxudwlrqv#dv#qhfhvvdu|1

P dufho/
L#grqÑ#vhh#lq|#ihdvrq#z k|#|rx#frxogqÑ#gr#lq#IP O4#wdwlrq#lv#z ho#lv#ru#lqvwhdg#ri#lq#IP O5#wdwlrq/#exw#w#rqo|#ihdoo|#vdyhv# |rx#wkh#DHR#wr#xqdu#ruelwdd#idfldw|#lqg#edfn#wlp h/#w#grhvqÑ#gr#lq|wklqj#wr#lhgxfh#wkh#xqdu#ruelwdd#idfldw|#wr#xqdu#xuidfh# dqg#edfn#wudyhd#wlp h/#exw#w#wkh#frvw#ri#l#grq0wulyldoo|#kljkhu#Iduk#wr#xqdu#ruelwdd#idfldw|#lqg#edfn#ghowd0Y1#Ñp #vnhswfdc#wkdw# vhhlqj#wkh#Iduk#l#lwwdn#elwdujhu#lv#jrlqj#wr#p dnh#p xfk#ri#l#ghdd#lwkhu#z d|1#Uhwlqj#l#slfwuh#z lwk#erwk#Iduk#lqg#wkh#P rrq# lq#wkh#slfwuh#z lwk#wkh#P rrq#ehwz hhq#|rx#lqg#wkh#Iduk,#lfwdoo|#vrxqgv#frrdnu#wr#p h1

£Mrq

Chris Stelter *says:*
April 18, 2016 at 7:51 am

Q lfh#wklqj#lv#z h#grqÑ#ihdoo|#kdyh#wr#fkrrvh1#\rx#fdq#fkdqjh#|rxu#p lqg#rq#wkh#o/#xvw#dnh#krz #LVV#vrp hwlp hv#rshudwhv#lw# orz hu#lowlwxgh#ru#p d{lp l}lqj#sd|ordg#ru#frqvwuxfwlrq/#wkhq#dwhu#lw#kljkhu#lowlwxgh#wr#p lqlp l}h#gudj1

I#kvhg#wr#kdyh#wurqj#rslqlrqv#derxw#IP O4#yv#IP O5/#hwf/#exw#wkhq#1#ihdd}hg#w#grhvqÑ#ihdoo|#p dwhu#ehfdxvh#|rx#fdq#wudyhd# ehwz hhq#wkhvh#rswlrqv#hdvlo/#lorz lqj#|rx#wr#jhw#wkh#ehvw#ri#erwk#z rugv#e|#xwdd}lqj#rqh#ruelw#ru#l#z klh#lqg#wkhq#vz lwfklqj# wr#dqrwkhu1

Hop David *says:*
April 18, 2016 at 1:25 pm

Wkh#QUR#lv#lq#lqwhuhvwlqj#ruelw#LwÑ#dlh#ri#lsvlghv#ehlqj#ghduo|#shushqglfxodu#wr#wkh#p rrqÑ#ruelwdd#soolqh/#glwdqfh#urp # hduk#grhvqÑ#ydu|#p xfk1#Wkxv#lwÑ#hnvv#yxoqhudedn#wr#dgdd#shuwxedwlrqv#urp #hduk#-lw#hhp v#wr#p h,1

Dq#QUR#z lwk#l#91;6#gd|#shulrg#z rxog#kdyh#l#shulrg#ntxdd#wr#27#wkh#p rrqÑ#vlghuhdd#gd|1#Wkxv#jhrp hwu|#ri#wkh#ruelw#z rxog# uhshdw#hdfk#xqdu#ruelw#Wklv#p ljkw#p dnh#suhglfwedn#hqgh}yrxv#vfkhgxdnv#p ruh#grdedn1

Wkh#jhrp hwu|#ri#d#lyhq#DHR#z uwp rrq#v#frqvwdqwo|#fkdqjlqj1#Vr#w#vhhp v#wr#p h#d#irrdÑv#huudqg#wr#vwulyh#ru#d#DHR#wdwlrq# wkdw#hp dlqv#frsoqdu#z lwk#wkh#p rrq1#Wkhuhiruh##z rxg#bgyrfdwh#bq#ntxdwruldd#DHR#wdwlrq#Ù #dnvv#ghowd#Y#wr#hdfk#bqg# dyrlgv#wkh#Vrxwk#Dwoqwlf#Dqrp do|1#Dw#dsrjhh#d#wudqvihu#wklsÑv#vshhg#v#rqo|#4<#np 2v#Dw#4<#np 2v/#yhq#d#khdwk|#soqlh# fkdqjh#grhvqÑf#rvw#p xfk1#Vhh#p |#eorj#srvw#rq#xqdu#lfh1

