

JYScãÑÑs ys-VÑÓ yÓ ÓÑÑ SéÑÑ Ó ú # úú'

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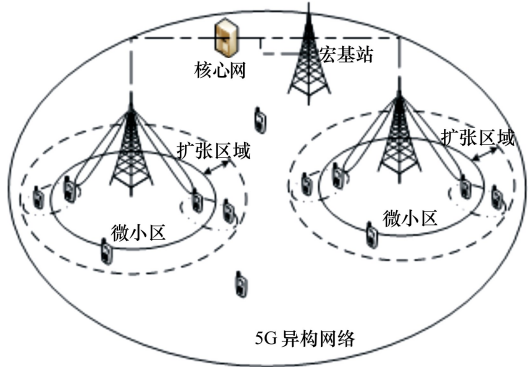
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 Fð*U XçX - \ ÷ G" Æ%& U ¡•d ÷k" >èò- \



○ 原始微小区覆盖区域 ○ 扩张后的小区区域
 ○ 波束服务的NOMA用户 - - - 光纤链路

: Î G*Ud %t @Û o Û < g4-4 Z ü W < gFz4>
 ,%9 "A < gK!C D°E %ü WÛ < g ' 0 Fz4 N_i f
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 CE= • - Kb*L = %ü W < g ² ± ± Ì >³, *Ud • g
 K_B%< N o" - Mg ² >³, *Ud • g K₀%< N
 N o% Ò c 0 *Ud Fz4 , V3ì %ü W § # M3q#½8
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 1 y_n " £ Z

$$y_{n\tau} = h_{n\tau} \sum_{k=1}^N w_k x_k + z_{n\tau} \quad \%B0$$

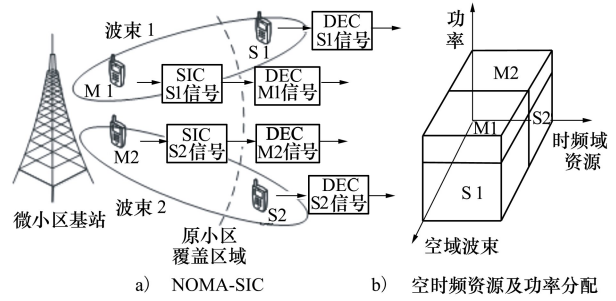
< Z "i â xB" O W n â xB" - "N W % pE. \$ x_k \ 0Y
 k W' CE8 0 W *Ud \$ ± ± Í

$$x_k = \sqrt{p_{k\tau}} s_{k\tau} + \sqrt{p_{k0}} s_{k0} \quad \%B0$$

< Z "s_{kτ} ¹ s_{k0} 3 X g h *Ud ¹ û *Ud ± ± \$ "\$
 Bàl s_{kτ} | 0 = B² p_{kτ} ¹ p_{k0} 3 X g h *Ud ¹ û *Ud ± ±
 Ì (" \$ Bà p_{kτ} + p_{k0} = B² h_{nτ} "i â xB" O W 3 X =
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 W' CE² 9 - # M 3 q # ½ , 7 " b ' ± ± \$ g L • Ñ
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 F z : 9 ± ± \$ Ì (' " 8 ä 2 (4 - T ± ± T 6 * É ÷ ÷ %
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a) NOMA-SIC b) 空时频资源及功率分配

$$+ 0ae ¶ X ö K è ì 3 +$$

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$$y_{n\tau} = h_{n\tau} w_n x_n + h_{n\tau} \sum_{k=1}^N w_k x_k + z_{n\tau} =$$

$$\alpha h_{n\tau} w_n \sqrt{p_{n\tau}} s_{n\tau} + \sqrt{p_{n0}} s_{n0} + \alpha h_{n\tau} \sum_{k=1}^N w_k x_k + z_{n\tau} \quad \%B0$$

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$$\tau_{n\tau} = \frac{|h_{n\tau} w_n \sqrt{p_{n\tau}} s_{n\tau}|^0}{|h_{n\tau} \sum_{k=1}^N w_k x_k|^0 + \sigma_n^0}$$

$$\sigma_n^2 = \frac{|h_n^H w_n|^2 p_n}{|h_n^H w_n|^2 p_n + \sum_{k=1}^N |h_n^H w_k x_k|^2 + \sigma_n^2}$$