Vr#L#ehdhyh#wkh#ehqhilwv#ri#d#DHR#wdwlrq#frsoqdu#z lwk#wkh#xqdu#ruelw#v#h{djjhudwhg1#Wklv#v#nvshfldo|#wuh#i#wkh#xqdu# orfdwrqv#ri#qwhuhvw#uh#d#wkh#srdnv1

Jonathan Goff *says:*
April 18, 2016 at 4:12 pm

K rs/

L#z dvqÑ#wu|lqj#r#vxjjhvw#d#DHR#edvh#wkdw#z dv#frsoqdu#z lwk#wkh#P rrq1##djuhh#wkdw#z rxgqÑeh#hdvleh1##z dv#xvw#wdwlqj# wkdw#ru#bq|#jlyhq#DHR#dflqlw|/#wkh#frp elqdwrq#ri#wkh#p rrqÑ#ruelwd#p rwrq#bqg#wkh#qrgd#hjuhvvlrq#ri#wkh#DHR#dflqlw|# hqgv#ks#surylglqj#Hduwk0r0P rrq#wudqvihu#rssruwqlwhv/#z khuh#wkh#p rrq#sdvvhv#wkurxjk#wkh#soqlh#ri#wkh#DHR#dflqlw|/#rqfh# hyhu|#:0<#gd|v1##kdg#hfdohg#ru#vrp h#hdvrq#wkdw#wkh#jds#ehwz hhq#d#xqfk#z lqgrz v#z dvqÑ#d#vwdg|#qxp ehu/#exw#p #qr# orqjhu#xuh#z k|##wkrxjk#wkdwuqrgd#hjuhvvlrq#ru#wkh#DHR#dflqlw|#v#d#vwdg|#qxp ehu/#bqg#wkh#p rrqÑ#ruelw#v#dllo|#brz # hffhqwlflw|1#Ehfdxvh#wkh#Hduwk0P rrq#ghsduxuh#z lqgrz v#uhqÑ#qwdqwdqhrxv/#w#p ljkw#eh#srvvleh#wr#slfn#d#shulrg#ru#wkh# QUR#wkdw#v#wkh#byhudjh#ri#wkh#jds#ehwz hhq#wkh#ghsduxuh#z lqgrz v/#q#d#z d|#wkdw#rx#fdq#p lqlp l}h#wkh#ghowd0Y#shqdlw|#z kdh# vwloo#dorz lqj#rx#r#hqgh}yrxv#xlfnq|#z lwk#wkh#QUR#dflqlw|#rq#bq|#jlyhq#Hduwk0P rrq#ghsduxuh#z lqgrzý

LÑo#kdyh#r#vhh#i#d#fdq#jhw#rp hrqh#bnh#P lnh#Orxfnv#r#xq#rp h#qxp ehuv#ru#p h1

£Mrq

Dennis Wingo *says:*
April 18, 2016 at 5:49 pm

Z kdw#Dqguz #vdlg1#

Ehiruh#rx#vwduw#udglqj#xqdu#hodwhg#ruelw#rx#kdyh#r#vhwwh#rq#z kdw#rx#uh#jrlqj#r#gr#ru#qrw#gr,/#rq#wkh#P rrq1#Wkdw# glfwdwhv#z klfk#ruelw#v#wkh#ehvw#P |#suhihuhqfh#ri#frxuvh#v#bq#lqgxvwuldd#fhqwhu#rq#wkh#P rrq#wkdw#p dqxidfwxuhv#lqwhusoqhwdu|# vsdfhfudiw#DOR#v#wkh#ehvw#soqfh#r#sxw#khp #rjhwkhu/#wkhq#rx#dnh#vw#r#HP O04#ru#lqdq#rxwilwlqj#z lwk#vuhvwuldo|# oxqfkhg#kdugz duh1#Wkhq#P duv#v#d#slhfh#ri#fdnhý ru#bq|z khuh#ovh#q#wkh#vrodu#v|vwhp 1

Dennis Wingo *says:*
April 18, 2016 at 5:51 pm

H{fhsw#diwu#hdglqj#MrqÑ#ghilqlwlrq#ri#DOR/#wkdw#v#d#qrq#wduwu1#33#np #v#du#r#brz #ru#d#wdedh#ruelw#z lwkrxw#rw#ri# surshoqdw#kvdjh1#3304333#np #v#du#ehwhu1

Jonathan Goff *says:*
April 18, 2016 at 8:48 pm

Ghqqlv/
L#glgqÑ#fdnduo|#wdwh#p |#jrdov/#exw#ru#wkh#xqdu#ruelwd#dflqlw|/#z dv#rrnlqj#ru#vrp hwklqj#q#d#jrrg#srlqw#r#xssruw# wudqvsruwdwrq#ri#shrsdn#bqg#fdujr2p dwhuldov#r#bqg#urp #wkh#xqdu#xuidfh1#Wkdw#grhvqÑ#p hdq#w#kdv#r#eh#wkh#rqo|#xqdu# ruelwd#dflqlw|/#exw#w#grhv#p hdq#wkdw#z dqwhg#vrp hwklqj#wkdw#fdq#erwk#eh#dffhvvhg#uhtxhqwo|#bqg#diirugdeo|#urp #hduwk/#wkdw#

fdq#xssru#xqdu#xuidfh#ghoyhulhv#z lwk#p lqlp dd#shqdowlhv/#lqg#wkdw#dv#d#jrrg#wkhup dd#qylurqp hqw#ru#fu|rjhqlf# surshoolqw#wrudjh1#Wkdw\#z k|#z dv#rrnlqj#dw#HP O05#lqg#QUR v1#Iru#dvvhp eolqj#d#vsdfhfudiw/#Irxg#vhh#d#833043333np # srodu#OOR#p dnlqj#vhqvh#i#|rx#grqÕw#qhhg#r#vhqg#shrsdn#ru#wxii#r#w#urp #Iduk#uhtxhqwo|/#lqg#i#|rx#|rxu#xqdu#dflowhv# duh#dood#yhu|#forvh#r#lwkhu#i#wkh#srdnv1#Exw#d#kljk#OOR#suredeo|#z rxgqÕw#p dnh#p xfk#vhqvh#ru#d#wudqvihu#qrgh1

£Mrq

Jonathan Goff *says:*
April 18, 2016 at 8:53 pm

K rs/
L#vsrnh#z lwk#lq#dvwurjdwru#ulhqg#P lnh#Orxfnv,#derxw#wkh#QUR#v|qfkurql}dwrq/#lqg#kh#wkrxjkw#w#z dv#z ruk#rrnlqj#qwr1# Z kdn#wkh#p rrq#kdv#rz #nffhqwulfl|/#Õw#qrw#}hur/#r#wkh#vlp lqj#ehwz hhq#rswlp dd#ghsduxuh#z lqgrz v#r2irup #d#OHR#edvh# lvqÕw#jrlqj#r#eh#shuhfwo|#frqvdqw#exw#suredeo|#forvh#hqrxjk#wkdw#wkh#ghowdOY#shqdow|#z lod#eh#p rghvw#Vr#|rxÑg#oxv#z dqw#lq# QUR#ruelwdd#shulrg#wkdw#p dwfkhg#ks#z lk#wkh#dyhudjh#vlp h#ehwz hhq#oxqfk#z lqgrz v#urp #wkh#OHR#edvh#dnho|#derxw#;0<# gd|v,#K rshixoo|#oolwhu#wklv#|hdu#kh#fdq#xq#wkh#qxp ehuv#rq#wkh#frqfhsw#i#kh#fdq/#Ño#hsruw#rq#wkdw#exw#w#rrnv#srwhqwldoo|# surp lvlqj/#lqg#z rxg#hp ryh#wkh#wz r#eljjhv#frqfhuqv#z lk#kvlqj#QUR v1#Wkh#wklug#frqfhuq#srru#frp p v,#rxg#eh#hvroyhg# z lk#hlwkhu#d#hod|#vdwhoolwh#ru#d#vhfrqg#ruelwdd#dflow|#q#wkh#rssrvlwh#vhw#r#QUR vu lh#i#|rx#kdyh#rqh#dflow|#q#d#vrxwk0 srlqwlqj#QUR/#|rx#rxg#kdyh#d#hod|#vdw#q#q#ruwk0srlqwlqj#QUR/#wkhq#|rxÑg#kdyh#qhdu#frqvwdqw#frp p v#fryhudjh1