9 # "û*Ud±±Ö c \$ g

$$y_n = h_n^H w_n x_n + h_n^H \sum_{k=1}^N w_k x_k + z_n$$

$$\sigma_n^2 = \sigma_n^2 \frac{|h_n^H w_n|^2 p_n}{|h_n^H w_n|^2 p_n + \sum_{k=1}^N |h_n^H w_k x_k|^2 + \sigma_n^2}$$

$$\sigma_n^2 = \sum_{k=1}^N |h_n^H w_k x_k|^2 + \sigma_n^2$$

ææ; h*Ud : 9±±\ "û*Ud : E = y i ç " ' " û*Ud i ç • g

$$\tau_n = \frac{|h_n^H w_n|^2 p_n}{|h_n^H w_n|^2 p_n + \sum_{k=1}^N |h_n^H w_k x_k|^2 + \sigma_n^2}$$

#± æu@@@

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 %og " æ = • ±± æ" U - WÛ < g Z "m6 h*Ud
 ±±E6 Eçx

$$\Gamma_i = \sum_{j=1, j \in K} r_j$$

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È(ÿELç "r_i g ' #0Yi W*Ud±±ELç %

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 'ã . Ô*L >è >Fü "H = h_B - h_N Ò " " æ = •
 - Füg

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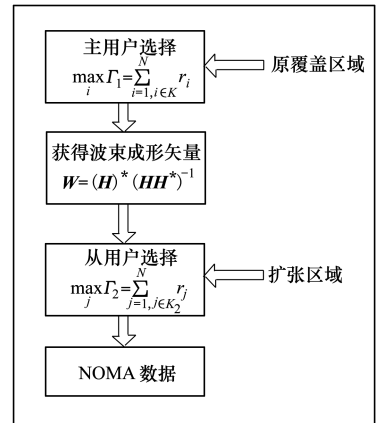
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 (' - T C Ì F %

$$\Gamma_j = \sum_{i=1, i \in K} r_i$$

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+ æÛ < g ¶ Xökèæu"n/8 +

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æÿ • M: h_B ∑_{k=1}^N w_k x_k " *^E L# " æµK' " i ç •
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$$\tau_n = \frac{|h_n^H w_n \sqrt{p_n} s_n|^2}{\sigma_n^2} = \frac{|h_n^H w_n|^2 p_n}{\sigma_n^2}$$

4) 5 %! o < 1 %o o < " Ä] " æn ±±hELç g

$$R_n = W \cdot k_0 \beta + \tau_n \sigma + W \cdot k_0 \beta + \tau_n \sigma =$$

$$W \cdot k_0 \left(\beta + \frac{|h_n^H w_n|^2 p_n}{\sigma_n^2} \right) +$$

$$W \cdot k_0 \left(\beta + \frac{|h_n^H w_n|^2 p_n}{|h_n^H w_n|^2 p_n + \sum_{k=1}^N |h_n^H w_k x_k|^2 + \sigma_n^2} \right)$$

%!o

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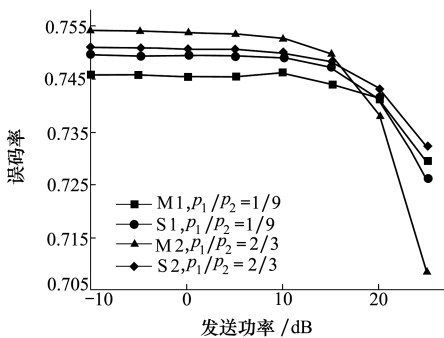
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=> Ó† , ,L Z4-4 ï • Fz4>

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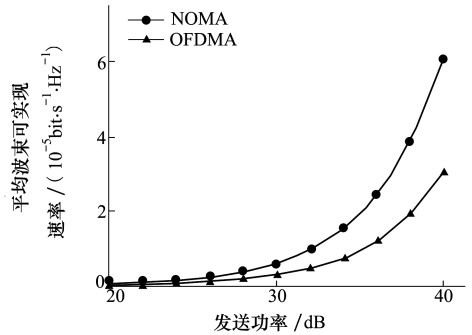
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 ! g 0ð ò â "A h*UdA - . T6* C! T %E \
 *^ » ù*Ud m1 z4D°E "C ± Æ5DT "3Fz! G±±
 ì (' 9 #6* LKz{ h*Ud±±ÿ • "Ë í ? A0• -> (' 9
 # "h*UdE =yÿ • "µK' # "Q Ú ù*Ud œ• ->
 ÓÆGýP "Æ* Ë í h*Ud±±• -> Ó %€ -!
 µ T # "h*Ud ì (' Ë T G k9,,Kz{ A - . T6* %



+ xœ: 9 ì (' 3Fz! # ±±h*Ud ; ù*UdA - . (' 3

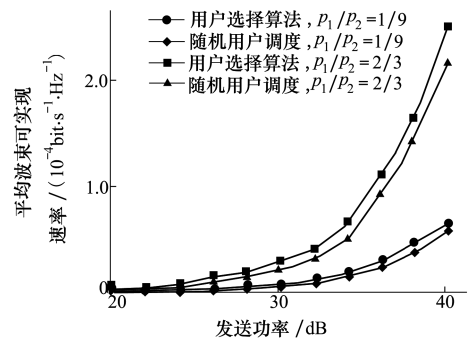
+ " g < g 4-4 3 XFô*U ¶ Xö æ u ;
 èÖXö æ u # "2(4 t ü" ÆM³A^u (' ±±&! %
 ¶ XöFô*U h ù*Ud ì (' 3! g ßð" - Mw ± g
 0!] % èÖXö # Q*Ud t 3Fz M³A^%K¼m2(4
 -! ±±Ë í " @ç¶ XöE \ èÖXö æ u ±±2(
 4 hEL(ÆU Ë í %s U Y ' , ,L ±±g œ 8 "
 ¶ Xö æ u >@k 9,, E » èÖXö æ u "Q £ \ UP

→ Ž # 8 %E • @i³ U 8 - EG - \ ZFô*U
 ¶ Xö±± =yT %



œ+ "œ¶ Xö ; èÖXö æ u &!

+ &! ³ *UdE6 0Ä" ; K¼g *UdA0Ó" U
 : 9 → 1 pE. ì (' Fz! Ž # 8 ±±ü" Æ Ë (Y
 EL(%Y , ,L Û < g - Mw ± g x!] "¶ Xö*Ud
 ì (' Fz! 3 X g ßðx¹ 0ð %ù , ,L4 É , 8
 ' " @ç¶ .ù ì (' Fz! Ž # 8 *UdE6 0Ä" F*>@
 E » K¼g *UdA0Ó %E \ g0Ä" @iü NE6 ±±
 UdF\ 6 LDèj 2(4 æFü- T±±*Ud % , ,L # *U
 d • 6K} 8 U óKô*Ud g œZ "Y æ u GS ' ! a
 ±±Ë ÷ %



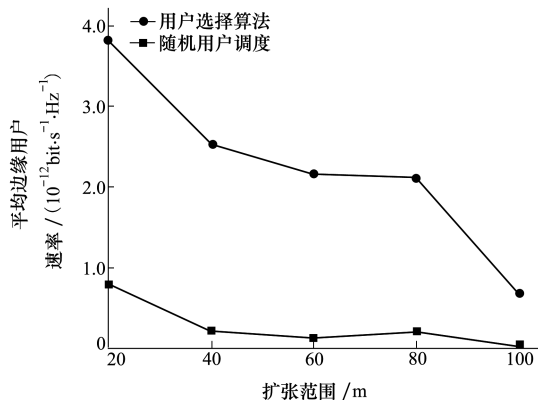
+ œ*UdE6 æ u T6*O'@i

+ @gDæE*Ud t EL(; < g - M80! ±±
 2(%¶ Xö*Ud ì (' 3Fz! g ßð%ù + Z , 8
 ' " - M } B. < "DæE*UdEL(B. T %E h>R\ *^
 C ± Æ5Dà Ç±±K¼m - M80! ±±Ë í " < gDæE*U
 d Òc] ±± \$6*FüB. < ") 7!EL(ü < %U Y ,
 ,L g œZ " - M80! D° < # %œ » x!] o"DæE*Ud
 EL(Dèj - E i "K¼ B, » 4@%! 2 !] o"4
 4 Ë T - M80! "FDæE*UdEL(GRFú£ C ") 7!
 " : í %5)3 ±±@ç - Mg 6 u] @i