Dq|krz/#rrg#ru#wkrxjkw1

£Mrq

N/A *says:*
April 18, 2016 at 8:55 pm

IÑp #wuxfn#e|#wkh#qwhuhvw#ru#surshoolqw#oxqfk#hfhlyhu#vdwlrq1#Z rxgqÕw#d#SFR#ru#QUR#eh#suhiuhuhg/#vlp so|#e|#wkh#qxp ehu# ri#rssruwqwlhv#r#hdfk#w#urp #wkh#oxqdu#xuidfhB#D#SFR.HP O5#ru#QUR.HP O5#sdlulqj#vhp v#p ruh#dssursuldwh/#dv#HP O5# lv#d#surshu#jdwhz d|#vdwlrq#wkdw#krxg#eh#hdvrqdeo|#hdfkdedh#urp #wkh#rz hu#Ëwudqvlw#vdwlrq#ruelwÕ#krxjk#e|#wkdw# p hdvxuh/#dl#yhu|#srodu#OOR#p ljkw#eh#p ruh#ghvluhdedh/#vlqfh#ksp dvv#urp #surshoolqw#oxqfk#h{sruw#ghowdY#r#wkh#wudqvlw#kxe1

Nathan Wilson *says:*
April 21, 2016 at 9:21 pm

Idvflqdwlqj#glvfxvvlrq>#vhyhudd#jrrg#rswlrqv#ru#d#wrs#rq#wkh#z d|#r#P duv1

Iru#jhwwlqj#r#lqg#urp #Oxqd/#l#kdyh#qrw#vhq#dq|wklqj#l#dnh#ehwhu#wkdq#d#urwdwlqj#vsdfh#ndydwru#urwrydwru,$#K vlqj#d#vhwkhu# dqg#oujh#edoodvw/#z h#fdq#wruh#p rp hqwp #urp #d#vrolu#ndnfwulf#sursxovlrq#v|vwhp /#lqg#wudqvihu#w#r#d#wklv#xlfno|1#Vr#d# urwrydwru#q#orz #xqdu#ruelw#vd|#533#np ,#dorz v#wkh#idvwhvw#wudqvlw#lp hv/#soxv#frqvxp hv#hvv#sursoolqw#dnvv#kdxolqj#urp # Hduk/#lqg#p ruh#Oxqdu#{sruw#ru#rwkhu#kvhuv,1

D#urwrydwru#q#d#srodu#ruelw#fdq#surylgh#wz lfh#p rqwko|#vhuylfh#r#d#z dwu#soolqw#Exw#q#lq#htxdwruldd#ruelw#khuh#z lod#eh#3# wudqvihu#rssruwqlwhv#shu#Hduk,#gd|1#Wklv#v#{dfwo|#z kdw#rqh#z rxg#z dqw#ru#d#oujh#Oxqdu#flw|1

Colin Helms *says:*
April 17, 2017 at 9:18 am

Frxog#|rx#sxedvk#d#eledrjudsk|#ri#wkh#ruelwdo#glvfxvvlrqB##ehdhyh##kdyh#vrp h#ri#wkh#vrxufhv/#exw#w#hhp v#wkhuh#v#p ruh#ri#d#hdoOwlp h#glvfxvvlrq#wkdw#|rx#duh#suly|#wr1#LÑh#jrwhq#lqwr#bq#dujxp hqw#erxw#wkh#wdwlrq0nhhslqj#ihtxluhp hqw#ru#D5#K dor#ruelw#z lwk#d#sduwqhu/#exw#|rx#lqglfdwh#wkh#frp p xqlw|#v#frp iruwedn#z lwk#wkdw#frvw1

Jonathan Goff *says:*
April 17, 2017 at 11:02 am

Frdq/
Wr#eh#krqhvw/#ggrqÑ#kdyh#p xfk#ri#d#eledrjudsk|#ru#wklv#srw#rwkhu#kdq#wkh#suhvhqwdwlrq##ihihuhqfhg1#G lg#w#kdyh#d#eledrjudsk|B#Dovr#vrp h#ri#wkh#rwkhu#frp p hqw#ihjdughj#wkh#qgxvwu|#p d|#kdyh#ehhq#edvhg#rq#glvfxvvlrqv#z lwk#shrsdn#z kr#gr#idjkw#g|qdp lfv#ru#d#bylqj1#Vruu|#i#wklv#vqÑ#dv#wkrurxjko|#grfxp hqwhg#dv#|rxÑg#bnh1

LwÑ#ehhq#d#z kdn#vlqfh#I#z urh#wklv#duwlfdn#krxjk/#bqg#I#z dqwhg#r#gr#d#rorz 0xs#duwlfdn#z lwk#vrp h#xuwkhu#krxjkw#vrp hwlp h#vrrq1

£Mrq