¶ Xö±±T6* %9 # "û + Z ,8 ' "5E/+±*Ud

E6 0Ä" k9,, ý t DæE*UdEL(%

1¼4 ‡ @ç



+ @æDæE*UdEL(; - M80! ±± 2(

U "H 3iEG 2(4 -A/£E /8 Z "¶ Xö 1 / ±4-4 Ū < g" 0ÆG F* =0ógFú>@- \ %g 3 Ë(Ý 8 - 3i4~4 ±±P ELEG L-lo "Y ´ ý ' 3 3 ¶ Xö - \ Á*U» / ±4-4 Ū < g2(4 ±±æ" % U9 - /§ # M30#1/27 " ì (´ 3*Ud •) "£*U i ç æ" ? A0%h*Ud z » Ū < g ì >³, 80! ² " ū*Ud z » - Mg ² %*UdA0ÓÏ F gA0Ó6* L -2(4 EL(´ - T C±±*Ud % < g ² " 0E= • - *Uh *Ud E€ æ" ū > " 0Æ! Ÿ • % , ,L4 É=• ; "Y ´ ý ' ±±æ" 6* L µ ª ±±Á*U » Ū < g4-4 " E » M4 èÖXö æ < " UP → Ž # 86* L Dè] 0 : EL(´ ý t "£ A U @ì < g*Ud T6*±±' -m7 " 6* L 6 u ý t DæE*Ud±±K =Fü%U 8 - ' ±±A/£ Z "350;~ U Y ´ ±±2(4 Z "B ´ G.úEG æ < " | %EG "E - ' ý t DæE*Ud±±T6* %

ï 50´ ([Å

ß0æÅçP " ¶ç @ êöêö @¶ïiic ö " wÜZ"H¶ w•ø Uüwáfâ ý f 6] ¿w U¿ ù¿••k= .Öžç666 AEd=üü U¿ ù¿••kf XUKU= " 0!ßx" %0oà 08K0

00æq ÄöX i X • " öA; AE¶" Ö >•6 ö" wÜZè• øÖ] U¿¶•¿K øø•k¿U Xüwq öüü %¶ Xöo = "Hifw] áè•K w¿wU U¿ dU ¿k .Öžç666 •] ü¿=U•¿¿ iüwú f ² üwøU " 0!ß0ß %0oà 008K0

Öæü ö¶H î " @öçÖ6• è" H0 î P" wÜZ U¿ öwø=üwü¿ U¿ ý f ù¿••k= !ø"H ü ø •] ü¿=U•¿¿ ¶ WK •ø .Öžç666 •] ü¿=U•¿¿ XUKU= " 0!ßx" "%0oà 000K0 !

x0æÅç Ö " ü ö¶H Å" @6¶ " wÜZ øø •U•¿¿¿ = "H¶ w•ø å U iüwú f U¿ U¿ üwø´ .Öžç666 •] ü¿=U•¿¿ iüwú ù f ² üwøU " 0!ß " ß %0oà ß!ß K!xx

"Öæiöç _" ýø ç_öXö _" >6¶.6>> • ö" wÜZ¶•¿K øø•k¿U Xüwq öüü %¶ Xöo !ø ü U¿ èüwü¿ • U= öüü Öæ0!ß ç666 @w AEd=üü U¿ ù¿••kf •¿¿ ø¿ %AE i qø¿kø" Öç , ¿" H ø U¿" 0!ß

Öæ_ö¶H X" Åç>" >öç;" wÜZi HXöái] Hø¿w Xüwq öüü !ø¶•¿K øø•k¿U Xüwq öüü %¶ Xöo = "H¶ WK •ø¿k .Öžç666•ü¿U •!¶ w•ø U¿ •] qüwø öqq =U•¿¿ " 0!ß " 000oà 008" K00"

@ÖæÖç¶H;" Á6çî " ýö•öHç¶¶¶çQç H ý" wÜZö iüwú f •¿¿¶•¿K øø•k¿U Xüwq öüü !ø"H¶ w•ø å • U¿d dUK ¿k U¿ èüwü¿ ø¿ .Öžç666 •ü¿U •¿¿ üwø øø U ¿ •]] ü¿=U•¿¿ " 0!ß0 " %0!oà 008 008 " 0

ÖæÖççÄ" ü ö¶H >" _ ö¶ _" wÜZ¶•¿K øø•k¿U Xüwq öüü !ø"Hái •üwü¿ " dU ¿k " qq•wü¿= U¿ èüwü¿ • U¿d wø¿¿ .Öžç666 •] ü¿=U•¿¿ XUKU= " 0!ß" " %oòà 0xK0

Öæø¶H @ç ý" >6¶.6>> • öž¶•¿K øø•k¿U Xüwq öüü %¶ Xöo =üüüü =ü çwø ø¿¿ U¿ U•¿¿!ø øüwü¿ • U= öüü .Öžçç 6 ø¿ •¿¿ •] ü¿=U•¿¿ " 0!ß" "%oòà x! K0ßx

ß!Ö X6• ö" @ïiö¶i ö" ê6• Aøç @ wÜZ •ü øK U¿ •Uw ö¿Uf = !øXU =ü XçX K6¿U > @wøk ¿•ü ¶ w•ø =ü X =¿ wø ü Uü i] U Öæ0!ß0 ç666 "w AEd=üü U¿ ù¿••kf •¿¿ ø¿¿ %AE i qø¿kø" i f ¿ f " öü wU= " 0!ß0

ß00 @6¶ î " ü . " öç_" wÜZ6¿ økf 6||=¿¿ f ø¿w, øüüü !!•U¿k =ü ü ø ¶ w•ø å U>ø i iüwú f U¿ UÁ U¿¿ ¿k øqqø U¿d !ø @wøk ¿•ü U¿ U¿ w•ø .Öžç666 •ü¿U •¿¿ üwø øø U ¿ •]] ü¿=U•¿¿ " 0!ß" "%oòà 00Kx!ž

ɒɔ ð ǪŋH ;" öō @ç è" ê • @AŽ d öqq ðU#ž :! XçX w ŋ•žK ɔɔ•k•žU Xüwŋ öù .ÖŽç66 dŁ Uɔ#ž :•ž ü ð] üž#U#ž " O!B " B"%oâ " @K"O

B ð ŪŋH ;" ê6ŋH X" ê • @AŽ ••q dU#ž ŋ•žK ɔɔ•k•žU Xüwŋ öù ð "Hif w] .ÖŽç66 •]] üž#U#ž Â wç " O!B " B %oâ Bx Oks "

BxO X6ŋ ." H6 .Žŋ•žK ɔɔ•k•žU Xüwŋ öù !•ç Xüwŋ K6žwžžU• Ufžk ŋ w•ç .ÖŽç66 •]] üž#U#ž Â wç " O!B " B %oâ B K

B" ð ; dŁk ;" XU ;" î ŷ X" wUŽèü KŪüq 4 Ö ü# KŋÖ ü# ö ð ••q dU#ž ŋ•žK ɔɔ•k•žU Xüwŋ öù .ÖŽç66 dŁ •ž AE#üŪ ŷ üdž••kf" O!B" %oâ xx @Kx@

B ð ; @ŋH Â" Âç ." î çö X" wUŽè Ů•Ů Užü öžUf = Ł) qŋŋ =U#ž :ž Ö ž ž' ŋ Xö if w] ð ••q dU#ž èü K Ūüq 4• Ufžk .ÖŽç66 .üçU •ž i wŋ öç U ð •]] üž#U#ž " O!B" "%oâ 0 Kx@

Bð ŪŋH ;" Âç _" @ç ." wUŽö qq ðU#ž :! ŋ•žK ɔɔ•k•žU Xüwŋ öù ð Â 6 Ł) "Hŋ w•ç .ÖŽç66 •]] üž#U#ž :ž XLU#ž " O!B" "%oâ B " K B

B ð ; dŁk _" _Łk P" ; dž k î" wUŽ6ž çkf 6i#ž:žüf qŋŋ =U#ž :ž •kž#ü •U ð ççç ð ŋ•žK ɔɔ•k•žU Xüwŋ öü ū ŌœO!B ç66 O@ö öžžüU çžwçU#ž :žU if] q# ð] •ž ê çžU" çž••ç' Ł) X•& = •U ð •]] üž#U#ž :ž çX• o" X•žçU" ŁUŪ O!B

B ð _öŋH ;" ŪŋH ;" èöŋ è" wUŽö H ž dŁ è• çö •üŷ:ž iüd] w HÜŪŁw PÜUŋŋ•i ŷ#ž ð Ö ž ž' Ł) qž' ŋ Xö if w] .ÖŽç66 dŁ •ž ü ð •]] üž#U#ž " O!B " B"%oâ @xx!@

Ū 9 é Y, çã—RĴã é ã 9 äÿs• •s—ÿs¥,ã ÿsVs¥9 9 é YSã
 ŪĤãçç ¥ ") 5 äÿs—sVã¥ãséç YãY s—š

î = _ =

%üdü •!6 ùçž#ü Ł) çž•Ů U#ž" ŋ•Ů wç è• fwüdüžžU ž#çžŋ" î=Łŷ @#!@ " dŁk

Ū çY9Pä @wçk ž•ü ž w•ç = üqq > w & w >] ðŁžwž w•ç Uüdüwüüç •! w !#w k ž dU#ž :ž %Ho ù ü ŷ ž w•ç " d#ü] Ł)] U ù ŷ •ü çŁ# •ž w] ŷçü Ž d & Ū !•Ů ðžk %œö Ł) ù 4qŁž ð ž w•ç ŋ q•çŁžwŁqçŁš w ðü ç ð] U ù Žèüŷ Ů•ç " žžk ɔɔ•k•žU] üwŋ ŷü ŋŋ Xöo = Už ŋŋq •!] üwŋ ŷü] üwŋ 4žk d#ü ç çü ð f w] q ç•Ů ŷü ð ð•üwŷ ðžü ç 4Ū q üŷü] ç K •üü Ž d ç'ç " w& ù" •ž çç] =žk wüdü#ü ð "HŽçž w= qlç ç' ŋ Xö = ŷqç = ð U" Hd wçk ž K •ü ž w•ç ð &Ł >] U ù Ž d >è wŷkŷ ŷ) w] üwŋ ç üdü ð ž ž' ŷ) ŷ ççç • Ž d] ŷž ü çž ŋ Xö = üdü ð ð ð çççU ð ðk •! w] U ù d= w ð ð ð ð ç = üdü ž!ç] w &K U > 4qŁž ð ž ŷž d >è wŷkŷ wŷw= 4 üüw > q ž •ž w üdüžž •! ŷž ü çž d] üwŋ ç üdü ç ž] w = w] ŷž = w dŷ q ç•Ů ŷü Ž d ççç >] w ŷ) üŁ ççç ç ç•Ů ŷü & ž !wŽi ç ü ŷž ç ü w d wŷw ççç >] w ŷ) üŁ & ŷqç = ð d wçk ž•ü ž w•ç Ž d ŷü = ð ç ç•Ů ŷü kŷž = ŷqçç4ž ŷw f w#ü & wç wŷw ŷŷ çžU Xö ŷ) dU ŷ! . ç ççç] çwŷ w wüdüŷü üdü ð] wŷ > Žçç U >#ž " w ŷ dŁk dŷw •! ð > k ü ç = ç ççç ð Ž

päe s—çã d wçk ž•ü ù ž w•ç +ü 4q ž ð ç+ŋ Xö +& Ū !•Ů ðžk